Laser Technology: Future Perspectives in Marking and Identification

by Thomas Parchmann

Welcome to the fascinating world of laser technology.

Industrial laser marking offers unique coding and traceability at each component's level. Counterfeit-protection technologies can be customized. Identified parts help to pinpoint problems and minimize unjustified charges of product liability as well as identifying parts and products for internal manufacturing logistics.

Laser marking is today's most modern kind of industrial direct marking. Advantages include a highly efficient coding technique with, for example, 2-D codes, plain text, logos and product protection marks. It offers direct, non-contact marking of almost all materials and provides high contrast, even with oil-lubricated metal parts. Codes can be integrated into networks via COM/DCOM architecture. Once applied, the code is resistant to manipulation, friction and temperature while remaining easily readable.

The Spread of Laser Marking

The two main factors in the increase of laser marking are the replacement of traditional marking methods—chemical etching, pad printing, inkjet, mechanical engraving, stamping, labeling—and the need of business to track components continuously around the world. There is a demand for 100 percent parts follow-up during automated processes, prompted by worldwide "ISOmania" and the need for quality assurance, traceability, counterfeit protection and parts tracking and logistics.

Figure 1

Figure 2

Traceability

Laser markers provide fast traceability, allowing for rush projects. The main fields of distribution are found in automobile and auto supply industries; electronics, micro-electronics and air-and-space travel industries; and in identification related to government documents and projects.

Individual parts are in essence "fingerprinted" and can be tracked and followed during the manufacturing process. Marking such as this helps prevent parts counterfeiting.

Traceability is based on unique inscription and continuous technical data documentation. It can keep recalls down to a minimum. Requirements for traceability are defined through ISO9000:2000, QS9000, VDA 6.X and ISO TS 16949. If there is a problem, the cause can be traced quickly and unambiguously to supplier, day and layer, machines, material, delivery, use or perhaps even the customer. For instance, materials can be researched and traced during the lifetime of an automobile and can be examined for possible improvements through research on accidents.

Product Liability

Product liability is the legal responsibility borne by a manufacturer or seller of a defective product for damage or injury that such a product causes to buyers, users and bystanders.

By unambiguous, direct inscription for evidence, information on coding and pertinent data handling, defects can be traced to their cause in case of legal action. Parts tracking can help uncover cases of the use of foreign parts, counterfeit parts or unauthorized repairs.

Protection Against Counterfeiting

Counterfeiting of parts is a rapidly increasing economic and technical risk. Laser inscription provides clear marking suitable as legal evidence in a lawsuit. It can protect manufacturers and their suppliers from unjustified damage claims and thereby reduce insurance expenses and loss of consumer trust. The legal components of identification by laser marking include combining a company code and logo in the manufactured parts.

Marking, Coding and Vision Solutions

The advantages of two-dimensional barcodes lie in compactness and automatic mistake correction. Laser engraving provides 25-200 field data amounts, as with barcodes; 1-3,116 figures or 1-2,335 letters or a combination.

Data matrix code will enrich the world of manufacturing logistics, quality assurance and manufacturing technology. Minimal space is required—realistically, .0031 square inches (2mm sq.). It is ideal for the smallest building groups—miniaturization in the electronics. It provides a worldwide uniform standard—software, reading systems, education legibility—and offers high data security in reading safety. Coding directly on the material eliminates the need for labels, and marks survive in harsh environments.

Growth Market

Laser inscription is one of the biggest growth segments in laser material treatment. In Europe, laser inscription is used primarily in the auto, electronics, medical technology and synthetic material industries.

Modern laser inscription offers non-contact, precise marking even with the smallest micro-markings. Laser marking can be expected to last 20 years and involves no pre-printing costs such as for plate and film.

The technology, however, has been quite complex, with frequent need for maintenance. Water-cooling systems necessitate water connections and catchment basins and require approximately 64.58 square feet (6 sq. meters) space. Installation, an engineering project, is time-consuming. These factors mean that up until recently, laser marking was affordable mostly to large business enterprises.

The core business of Compact Laser Solutions GmbH (CLS) is laser marking systems. The company has 20 years of experience in the development of YAG lasers, with emphasis on diode-pumped YAG lasers. It is a forerunner in compact laser markers, solution provider for symbology technology and partners with 100 of the top auto and electronics manufacturers.

The company offers diode-pumped (solid state) lasers featuring low operating costs and accurate marking up to 10^{-6} m. The system integrates easily into automated manufacturing environments and creates marks that are reproduceable at any time. The open system interfaces flexibly through COM/DCOM. The user-friendly, flexible marking software is object-oriented and features graphical flow chart logic. True Type fonts, vector and bitmap files integrate directly and allow application of variables to individual marking

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SIDEBAR

2-D Code: Generally square or rectangular patterns that encode data in two dimensions—the height and length of the symbol. There are two types: *stacked barcodes* sit one atop the other and can be read by special 2-D scanners or by CCD and laser scanners with special decoding software; *matrix codes,* based on the position of black spots within a

matrix, are more compact than stacked barcodes and can be read only by a 2-D scanner. The advantage of 2-D Code is the ability to put a lot of information in a small space.

COM/DCOM: COM stands for Component Object Model, a software architecture that allows applications to be built from binary software components. It serves as the basis for higher-level software services. DCOM stands for Distributed Component Object Model, a protocol that enables software components to communicate directly and securely over a network.

ISO 9000:2000: A set of quality management systems, recognized and accepted all over the world, that applies to a wide range of organizations and products.

QS 9000: Quality system requirements developed by DaimlerChrysler Corp., Ford Motor Co. and General Motors Corp. for the purpose of setting a single quality standard for suppliers of production materials, production and service parts, heat treating, painting and plating and other finishing services.

VDA 6.X: Quality guideline of the Federation of German Automotive Industries (VDA) for evaluating quality systems of manufacturers for the automotive industry.

ISO TS 16949: An automotive quality system based on ISO 9001:1994, AVSQ (Italian), EAQF (French), QS-9000 (U.S.) and VDA6.1 (German) catalogs developed by the International Automotive Task Force (IATF). It defines a common quality system for the automotive supply chain.