RFID labels to identify OTR tires
It is not a question of “IF” but “When”

Vulcanized RFID barcode bead labels will become common within a few years, for the identification of tires in general, especially for Off The Road (OTR) tires. OTR tires are a strange product group within the tire industry. On the one hand, because these tires can be counted among the most expensive category of tires, tire failure usually has major (financial) consequences. On the other hand, the production methodology it makes difficult to apply identification methods before and or after vulcanization.

OTR tires are among the most expensive types of tires. The final price for the largest tires can easily go up to $100,000 or on the gray market, in the event of scarcity, much higher. Keeping stocks of OTR tires can also be very expensive because the type of tires differs across companies and machinery requirements. However, the greatest cost of a failing tire is the damage to machinery and loss of production after a tire blowout, for example. The location of the machinery (and tires) is often difficult to reach (a remote mine in Australia, for example), which can further increase costs. Therefore producing high quality, long-lasting tires is imperative for tire manufacturers worldwide. And fleet owners know that the overall total costs of ownership of a complete fleet of machinery are highly dependent on the quality of the tires.

Controlling the production processes and therefore the quality of OTR tires is very difficult for tire manufacturers. With little success, methodologies such as vulcanized physical batch numbers on steel identification plates, laser-engraved QR code, and QR code bead labels have been extensively tested and sometimes implemented to control production processes.

Vulcanized, physical batch numbers, attached by steel identification plates. Thought to be the oldest way to link batch information to an individual tire. Immediately after the construction phase, a precoded number within the steel plate is transferred to the tire during vulcanization. After vulcanization, the plate will be removed and a batch number is vulcanized on to the tire. However, the precoded number contains only production date/time information and no detailed process information since it’s impossible to automatically couple machine/process information to the individual tire. OTR tires are in use within very harsh environments. Damage from boulders, mud, etc will cause “an unreadable unidentifiable tire”. This can lead to customer claim handling nightmares.

Next, the use of engraved batch information, hardly adds anything to quality improvement of the overall production processes. Some tire producers are trying to use laser-engraved QR codes to control production tire quality. This can be costly and ineffective. The machinery to laser-engrave is expensive, it requires specialized labor and, within the field, changing the tire, especially OTR tires, without damaging the laser-engraved QR code is almost impossible. A damaged QR code means an unidentifiable tire.
Vulcanized barcodes- or QR code bead labels. Most OTR tire manufacturers have tested or are using barcode bead labels to identify the OTR tire and to couple some processes to the individual tire. These labels are (successfully) in use for passenger car (PCT) and truck tires (TBR), providing manufacturers with the capability to store production data to an individual tire. However, within the production processes of an OTR tire, the bead label undergoes a large amount of stress, leading to an unreadable label, and thus an unidentifiable tire. OTR tires are produced by using so-called non-segment molds (a mold consisting of only two parts, no segments). This type of mold, because there are no segments, has a much larger percentage of ventilation holes also in the bead area. The moment the bead label is applied to the bead, there is a fairly large chance that it will be applied exactly at the level of a ventilation hole in the mold. During vulcanization the rubber floats through the ventilation holes and either the barcode becomes illegible or the barcode is damaged by the pressure of the rubber.

Due to the ventilation holes rubber floats over the barcode. Barcode cannot be read anymore but RFID still works

Another hindrance to using bead labels is the damage caused when releasing the tire from the mold. Since these tyres are often produced by using non-segment molds, the mold parts move a bit to release the tyre after vulcanization. When the two mold parts are simultaneously moved to release the tire, the very thin bead labels, tend to shift and can get lost or damaged. Again this will lead to an unidentified tire.

Fitting a tire on a rim can also damage the barcode image. The rim or fitting machinery could damage the tire, making the barcode illegible. Using barcodes requires a line of sight, however, in reality, an OTR tire is very large, which makes it difficult to read during production. And impossible to position the tire automatically within the line of sight of a barcode reader. Therefore it is infeasible to use barcodes to automatically store every production process step.

Intensive tests show that even when the RFID barcode bead label is stressed by the fitting machine, or use of the tire, for examples, the barcode itself is sometimes not readable but the RFID tag always survives (latest outcome after two years in use defect rate is only 0,0001%). The aforementioned impossibilities when using QR code bead are a little less because a QR code is much smaller in size.
Therefore the percentage of damaged codes is less compared to the use of barcodes. But, overall when used for OTR tires, the percentage of damaged codes are still too high.

Even when (deliberately) placed wrong (edge) barcode cannot be read, RFID still works

Over the last 5 years, FineLine Technologies has been working in partnership with major tire manufacturers to develop and test its patent-pending RFID barcode/QR code. This RFID barcode/QR code is developed specifically for small, curved motorcycle tires, passenger car tires (PCT), large and more robust for truck tyres (TBR) and extreme robust OTR tires. Using this RFID bead label OTR tire producers are able to store all production data automatically to an individual tire. FineLine has worked with a large OTR tire manufacturer to implement it’s RFID barcode bead label to track individual tires from the building machine stage through to customer delivery.

