



# Improving 3D Scanning with Optically-Superior Blue Laser Technology



## The FARO® ScanArm HD: High-Definition, Industry-Leading Speed, Accuracy, and Resolution

FARO®'s Laser Line Probe HD is a non-contact 3D Laser Scanning attachment for the FaroArm®. When combined with the FARO Edge Arm, the system is known as the FARO Edge ScanArm HD. The ScanArm HD is ideal for quality inspection and product development. It offers capabilities such as point-cloud comparison with CAD, rapid prototyping, reverse engineering, and 3D modeling of free-form surfaces.

The ScanArm HD combines all of the advantages of a hard probing system with the capabilities of 3D laser scanning, to provide rapid point cloud collection with high-definition resolution and precise accuracy – all in a compact, easy-to-use, and fully-integrated system.

- Scanning speed, delivering highest possible productivity
- Accuracy, providing the ability to meet tight tolerances
- HD resolution that captures clear, noise-free data with intricate details
- Scanning of challenging surfaces including dark and reflective materials

## Key Design Parameters

In designing the ScanArm HD, FARO's engineers recognized that a number of factors must all work in harmony to optimize performance. It can be tempting for a buyer to look at one or two specs on a spec sheet and arrive at an incorrect conclusion as to which product is best. Key elements in a scanner design must all come together to produce the final result. If one element is sub-optimal, it cancels the benefits of other design elements. Consider a car that may have a powerful engine, but poor driving performance because of a bad steering or transmission design. For a laser line probe product, the key design parameters impacting performance are:

- Laser type – typically blue laser or red laser
- Optics – the lenses used on the camera
- Frame rate – the speed at which the camera can capture a scanned area, measured in points per second and driven by the chip set that the camera uses
- Laser line width – also called beam width or scan stripe width

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The ScanArm HD combines the power of a blue laser, state-of-the-art camera and optics to maximize:

## Laser Type

Today's scanners employ one of two laser types: blue laser or red laser. Earlier scanner models, including FARO's previous V4 and V5 (ES) LLPs, used red laser technology. The new FARO ScanArm HD leverages an optically-superior blue laser technology.

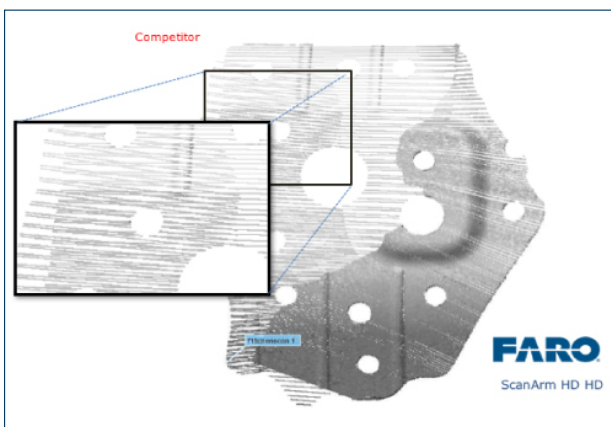
While blue laser technology is more costly than red laser technology, a blue laser has the laws of physics on its side because it has a shorter wavelength than a red laser. A blue laser delivers improved scanning results due to its intrinsic higher resolution and provides a 50% reduction in speckle noise.

**Benefits:** The ScanArm HD's blue laser offers 50% better optical resolution than a red laser scanner. This difference is most noticeable when scanning optically challenging objects with dark and/or reflective surfaces. With red laser technology, it is sometimes necessary to use a special spray on the scanned object to make the surface less reflective. The blue laser's higher resolution reduces the need to spray parts. This removes an unnecessary step from the measurement process and saves valuable time and productivity.

## Optics

The FARO ScanArm HD boasts superior, large-diameter, custom optics. While lens size is only one consideration in optical design (other considerations include coating and the arrangement of the lenses), it certainly impacts scan accuracy. A larger lens is able to:

- Collect more data
- Deliver better accuracy by collecting more light – producing sharper and brighter images
- Offer a bigger “sweet spot” in terms of data collection, overcoming the blur or optical aberrations that smaller optics may create at the edges of a scanned area
- Support a wider laser line width that scans a larger area, providing faster, more productive scanning

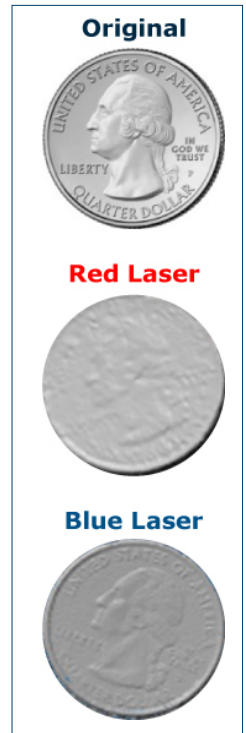


**Benefits:** The ScanArm HD's large optics, provide higher accuracy in scanning and greater productivity in comparison to most scanners on the market. The blue laser and high resolution optics combine to deliver faster scans with higher resolution and better contrast, outpacing competing solutions.

