SCANNNECT
Total Tire Traceability

TOUCHLESS
Non-Ablative
Glass Cutting
Editorial

Over 1.2 billion tires from well over 1,000 factories end up in the hands of consumers every year.

1.2 billion tires, of which manufacturers are hardly aware of who uses them when, where, and how. A mountain of rubber, steel, and plastic that brings along with it the potential issues of warranty, liability, or disposal. And a staggering market volume, which could be replaced in a few years if you only knew who the end customer is.

Customer retention and product traceability in the tire industry are still capable of further development. The marking technologies used are too inadequate, the trade levels and their IT systems too fragmented. Still.

Our vision: In a few years, the origin and life of a tire will be traceable on a smartphone or a computer in seconds. Using a camera phone and an app, customers will be able to scan a laser marked QR Code and with a few more clicks, order a fitting spare tire online. Fleet managers can keep an overview on the usage, retreading, or loss of the used tires at any time. Car makers and their service providers will work with standardized systems for logistics, installation, and the rare case of a recall. Legislators will mandate the individual marking for reasons of environmental and consumer protection (keyword “illegal disposal”). A “Universal Tire Identification Number” will be applied to all tires, issued the same way across all manufacturers and in all countries.

Does this sound unrealistic? Maybe, but so did ISBN numbers for books, European Article Number [EAN] codes for groceries, or the Green Dot for recycling at one time.

We will see if our outlook comes true. It will not fail on account of technology, as you can read in our special on SCANNECT – our latest innovation.

I hope you enjoy the new issue of 4SURfaces

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For the past few years, 4JET has been providing production solutions for the laser drilling of glass. While laser ablation is ideally suited for the manufacture of small inner contours and through-holes, outer contours require a quicker method with the least possible damage to the edges.

Thin and ultra-thin glass is used today for scratch-resistant mobile phone displays, flexible solar cells, organic light-emitting diodes (OLEDs), electro-optic printed circuit boards, and battery applications. For these applications, it is essential for glass materials to have favorable thermal, electrical, and optical properties. In comparison to alternative materials, durability and weather resistance are also distinctive features. Separating thin glass with laser radiation yields high potentials for improving quality and cutting costs during processing.

Compared to the cutting of semiconductor materials, where the use of lasers has become the norm, additional requirements must be met when cutting thin glass in order to facilitate the subsequent application. For example, displays and photovoltaic modules have relatively large dimensions and must withstand mechanical stress. Because the fracture behavior of the glass components depends on the character of the edges, the cutting edges must satisfy particularly high demands. Micro-cracks or chips lead to premature failure of the glass component.

4JET works with a dedicated team focused on the development of new cutting processes and systematically combines theoretical and experimental analyses. In doing so, 4JET also utilizes extensive analytical equipment, including scanning electron microscopy, laser scanning microscopy, and polarization microscopy, as well as digital bending testers. Based on the Lablator machine platform developed by 4JET, the processes are developed with widely customizable machine architecture, and all the same time fulfill specifications close to production.

4JET is working on innovative solutions for the separation of flat glass substrates. The method is based on the principle of controlled crack inducement. Through suitable introduction of the laser radiation, the crack contour is guided through the glass substrates in a controlled manner along the target contour. As a result, the cutting process is comparatively quick and virtually free of particles. Due to the extremely flexible adjustment and control capabilities of the laser processes, significantly better edge qualities are achieved in comparison to conventional cutting methods. Laser processes can also be scaled and parallelized in virtually any way.

Until now, with display glass of different materials and different thicknesses, contour cuts were possible at speeds between 40 mm/s and 400 mm/s. The figures at the bottom of this page show microscopic images of the cut edges. Depending on the selected process parameters, different roughness characteristics are achieved. For some glass types, like the Gorilla® glass shown here with a hard layer thickness of 40 µm and a total thickness of 0.7 mm, a roughness of Ra < 0.5 µm is achieved.
The EDS Combitool by 4JET combines three process steps in the manufacturing of CIGS thin-film solar cells into one system.

4JET offers new entrants into the CIGS technology a production capable pilot system that combines bus bar exposure, laser edge deletion and laser drilling of via holes into one platform. The “all in one” design is a cost efficient and compact solution that offers state of art processes. The installed laser sources and tools are identical to the proven 4JET solutions for mass production.

The platform can be retooled to accommodate different module sizes as well as mini modules for R+D. By switching to a single process operation, the tool can reach mass production tact times of below 60 s per substrate.
Scan and connect!

A solution to individually mark every tire with a unique and permanent QR (quick response) Code could be a game changer for traceability and customer relationships in the tire industry.

The novel SCANNECT laser marking process developed by 4JET can engrave an individual matrix code in tire sidewalls. The high contrast engraving can be read using a regular smartphone or by most handheld barcode scanners.

