

TRACEABILITY OF HIDES AND SKINS: FROM FIELD TO LEATHER

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ABSTRACT

Quality of leather is deeply dependant on the origin of the livestock including breeding, transportation, slaughter and preservation. 15 years ago, the French leather industry has commissioned CTC to improve raw material, which require a unitary link between the quality of leather and its origin. This was the beginning of a huge project: traceability of hides and skins through the supply chain, from breeding to finished leather. Data is captured from the animal's ear tag at the point of slaughter which is then transfer on to a paper bar code. Hides and skins traders will then transfer definitively the code from the paper tag to the hides thanks to an automatic CO₂ laser marking device on the hair side in the neck region. That unitary traceability is resistant to all the tanning process and still visible until the crust stage. Then it can be visually or automatically read throughout the subsequent tanning process steps, thanks to an automatic reading system based on artificial intelligence. This technology has been implemented by several abattoirs, traders and tanners.

Traceability is the essential tool for quality management throughout the supply chain. It helps the identification of the origin of defects for improvement and provides the origin of the different grades of hides and skins. Upstream feedback within the supply chain progressively enhances the yield of grade 1 and 2 hides and skins.

This realistic industrial solution is a major issue for the leather industry whether it is for the improvement of quality or mastery of the supply chain and sustainability.

Keywords: traceability, supply chain, identification, leather, tannery

1. Introduction

CTC, committed for over 15 years to developing a unit traceability solution for leather, has successfully brought this challenge to fruition in recent years.

Indeed, CTC is now capable of offering an industrial-grade global traceability solution for the leather supply chain. This issue is critical for the entire sector, both for improving hide quality and for clearly and formally identifying the origin of raw materials by tracking all stakeholders involved in the transformation chain.

What was initially a quality-focused project now responds to broader concerns such as animal welfare, natural resource management, environmental preservation, and consumer safety. Today, it is essential to ensure the origin of materials and components used in a product. It is equally vital to be able to monitor industrial transformation processes to ensure compliance with environmental, social, and animal welfare standards.

To achieve this, it is imperative to link reliable, secure, and automatically generated data to each product in an industrialized and seamless way.

Therefore, unit traceability of hides and leather is clearly a key issue for the leather sector. The tools developed by CTC — which are detailed later in this document — make it possible to automatically (without human intervention) and industrially (integrated into the production line without slowing down manufacturing or requiring extra labor) generate trustworthy data. This data supports the leather sector in promoting responsible management and material traceability.

CSR (Corporate Social Responsibility) concerns are now a central issue. Whether used for communication purposes or to comply with legal requirements, brands and companies must be able to demonstrate and prove their CSR claims. Traceability is the essential tool to support these claims.

Commenté [TP1]: C'est 15 (abstract) ou 30 ans ?

It is immediately clear that data generation is the starting point for any upstream or downstream traceability system. Managing this data is also a critical step, requiring secure storage, fast access, and high-performance processing to deliver accurate and timely information.

CTC's unitary traceability solution is based on four modules that ensure complete traceability from birth to hide cutting.

In most industrialized countries, this solution is built upon mandatory meat traceability systems, which provide reliable and secured information on the animal's life, accessible via slaughterhouses.

In countries where meat traceability is not yet implemented, leather traceability begins at the slaughterhouse. Information prior to slaughter is declarative and provided by the slaughterhouses, with transparency for the client.

This solution is compatible with all types of hides. While initial developments focused on calf hides, scaling to bovine and goat hides required no process changes. For sheep and lamb hides, adaptations were made to ensure the same level of quality and reliability with the same technology.

2. Material and Methods

First module:

The first block involves applying a paper label to each hide before the skinning operation on the slaughter line. This paper, specifically its inscription, is designed to withstand the upstream preservation process, including brining, until the CO₂ laser technology is used to transfer the identifier directly into the hide.

This step ensures traceability continuity by linking the animal ear tag (used for meat traceability) to the second module of the leather traceability system.

Second module: ALIS MARKING

The second module is a key component of the traceability system, enabling the transfer of the tag's data deep into the hide's structure. This is crucial, as the paper label applied in the first module cannot withstand the chemical and mechanical processes of beamhouse and tanning operations.

This device, co-developed with a laser system integrator, uses medium-power CO₂ laser sources, ranging from 120 to 180 watts. CO₂ gas lasers are an established industrial technology with over 20 years of reliable use and are suited for organic materials due to their high affinity.

The preferred marking location is the shoulder area (collar), on both sides of the spine line, allowing for continued identification of the hides even after splitting. Marking a 16-character code in two lines of 8 digits takes approximately one second, making this process fully compatible with masked time during rawhide sorting or weighing operations.

The developed device ensures a permanent and industrially integrated marking, containing all the essential data for unit traceability of each hide.

Safety is a critical factor in this technology. Using high-power laser sources in an industrial environment must not pose a risk to operators. In our system, all laser beams are fully enclosed, eliminating any safety hazard. Additionally, fume extraction is handled at the source, preventing any odour pollution in the workshop, which would otherwise be unacceptable for the workforce.

The entire system is protected under a co-patent, securing its exploitation rights across Europe.

Hides are typically marked at the salted raw stage, although fresh marking is also possible. The main difference lies in marking speed and required laser power. The process uses thermal ablation by laser radiation, and for hydrated (fresh) hides, water must be vaporized before penetrating the dermis. Two technical options exist:

- Use the same laser power, but increase the marking time to allow for deeper penetration.
- Maintain short marking time by increasing the laser power, thus boosting energy density at the focal point.

While marking directly on the slaughter line would theoretically remove the need for the initial paper label (module 1), this approach introduces significant production constraints that are currently unrealistic for the meat industry.

Bovine and goat hides are marked on the grain side, i.e., through the hair, allowing for continuous numeric marking without perforation.

Ovine hides require a different approach due to the unpredictable wool thickness and the risk of wool ignition during marking. Therefore, they are marked on the flesh side, which requires perforating the skin.

A custom dot-based font was developed to ensure readable and durable marking, and avoid the "postage stamp" effect, which could lead to tearing or weaknesses during downstream processing.

Third module: ALIS Reading

The third module, a key differentiator of CTC's technology compared to competing solutions, lies in its ability to automatically, industrially, and non-destructively read the laser markings at various stages of the tannery process.

Marking raw hides without the capability for automatic reading is pointless, as no industrial company can rely on human operators to visually read each code one by one.

This technology is based on industrial vision systems. During various operations such as sorting at the tanned or semi-finished stage, or on conveyors feeding or unloading machines (e.g., wringers, finishing lines, or measuring units), industrial cameras, either line-scan or area-scan, are integrated into the process.

Once a precise image of the marked area is captured, it is processed using a combination of image processing algorithms and neural networks (AI) developed and trained in-house. Artificial intelligence is crucial here to compensate for marking distortions caused by the tanning process and the natural elasticity of the hide, which leads to unpredictable deformations.

The system achieves accurate recognition rates exceeding 90% when the markings are correctly applied and clearly visible. