



Business Perspective: Overcoming Barriers to Industrial Laser Performance Measurement

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Technological advancements in laser sources and the systems in which they are integrated have provided the industrial laser user with higher quality and more consistent laser processes. Laser OEMs and systems integrators continue to make improvements in their products and services thanks to partnerships with system component manufacturers, laser applications development houses, and end users.



During the development of these laser systems and installation in the applications in which they will be put into service, performance measurements of the components and the system as a whole are taken so that the highest quality system is delivered to the laser user. Yet in many cases, ensuring the system continues to perform as designed once installed doesn't seem to be a high priority for the end user. Is protection of this large investment not a priority?

As lasers continue to advance in quality, consistency, and power, so too have the systems that measure laser performance. But three things have not changed about lasers.

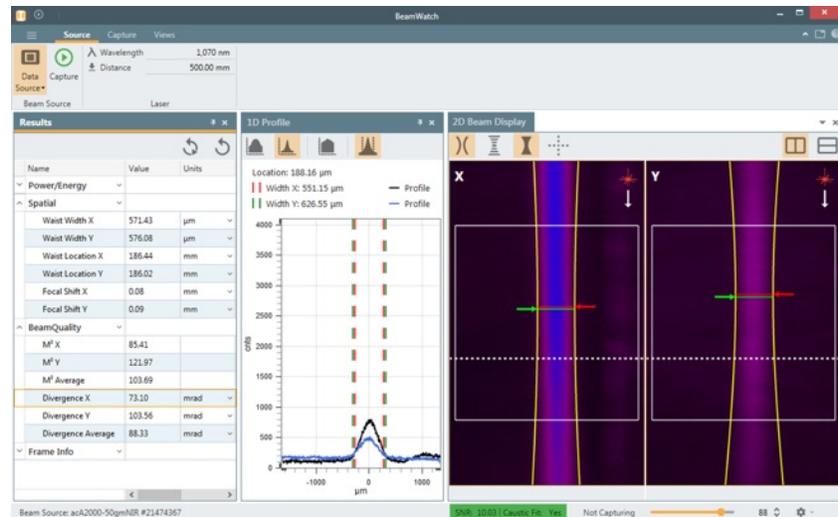
1. Lasers systems consist of components that are made of physical matter and will degrade in one way or another over time.

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- The laser's power density (laser power at the work piece with respect to the area which it is focused down to) will define how the laser interacts with the material that is being processed by the system.



- The physical changes in the laser system will translate into changes in the power density supplied by the laser.

Only through periodic measurements of the laser system as a whole can these changes be managed. Which brings us back to the question: why aren't these measurements important to the end user? The answer involves a variety of barriers to advancement. Some have been overcome, but some have yet to be fully addressed.

Physical Barriers

Industrial lasers are typically designed with enough power or energy to process material through joining pieces together, adding material, subtracting material, or changing the physical properties of the material. Historically, it has been difficult to measure these lasers (especially at the laser's focused spot) because you could very well end up "processing" the measurement equipment during the measurement.

Advances in laser systems and applications have resulted in the increase of laser powers in fiber, disc, and direct diode lasers. Materials that could not efficiently be processed before now can be or soon will be. Materials also can be processed at faster throughput rates. As needed as these advances are, they present a few problems.

First, as laser powers climb, the thermal effects and degradation of the laser system through component contamination and/or aging are amplified. As this degradation happens, changes in the power density take place, with either the reduction of laser's output power, or changes in the laser's focused spot size and/or location in relationship to the material being processed.

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Second, measurements on higher-powered laser systems have proven to be problematic in the past. Impinging on the beam, either at or before the point of focus will eventually hit a wall because the power density will simply be too high.

Overcoming Physical Barriers

Changes in the laser system due to eventual thermal effects will change the process, usually resulting in an inconsistent result, such as a poor cut or a reduction in the joint. If traditional methods of measurement cannot effectively measure the changes in the laser, how can these changes be managed?

The answer is non-contact measurement in the form of a technological breakthrough – [BeamWatch](#)® by Ophir-Spiricon. BeamWatch takes a measurement of the laser by using a camera with a lens to image the Rayleigh Scattering off of the focused beam which gives an image of the laser at and around the focused spot, or the “beam caustic”, without coming in contact with the beam. Since it does not impinge on the beam, the high power density doesn’t damage the measurement equipment; in fact, it actually improves the signal provided for analysis.

Since it is a camera-based system, data points can be taken several times a second and dynamic measurement can be made. These dynamic changes allow the laser user to view and measure the laser’s performance as it happens. Shifts in the location of the focused spot, the size of the focused spot, the M^2 of the laser, along with several other critical measurements, can be measured in amount with respect to time.