At the building machine, operators apply a roll of 200 pre-printed and pre-coded RFID bead labels at the building machine, pre-associated with the machine and therefore type of tire to be produced.

When the tire is built, the operator applies the RFID bead label in the bead area by hand or automatic applicator. To identify the right positioning, the manufacturer is using a laser. When the label is applied direct coupling between building machine (type of tire) and the physical green tire is made. From here throughout the rest of the processes, the tire can be identified as a unique, individual tire.
Position on the green tire. Can be applied on the building machine or just after building on the rack or conveyer belt

Within the building process, the tire is transported to the weighing area via a conveyer belt. At this stage, the type of tire is automatically identified by using the RFID code and the system “verifies” tires specification such as weight. Tires are automatically rejected or accepted based on the verification of data stored within the RFID bead label. The individual weight of the tire is stored in the database, using the RFID code as the unique identifier and matched to the unique tire.

Due to special development, paint can be removed easily before or after curing

From the weighing area, the tire is transported to the press/mold. Automatically the tire is recognized by using a small RFID reader in front of the press. The alarm is activated when the wrong tire is in front of the wrong press.

After vulcanization, the tire is transported to quality check. Here a QC employee and subsequent quality check are matched to a tire. Once the tire passes the quality check, it is transported to the X-ray. The X-ray machine recognizes the tire using the RFID code and starts the specific program for this unique tire. X-ray data is matched with a unique RFID code and tire and stored in the database.
Inventory management is also a major benefit of using RFID from manufacturing through the supply chain. Once the tire goes into the area to be palletized, by rolling the tire through a portal we are able to automatically couple the RFID barcode bead label to a rack which is RFID tagged. Within the warehouse, manufactures can “follow” the racks, since it is already documented which tires are on the racks.

The rack can then be tracked within the warehouse where the rack is associated with a warehouse location or zone. From a fixed location, through the rack/location, operators can easily identify and find every individual tire in the warehouse. Using individual tire and rack information, order picking is simplified. Since all tire data is in the database, operators can create an order picklist. In the case of an OEM customer for example, the system will create a list of last produced tires. The order picker will be forced by the system to pick tires in specific locations and racks. In the event the order picker picks the wrong rack, an alarm is activated when entering the loading dock or temporary warehouse.

When loading the trucks, it's easy to automatically count the different types of tires and match the specific tires to a retailer, auto-manufacturer or purchaser’s order using all the production data available in the system. A PDF can be automatically sent to the client for product delivery verification.

The benefits of RFID extend beyond the manufacturing environment to the individual consumer as well. Full relationship transparency between the consumer, tire, manufacturing source and production data will become commonplace.

To compare barcode bead labels versus QR code bead labels versus RFID barcode bead labels. I executed a large test across 1 000 tires using different types of bead labels. FineLine produced 1 000 barcode labels, 1 000 QR code bead labels, and 1 000 barcode RFID bead labels all having same number range (0 to 1000). On each tire (1 000 in total) the three different types of vulcanizable labels having the same number (so three times e.g. 00001 etc..) were applied.

For testing purposes three different solutions on each OTR tire. Outcome barcode 70%, QR code 80%, RFID barcode bead labels 100% (across 1000 tires)
At the end of the line, after vulcanization at quality control, the readability of each different type of label was tested. The outcome was:

**Readability of the barcode bead label on OTR tire 70%**

**Readability of QR bead label on OTR tire 80%**

**Readability of RFID barcode bead label 100%**

The RFID bead label, applied on the bead, has a reading distance of around 2.5 meters+ using a stationary RFID reader and up till 1.5 meters using a handheld reader. This performance is plenty enough to cover all the above-described processes.

RFID barcode bead labels are beneficial throughout the tire manufacturing supply chain and logistics. As the use of RFID becomes common place to ensure tracking individual tires from production to consumer labels that can capture the data, with extensive manufacturing and operating conditions will be mandatory. This holds true particularly for OTR tires that carry high costs and even higher consequences the necessitate quality production and identification. At FineLine Technologies we can help facilitate the implementation of RFID barcode bead labels at your manufacturing facility.

**About FineLine Technologies**

FineLine Technologies develops and produces barcoded, and RFID integrated labels, tags, and stickers for major tire manufacturers, retailers, re-treaders and fleet operators, worldwide. Our innovative RFID enabled tags for mold management, tire production, logistics and fleet management organizations are helping to improve the global tire market, with better inventory accuracy, traceability and connectivity. Learn more at [www.finelinetech.com/tires/](http://www.finelinetech.com/tires/).

**About the author**

Jos Uijlenbroek, was a co-founder of Ferm RFID Solutions, now a division of FineLine Technologies (USA). Jos is an industry leader, instrumental in the design and implementation of FineLine’s cutting-edge RFID solutions for OTR, passenger and TBR tires.

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