The SCANNECT solution – short for “scan and connect” – enables a long standing wish of the tire industry: being able to get in closer touch with its end customers.

Why Marking?

Individualizing a tire with 4JET SCANNECT provides advantages for all stages of the tire value chain:

- Manufacturers can address their end customers with specific marketing campaigns, such as warranty extensions, winter tire promotions or social media campaigns. Offering additional benefits or interesting content that can be linked to the tire ensures that a direct communication with the end customer is possible.

- SCANNECT QR Codes can be employed as a means of assuring tire traceability and reducing the impact of product recalls.

- SCANNECT marking can serve as a distinct security feature protecting the tire maker from product piracy. Besides the technical hurdle of the laser marking process, SCANNECT QR Codes can embody a 128-bit encoded digital identity certificate that proves tire authenticity. Finally, the visible copy protection feature will promote the intrinsic value of the tire brand.

- Car manufacturers will benefit from the SCANNECT QR Code by being able to track and trace tires or mounted wheels through their production. Additional information can be provided for the car OEM with the tire, such as quality information or additional data.

- Commercial fleet managers can use laser markings to organize inventory, track usage and prevent theft.

- Tire manufacturers, trailer rental companies or full leasing providers can support their fleet service contracts that are based on a flat rate per kilometer. End customers can retrieve valuable technical and commercial information about their tire properties, suitable replacements or quickly enter online market places for replacements or to sell used tires.

QR Codes – How they work

Different to the one-dimensional barcode that is designed to be scanned by a narrow beam of light, a QR Code is detected by a two-dimensional digital image sensor and then digitally analyzed. The three distinctive squares at the corners of the QR code image are localized, using a smaller square (or multiple squares) near the fourth corner to normalize the image for angle of viewing, size and orientation. The small dots throughout the QR code image are localized, using an error-correcting algorithm to compensate potential damages of the code.

QR Code sizes depend on the number of data they represent. The highest version is capable of storing up to 4,296 alphanumeric characters while version 1 will code up to 25 alphanumeric characters only.

The amount of data that can be stored in the QR Code symbol depends on data type (the input character set, e.g. alphanumeric or numeric), the so-called version (indicating the resolution or number of modules), and error correction level.

However, “black” is a relative description. While an ideal (physical) black body absorbs all incident electromagnetic radiation, a surface will appear as “black”, if it absorbs the majority of the visible light.

SCANNECT – How marking works

Unlike other organic materials the tire surface does not change its color upon heating or engraving with a laser. Carbon black as the main color medium simply is too chemically stable to undergo color changing chemical reactions.

SCANNECT laser marking can be combined with a human readable serial number. Furthermore logos as well as customer or country specific engravings can be added during the same production process allowing for increased production batches and/or reduction of stock.

The SCANNECT marking can be performed via four different methods: (1) Directly on the tire in the tire factory, (2) after curing of the tire, either in the tire factory, further downstream in the car/wheel assembly or at the point of sale. (3) After curing of the tire, (4) After curing of the retread tire manufacturing worldwide.

Unfortunately lasers are not widely used in new tire and retread tire manufacturing worldwide. The laser markings are applied after curing of the tire, either in the tire factory, further downstream in the car/wheel assembly or at the point of sale.

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like any other QR Code it can be read with a standard QR Code reading device, be it an industrial QR Code imager or a camera-equipped mobile phone running on Apple iOS or Google Android apps. Like printed QR Codes the readability of the SCANNECT Code depends on a number of different parameters, some of which are relying on the Code itself like contrast, resolution and size. Other important parameters are type and capability of the reading device and the lighting conditions.

4JET has intensively tested with several modern reading devices and smartphones/apps. In total the tests prove an excellent readability with the tested industrial devices over a broad range of QR Code sizes and data capacity required. Older smartphones or smartphones with reduced camera capabilities show a satisfying reading performance with some limitations depending on lighting conditions.

Laser engraved QR Codes are recessed into the surface of the tire and hence protected from wear. However as damages or contamination cannot be excluded for a used tire for any consumer related application the highest error correction level allows for 30% loss.

4JET’s SCANNECT software engine enables QR Codes with maximum error correction and information capacity sufficient to link to an individual serial number on a website on a 1 cm² surface. Smaller sizes can usually not be read with all smartphones due to the limitation of the optics of those devices. In an industrial environment with lower requirements for data capacity and error resolution and devices capable of reading Micro QR Codes (readable with dedicated vision solutions) the QR Code size can be further reduced.

Identifying tires with SCANNECT & DataMan

End customers can read out the codes marked with SCANNECT using a smartphone app. Professionals gain more transparency in the industrial process with the handheld readers of the DataMan 8000 series by Cognex.