Old Habits Die Hard

The next barrier is the fact that old habits die hard. When it comes to laser system maintenance, many times there is a “don’t fix what isn’t broken” approach. What some laser users have been doing for 20+ years is still fine for them today. The problem with this approach is that, more than likely, the methods and tools that were used 20+ years ago are not painting a full picture of how the laser is performing. This is especially true when it comes to capturing and analyzing time-based laser characteristics. Legacy equipment such as laser “power pucks”, acrylic mode blocks, and laser burn paper, provide single data points over a short period of time. Today’s systems provide data from beam-on time to several seconds, minutes, or even hours later, giving the laser technician a more complete story of how their laser system is behaving.

Old habits can also hinder the adoption of new equipment. The application of newer laser measurement technologies can be intimidating at first. However, understanding what the laser light is doing (converging or focusing, collimating, diverging), is critical. Once the measurement system is in place on the laser system,

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navigating and manipulating the software can also be a daunting task. Thankfully, those who develop laser analysis software realize this and have designed software that is simple and easier to use, and utilizes industry standard measurements and graphics rich presentation of the data being collected for review.

One barrier that seasoned laser technicians will confront, whether they're willing, able, and eager to apply new measurement solutions or not, is the adoption of new technology. Naturally, there is a tendency to be cautious when new technologies are introduced, because there is the question of whether or not the data that is collected and the results that are produced are accurate. As an example, the introduction of the BeamWatch beam analyzer in 2013 generated these very questions, mostly because the method of generating the signal that is analyzed was new to the industry. From the early design days, these questions were taken into account. Ophir-Spiricon engineers are confident that the data that BeamWatch provides is accurate within +/-5%. This confidence is based on many years of measurement data and experience, mathematical proofs, and a comparison of results with known and trusted measurement techniques. Those who have used the BeamWatch system on their laser system(s) have not only gotten results that they expected, but also have gotten information about their system that they have never captured before.

Environmental Barriers

In addition to physical and old habits barriers, there may also be environmental barriers that are beyond the user's control or that the user will have to work hard at to overcome.



Time is money and when one of the most expensive tools is down, money is lost. A common assumption is that the laser should be running at all costs and only maintained when it is either very inefficiently making parts or not making parts at all. In most cases, the overall cost to this approach is far greater than the proactive approach of monitoring the laser's performance over time and looking for trends that would indicate that corrective action needs to take place. Most laser OEMs and systems integrators offer training on the maintenance of the laser system which help the laser user to not only better understand how their laser system works, but also allows them to maintain high quality processes and effectively troubleshoot problems when they arise.

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Regulations

In many industries, laser systems are highly regulated. Answering to regulating agencies, such as the FDA, requires companies to prove that their laser system is operating the way it is designed to. Laser measurements are often required as part of the regulation.

If measurements are not required, steps still need to be taken to ensure that the data collected is accurate and that it can be used to optimize the laser process. This barrier can sometimes discourage the laser user or technician from applying modern laser measurement practices. However, this does not change the fact that **dynamic laser measurements are the only way for the laser user to obtain a comprehensive analysis of the laser's performance.** For this reason alone, today's laser measurement solutions should be seriously considered.

Often, the user or technician of the laser will immediately see the benefits that electronic laser measurement solutions bring to their position. They will have an Ah-ha! moment when they can see what the beam actually looks like and can see that hard, quantifiable data can be applied to the beam. But often, those who hold the purse strings will not experience the same Ah-ha!. I've been on the sales side of the business and found it frustrating to be able to effectively demonstrate a solution for a potential customer only to have the sale stall because their manager could not be sold on the solution's benefits. In this case, the customer needs to realize that the proper application of laser performance measurement coupled with proper laser maintenance training is far less expensive than the costs associated with the maintenance of a laser system after catastrophic failure.

Why the Barriers?

When laser technology advances are considered as a whole, the applications seem limitless. But with these changes comes the need to better understand and characterize these lasers, and the need to understand how they are behaving once they are put into service. While there have been physical barriers to taking laser measurements in the past, these limitations have been addressed and removed. The systems that measure laser performance, for the most part, are simple to use. If you understand basic laser behavior, the systems can be easily setup and damage can be avoided. And, in the event that you are using a 100% pass-through system, like BeamWatch, damage to the system cannot take place if set up properly. Old habits and environmental hurdles can be overcome once the value of a proactive vs reactive approach to laser maintenance is realized. With the removal of these barriers, the true benefits to applying laser performance measurement to an everyday maintenance routine will be seen.

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