## Frame Rate

The ScanArm HD's camera uses the most advanced chipset available to deliver the fastest possible frame rate of 280 frames per second (fps). Frame rate (also referred to as refresh rate) refers to the number of times per second that the camera gathers new data on the part being scanned. Competing products use older, less expensive chipsets that only support frame rates of 100 fps or slower.

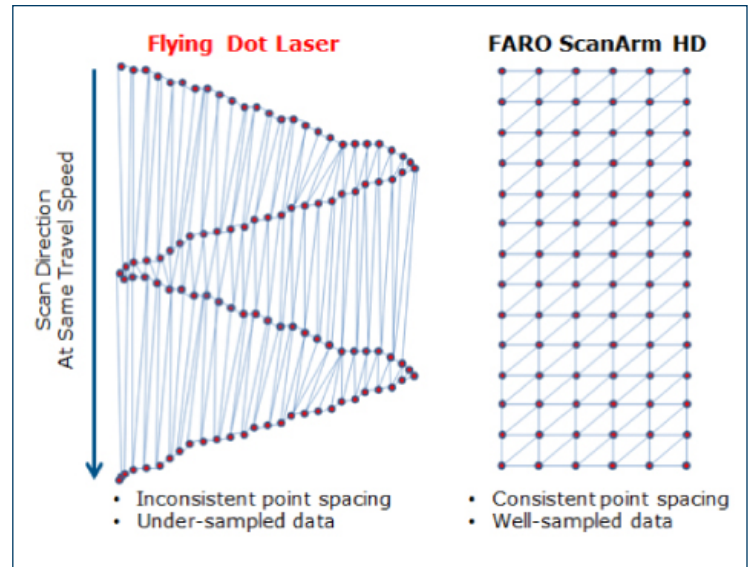
**Benefits:** Higher frame rate produces faster scanning with superior resolution, delivering greater productivity. A frame rate of 280 fps by itself delivers 2.8 times the scanning speed of a frame rate set at 100 fps. A higher frame rate also delivers superior scan resolution. Scanners with low (100 fps) frame rates are prone to producing gaps or blurs in measurement data if they move at the same travel speed as the ScanArm HD across a part.



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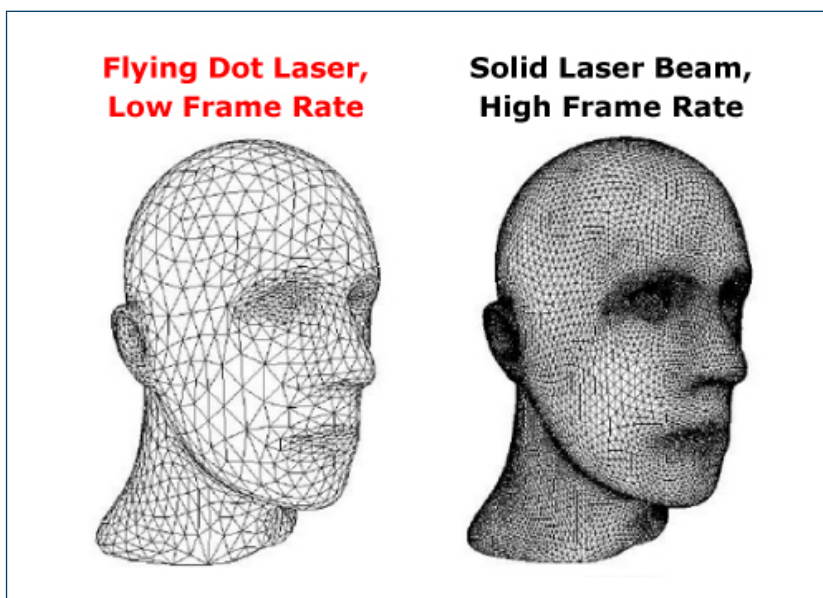
## Laser Line Width

The ScanArm HD features laser line width of 150mm. Laser line width (also called beam width or stripe width) is the end-to-end distance of the laser line or stripe produced by the scanner's laser. The wider the laser line width, the wider the area that can be scanned in a single pass. Additionally, the ScanArm HD features a solid, blue laser beam. Some other scanners do not use a solid beam, but instead use a rolling shutter or "flying dot" arrangement whereby the laser oscillates via moving mirrors to produce the illusion of a solid laser line. The flying dot arrangement has inherent flaws, including vibration from the motion of the mirrors. Vibration causes blurs on the scan, potentially causing errors in accuracy and impacting productivity by forcing the user to repeat scans over the same areas. Flying dot technology also constrains scan speed and consistency.



