



## Customer Overview

AccuVein, a global leader in medical imaging solutions, presented Benchmark with a working prototype of their fascinating medical device, the AV300: a laser-guided, optical vein finder. Shine it on the arm, and it provides an instantaneous, non-contact, real-time image projection of the vein's location below the skin surface. While other vein finders existed, none were as simple, portable, or effective for patients with small, deep, or otherwise hard-to-find veins.

## The Challenge

AccuVein's ground-breaking proprietary technology delivers photons at a wavelength in the near-infrared spectrum to allow detection of the presence or absence of blood. However, to bring the technology to market, the medical device needed to address a variety of practitioner needs. It required a form factor and user interface that would be easy for clinicians to use, a precise optical alignment assembly process, advanced thermal management, and other requirements.

The device worked using a near-infrared laser to detect the veins and a visible laser light to project an image of the veins onto the patient's skin. The laser light had to be viewable even with the ambient light of patient exam rooms, and the product has to be designed to be eye-safe to protect clinicians and patients. Critically, both the visible and non-visible light needed to move a minimal and controlled distance very quickly to create a two-dimensional image. Commercially available

components could not achieve this required level of precision. Housing the two light sources in one enclosure generated significant heat, and traditional heat management strategies such as fans were not compatible with a compact design.

Original prototypes included a tabletop unit and a handheld wand. AccuVein knew that clinicians would prefer a smaller, easy-to-handle device, but it seemed impossible to fit all the necessary components into this shape. The entire device needed to be sufficiently rugged to survive an occasional drop and moisture resistant enough for use in a clinical setting.

When AccuVein first contacted Benchmark, these challenges were creating performance inconsistencies from one prototype to the next. Troubleshooting required extensive full system integration experience.

## The Solution: A Holistic Engagement

Benchmark leveraged its proven medical device engineering development process to systematically address the device's design challenges, balancing competing requirements while ensuring manufacturability. This laid the groundwork to bridge the gap between a working concept and a viable, marketable product.

Benchmark's Industrial Design team developed an optimal form factor and user interface, maximizing user comfort and usability. They convened clinician and patient focus groups to gather requirements and give feedback on prototype designs. Throughout this process, the industrial design team worked alongside the electrical and mechanical engineering teams to ensure the necessary electronics would fit with the form factors. Together, they were able to eliminate the tabletop unit and develop a lightweight handheld device.

The engineering team also used thermal modeling to understand the thermal management challenges and brainstorm solutions in the compact handheld design. Without an option for a cooling fan, the team was able to employ passive heat management with a heatsink built into the design. The engineers added a magnesium strip into the front of the body of the device where it could safely dissipate heat without interfering with user comfort.



The biggest challenge was the design and manufacturing of the micro-mechanical optical assembly. Using optical modeling simulation and innovative electromechanical design, the Benchmark engineering team developed precise mechanical controls of the mirror for the lasers. This also allowed complete control of the lasers to make the device eye-safe for users. AccuVein was able to patent this critical design feature.

Working closely with AccuVein, the product development process captured all the system's parameters, enabling performance to become controlled and reproducible, providing a path for design optimization. The Benchmark product design team, engineering and manufacturing experts were a part of the process, ensuring a smooth transition to full production.

The production also required unique Benchmark skills. AccuVein's AV300s were made using cleanroom assembly, including close tolerance active alignment for optics and assembly of die-level electronics. Microelectronics processes such as die and wire bonding, hermetic sealing/testing, wafer sawing, and cleaning of components are required for each build. Benchmark's in-house teams developed the automation and functional test processes.

When it was time to develop the next-generation vein finder, AccuVein engaged with Benchmark from the

beginning. AccuVein collected user feedback from users of the first-generation device, and it was overwhelmingly positive. Benchmark's engineers also worked to improve the design's manufacturability, as emerging component options allowed for simplifying the micro-mechanical system, reducing the cost of manufacturing and increasing the system's durability.

## The Result

The AccuVein AV300 developed with Benchmark was the world's first handheld vein viewer. With the AV500 model, AccuVein users experience a 350 percent first-stick success improvement, resulting in a 39 percent reduction in patient pain and 45 percent fewer escalations. Working closely with the AccuVein team, Benchmark's integrated design and manufacturing expertise significantly reduced time to market and enabled AccuVein to be a first mover in the space. Benchmark's proven credentials regarding QSR and FDA compliance, including ISO 13485 and laser safety certifications, allowed AccuVein to have confidence throughout the entire process from design to production. Working with Benchmark, AccuVein remains the world leader in handheld vein viewer technology.



**Benchmark**

56 S. Rockford Drive | Tempe, AZ 85281, USA

623.300.7000 | [www.bench.com](http://www.bench.com)

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