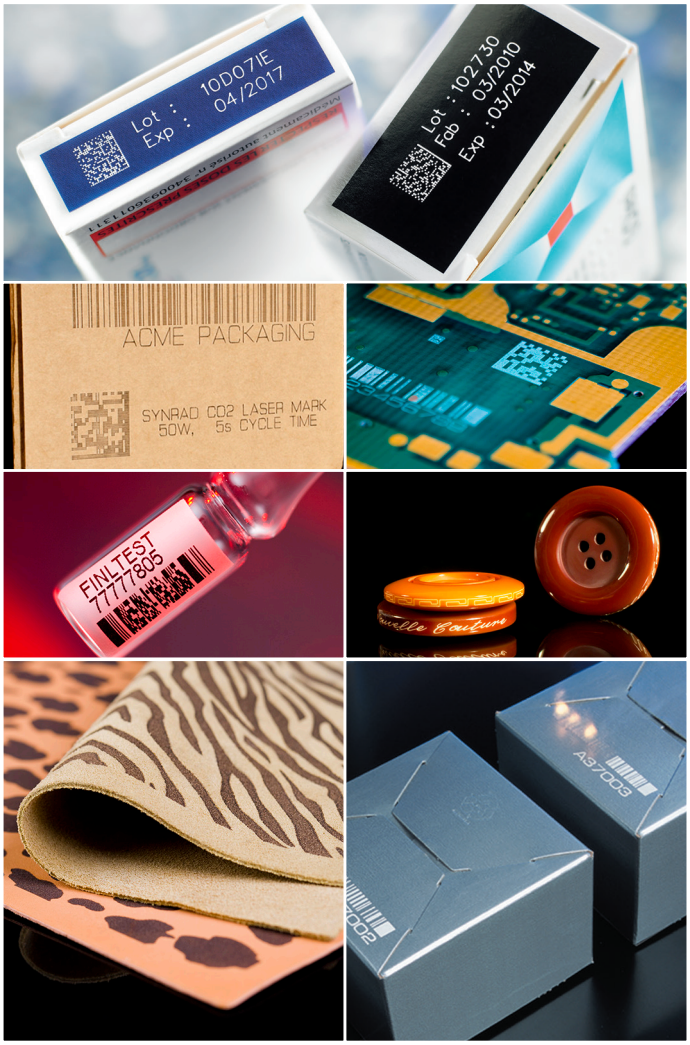
High Performance, High Yield Marking & Coding Systems

Realizing high return on investment for laser marking systems requires reliable laser performance. Synrad high performance CO_2 lasers have demonstrated reliability in marking and coding applications for more than 20 years, consistently delivering more value than the lower price alternatives.

Modern Marking & Coding Equipment Uses CO_2 Lasers

Utilizing CO_2 lasers to mark logos and product codes is not a novel concept. The benefits and returns on investment of laser marking systems are well known, and as a result, laser technology has developed to increase the throughput, yield, and versatility of these industrial machines. For more than 20 years now, Synrad high performance CO_2 lasers have set the global standard for performance and reliability of modern marking and coding systems.

- **Permanent Marks & Codes** – Laser marking systems use vaporization, chemical changes, and/or melting processes to achieve permanent marks and codes. These processes directly impact the surface of the target material, creating marks that cannot be rubbed off or smeared. Synrad high performance CO_2 lasers create permanent marks with precise control and reliability for accurate, repeatable, and consistent results. This permanency and consistency is vital to products and industries were traceability is paramount to operation quality and control.
- **Uninterrupted Production Lines** – Laser marking and coding systems require little to no maintenance, significantly improving factory productivity with minimal machine downtimes. Traditional ink jet machine downtimes attributed to clogged nozzles, ink refills, and other routine cleaning are eliminated.
- **Digital Precision and Control** – Synrad CO_2 lasers are designed to emit high quality laser beams that produce small, high power density spots for highly detailed, consistent marks and codes. Having both precise and flexible control of the spot size and power enable a wide range of permanent marking and coding applications. Unique application examples include marking alpha-numeric codes on contact lenses, and marking live beetles with numerical tracking codes.



- **Curved Surfaces** – When combined with 3-axis scan heads such as the Cambridge ProSeries2, graphic designs, codes, and text can be applied permanently to concave or convex curved surfaces. This is especially useful when marking consumer products such as glass beer bottles, painted metal mugs, or wood wine barrels.
- **Ease of Integration** – Due to the relatively small size and multiple orientation capabilities, integration into assembly and processing lines is straight forward. As with all industrial equipment, safety precautions need to be taken to ensure safe operation. With the proper training and safety measures, lasers are no more of a safety risk than traditional mechanical equipment.
- **Ease of Use** – Modern laser processing systems are digital and easy to operate, requiring minimal onboarding and training. Most systems do not require formal certification for operation. Laser settings associated with specific materials and design files can be stored as a baseline for future projects.
- **Flexibility** – Because CO_2 laser processing systems are digitally controlled, a single system can produce graphics, text, numbers, dates, barcodes, UPCs, QR codes, and patterns. The development of CO_2 lasers with optimized wavelengths (9.3 µm and 10.2 µm) and the expansion into higher laser power levels further extend the list of materials that can be marked or coded. The development of compact galvanometer-based beam delivery systems have also extended the versatility of CO_2 laser processing systems, enabling wider area coverage for marking and coding.
- **Total Cost of Ownership** –Synrad high performance CO_2 laser processing systems are a capital investment which requires rigorous cost/benefit analysis. When conducting the analysis consider not just the cost of any consumables that would be eliminated, but also consider the time savings associated with routine maintenance, change-overs, and cost of replacement parts for traditional equipment over the course of the expected lifetime of a laser processing system. Increases in productivity should play a large part in the cost/benefit analysis. Further, the increased capabilities that a marking system with Synrad high performance CO_2 lasers delivers expands application capabilities, generating more business opportunities and fulfilling the demands of changing requirements.