The new possibilities for tire marking are only as good as the readability of the codes by the user. While private end customers will be able to scan their tires in the future using their smartphone camera and the integrated illumination, an industrial solution is required for mass utilization in the tire plant, during tire installation, or for fleet customers.

The handheld readers of the DataMan 8000 series are particularly suited for use in production and logistics owing to their read distance of up to 100 m away and their large memory capacity. In this way, codes can also be read offline and outside of the immediate workspace. The base station comes standard with a built-in replacement charger and is compatible with all common Ethernet, USB, and RS-232 cables. Via Cognex Connect, the high-performance handheld readers can easily be integrated into the plant network. It is particularly simple to integrate the portable code readers by Cognex using the DataMan user interface. The reader can be set up quickly and easily with the intuitive software.

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Innovative welding or bonding processes in automobile manufacturing request perfectly pre-treated surfaces. Depending on the task, separating agents and oils must be removed or the areas must be provided with a specific roughness in order to produce a reliable joint. The use of lasers provides a dry, precise, and wear-free alternative to the conventional wet chemical or abrasive blasting methods.

Solid welding thanks to lasers

4JET has developed a system platform for welding preparation of gear components, which is particularly suited for rotationally symmetrical parts. In this process, production residues and oxid layers are removed from the joining surfaces. This takes place in a touchless manner and without substrate abrasion, because a consistent cleaning quality is achieved by a homogenous beam profile on the component surface. In addition, the energy can be set precisely, so that only those organic layers that negatively influence the welding process are removed. The surface of the component remains unchanged, because the required energy density for removal is significantly below the ablation threshold for metals.

Using a scanning beam deflection, in which the focused beam of a pulsed solid-state laser is guided over the rotating surface at a speed of several m/s, the surfaces to be cleaned can be processed in a defined manner. The processing speeds here are within the range of some 10 cm/s depending on the laser power used and the nature of the layers.

Selective, flexible laser preparation for welding and bonding preparation takes place in enclosed, fully automatic systems which can be integrated into linked production and assembly lines. Modular automation solutions allow for loading and unloading on the basis of workpiece carriers, by robots, or by hand.

Process control for perfect results

The 4JET systems are equipped with efficient process and performance monitoring. Integrated online monitoring of the laser power thereby ensures steady processing parameters at all times. At the same time, a process control checks the shift in color change or gloss level of the component surfaces.

The control system collects extensive operating data, which can be transmitted to the main computer at the customer’s plant and, at the same time, allows for remote support and fault analysis via a VPN connection.
In doing so, the release agents and other lubricants on the inner surface of the tire – the so-called "inner liner" – used in the production process are removed with laser radiation without compromising the structure of the tire.

The surface cleaned in this way enables the introduction of insulating foam for reduced tread noises, sealants for self-sealing tires, or the installation of RFID transponders.

The Tire Cleaning System (TCS) facilitates the fully automatic, dry, and contact-free cleaning of the inner liner. The variable angle of the processing head ensures gapless processing. Compared to conventional wet chemical cleaning, the process saves on consumable and recycling costs for the cleaning agents and requires less footprint in the factories. The system concept enables simultaneous loading and processing, providing for a particularly high utilization ratio of the solid state laser source.

The system demonstrates more than the usual benefits of laser systems, such as high process stability and low operating costs: Control of the 4JET system is based on a patent-pending intelligent recipe editor. The system automatically detects the tire dimensions relevant for processing and generates a fitting recipe. This innovation dramatically reduces the ramp-up phase in the factory and thereby shortens the return on investment period.

Bonding preparation is a key application of the 4JET surface cleaning process. Release agents and oils can be removed with laser radiation, and bonding areas can be prepared precisely. The method is also used today in the manufacture of modern tires and enables the applying of additional layers or components after the vulcanization process.

With the "Speed of Light" team, 4JET headed to the starting line at the Actimonda BusinessRun. The event with over 2,000 runners led through some of the athletic landmarks of Aachen such as the equestrian arena and the Tivoli football stadium. In the end, of course, they were a couple minutes over the speed of light, but everyone still had a great time and was cheered on by their colleague fans at the finish line after 5 km.

World-class universities and research institutes, as well as numerous innovative companies such as 4JET, together form the technological region of Aachen. To draw the attention of visitors and through traffic to this technological cluster, 4JET – together with other companies from the region – is financing prominent signs on the A4 and A44 motorways. Over 100,000 drivers pass the sign daily as of now, which is being constructed as part of the North Rhine-Westphalia industrialized state campaign.

An outdoor barbeque was waiting at the end of the route along the shore of Rur Lake. Many thanks to the nearby pub that saved our evening with a 50-l beer keg!