**Benefits:** A wider beam, coupled with larger optics, means that more data can be gathered in each scan frame. Coupled with the ScanArm HD's state-of-the-art frame rate, these two benefits can be multiplied to compare scanning productivity. For example, the ScanArm HD's frame rate is 2.8 times higher than most competing products. If the ScanArm HD's beam width is 1.7 times that of a competing product, the resulting scan speed differential is  $2.8 \times 1.7 = 4.8$  times better than the competing product. The ScanArm HD would scan nearly five times the surface area versus a competing product in the same time. In addition, the solid stripe (versus flying dot) results in a better, more even sampling of the scanned data points, and therefore, greater resolution and quality.

The differences between a solid laser beam and a flying dot arrangement are illustrated in the pictures below. A flying dot scanner is unable to produce uniform data or point spacing in the same way that a solid beam scanner such as the ScanArm HD does. With a flying dot scanner, the faster the movement, the greater the sparseness of data between data points.



The comparison between flying dot and solid beam becomes more apparent in the data pictured to the left. With the solid beam, more data points are gathered with consistent spacing. The resulting meshed file is a more exact representation of the original item.

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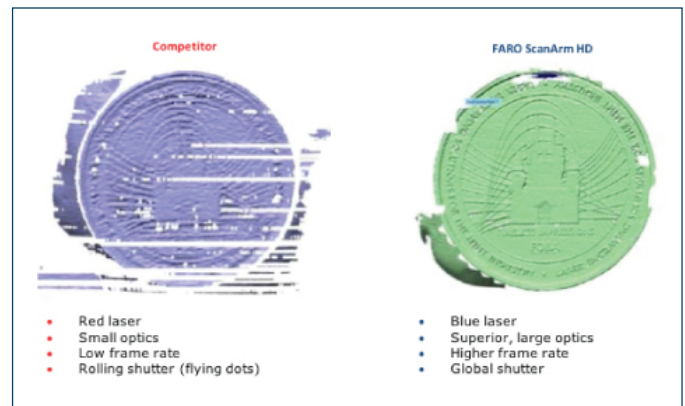
## Speed, Accuracy and High Definition Data in the Same System

With FARO's ScanArm HD, all of the design parameters and features are integrated seamlessly to deliver simultaneous high-definition resolution and fast scanning. The ScanArm HD eliminates the need for compromises between accuracy and speed. Manufacturer product specifications sheets are sometimes confusing and misleading. There are no established industry standards for laser line scanning, so product comparisons can be difficult. A manufacturer may tout the number of points per laser stripe, but the under-sampled distribution of flying dot data yields poor accuracy compared to laser line technology. Additionally, the resolution of red laser data is significantly degraded when compared to blue laser data. If the frame rate is not fast, scanning rates must be dramatically decreased to maintain desired accuracies. In summary: Quality of data points must be regarded with the same significance as the quantity of data.

## Exploiting the Laws of Physics for Optimal Scanning

Your company is considering an investment in scanning technology because measurement results are important to you. You want the most accurate results possible, while also maximizing productivity. The FARO ScanArm HD provides the best of both by using the most advanced laser, optics and camera technology to deliver accuracy, resolution, and speed, even from the most challenging surfaces.

That's why FARO is the world's most trusted source for 3D measurement technology.



## FARO's ScanArm HD – The LLP Designed to Exploit the Laws of Physics

The image shows the FARO ScanArm HD handheld scanner, a blue and grey device with a handle. It is surrounded by callout boxes detailing its features:

- Superior, High Resolution Optics**
  - Larger optics allow:
    - Increased sensitivity– better resolution
    - Wider field of view supports wider beam for faster scanning
- High Frame Rate**
  - Industry-leading 280 frames per second
    - More detail in less time
    - No gaps in scan data
- Blue Laser**
  - Less speckle noise than red laser
  - 50% better resolution
- Wide Beam**
  - Wide, 150mm laser beam
    - faster scanning
- Solid Beam**
  - Solid stripe versus “flying dot”
    - Consistent point spacing
- It All Adds Up**
  - Scan up to 6X faster than older and competing scanners
  - 30% greater accuracy
  - 50% better resolution
  - Scan challenging parts including dark and reflective materials

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