Keeping Pace With Industry Changes

Marking and coding requirements on packaging and products can change quickly, and variations between industries are becoming increasingly complex. Modern laser marking and coding systems are software driven, making them very adaptable to changing requirements and processes.

• **Regulatory Changes** – Marking and coding requirements are constantly developing and changing to accommodate traceability, expiration, recyclability, counterfeiting, and batch control. Marking and coding systems with Synrad high performance CO_2 lasers are extraordinarily well suited when it comes to accommodating change. Since the laser marking and coding systems are software driven, the vast majority of marking changes can be accomplished through the software interface, and will not require costly hardware changes. This remains true even if the change involves the addition of graphic based codes or marks to previous text/numeric only codes.

• **Traceability** – In addition to the marking and coding capabilities required for compliance with consumer or medical regulations, laser marking systems support traceability used to improve production processes and product quality. Inventory management systems that utilize scanning systems require precise, readable codes and marks. This is easily accomplished with laser marking systems that utilize Synrad high performance CO_2 lasers. Since laser marks and codes are permanent, they are reliable as a traceability source and are a critical component of enhanced quality control in modern, connected factories.

• **New Materials** – Expanding business to reach new markets often requires repackaging to accommodate regional preferences. Emerging packaging requirements have led to the development of new packaging materials, often requiring a combination of different materials to achieve optimum packaging performance. Marking and coding systems designed with Synrad high performance CO_2 lasers make permanent marks on a wide variety of organic based materials, including plastics, paperboard, printed foils, glass, and wood. This versatility makes Synrad high performance CO_2 lasers an attractive choice for an expanding business.

• **Upgrading** – As businesses expand, so too will their marking and coding needs. One major advantage of Synrad high performance CO_2 lasers is that the laser can be upgraded while other components in the system remain the same, or need only slight modification. Upgrades available to enable faster throughput, more detail, or larger coverage area, and are typically accomplished with different models within the same brand.

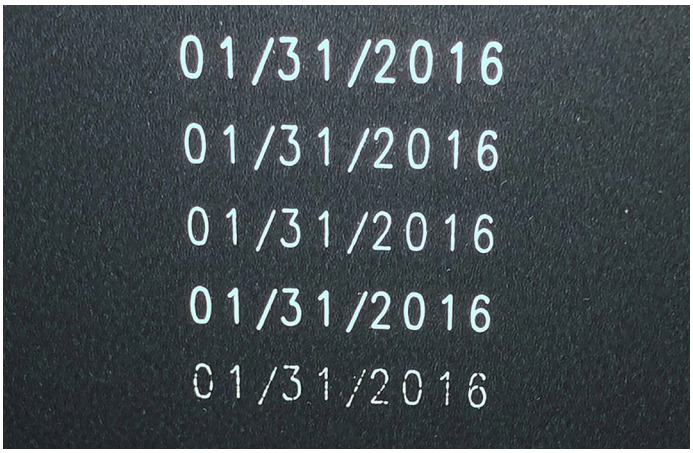
Not All CO_2 Lasers Are The Same

Since their introduction into the industrial marketplace over 30 years ago, sealed carbon dioxide (CO_2) gas lasers have established themselves as standard equipment for marking and coding. Several types of sealed CO_2 lasers are available, and it is important to understand the key specifications and potential trade-offs.

• **High Performance vs. Low Price –** Not all CO_2 lasers are created equal, and price is often strongly correlated with the laser's performance and construction quality. Synrad high performance CO_2 lasers are built to withstand the rigors of real-world industrial environments and to perform consistently well from cold start-up through to normal operating temperature. The unique Synrad laser design protects against harsh conditions, ensuring that all the lasers exceed specifications after delivery, and even in excessive ambient temperatures. Synrad lasers are engineered to prevent optics contamination, gas leakage, as well as unstable output power during operation. These preventative features are critical to reliable operation of the laser, but are also costly to incorporate. Lower price lasers may initially appear to be attractive alternatives to Synrad high performance lasers, however rigorous testing prior to purchase is recommended to ensure all application and reliability parameters are met.

• **Power –** For marking and coding applications, laser power is one of the key attributes that determines consistency in marks, codes, and throughput speed. Unlike glass tube lasers, Synrad's vi- and ti-Series lasers provide outstanding power output and a small size profile, both of which are critical for modern factory floors. Maintaining adequate laser power is critical to realize returns on high-speed production lines; under powered lasers will not be able to maintain marking and coding speeds, resulting in productivity losses. Synrad high performance CO_2 lasers offer a wide range of power options so users can choose the correct option for their specific application. Further, as output needs increase and marking and coding systems must accommodate higher line speeds, the breadth of available Synrad lasers enables straightforward upgrade paths with minimal refitting costs.

• **Power Stability –** The consistency of a CO_2 laser's output power is critical to achieving high yield in marking and coding systems. Synrad high performance CO_2 lasers have outstanding power stability from cold start, enabling reliable, consistent marks, and minimizing potential material or product waste. Many other CO_2 lasers currently available in the marketplace require a 5 – 10 minute warm up to achieve equivalent power stability. When used on high speed production lines, unstable lasers can result in significant amount of material or product waste at start up, lowering production efficiency and increasing operational costs.



Poor power stability can result in inconsistent marking and coding, note the variations in the date codes above.

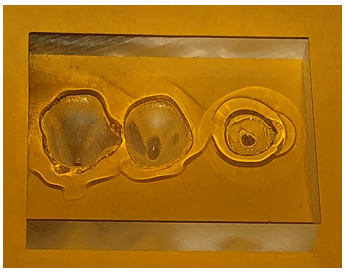
• **Wavelength** – All materials have specific wavelengths of laser energy that absorb best and achieve the desired processing effect. This is also true for laser marking and coding. While many low-priced CO_2 lasers are available only in the standard 10.6 µm wavelength, Synrad high performance CO_2 lasers are available in multiple wavelength options to accommodate a wider range of materials. When laser wavelength is not properly matched to the material, the resulting marks and codes may be unreadable due to over-melting, inconsistent due to lack of absorption, or damaged and burned-through due to excessive absorption. Selecting the correct wavelength for the target material is critical to ensure optimal marking and coding.

Polypropylene (PP) coated paperboard marked with a 10.6 µm wavelength laser delivers legible results, however there is some inconsistency in the mark.

The same material marked with a 10.2 µm wavelength laser delivers clean, consistent marks.

• **Beam Quality** – Synrad high performance CO_2 lasers produce a near perfect beam that can be focused to a very small spot size, increasing power density for higher speed processing, or enabling greater detail. Low-priced CO_2 lasers often have poor beam quality when compared to Synrad high performance CO_2 lasers. Poor beam quality results in poor legibility in alpha numeric codes and barcodes, UPC and QR codes that appear out-of-focus, and excessive melting around the mark or code. As product marking and coding requirements become more stringent, the need for clean, readable marks and codes becomes critical to avoid excessive production waste and potential recalls.

Mode Burns – laser output beams are tested using 11 mm thick pieces of acrylic, the resulting shape of the burn through holes provides a shape profile of the laser beam.



Poor Mode Burn - note the irregular shapes, side lobes, and excessive melting around the edges.

Good Mode Burn – clean circular pattern with minimal melting round the edge.

• **Reliability –** The reliability of a CO_2 laser processing system is based on performance over time. Each of the items listed above – power, wavelength, beam quality, and power stability are key elements that determine a CO_2 laser's reliability. Synrad high performance CO_2 lasers use patented designs, quality components, proven manufacturing processes, and rigorous quality validation testing to ensure reliable operation of our lasers. As evidence to Synrad's commitment to quality, the manufacturing facility in Mukilteo, WA USA maintains an ISO 9001:2015 certification. In contrast, low-priced CO_2 lasers are well known for having variations in power, lower beam quality, and poor power stability, each of which can have a significant impact on reliability.

• **Application Testing -** Novanta offers CO_2 laser application testing to Original Equipment Manufacturers (OEM), laser system integrators, material manufacturers, processors, and end users of automated machinery. The Synrad scientists and engineers are globally known as the CO_2 laser experts, and understand the parameters that ensure successful, efficient CO_2 laser processing. Using the latest Synrad high performance Synrad CO_2 lasers, Synrad applications engineers will determine the optimal laser power, wavelength, and processing best-practices to achieve the desired results. Based on specific user requirements, and using actual materials and/or parts, Synrad application engineers conduct tests using multiple laser configurations and settings to determine the best match. In addition, Synrad has the research and development capabilities to investigate new laser techniques, test new materials for laser processing, and solve laser processing challenges.

Interested in speaking to one of our knowledgeable representatives?

Americas & Asia Pacific

Novanta Headquarters
Bedford, USA
P +1-781-266-5700

Photonics@Novanta.com

Europe, Middle East, Africa

Novanta Europe GmbH
Wackersdorf, Germany
P +49-9431-7984-0

Milan, Italy
P +39-039-793-710

Photonics@Novanta.com

China

Novanta Sales & Service Center
Shenzhen, China
P +86-755-8280-538

Suzhou, China
P +86-512-6283-7080

Photonics.China@Novanta.com

Japan

Novanta Service & Sales Office
Tokyo, Japan
P +81-3-5753-2460

Photonics.Japan@Novanta.com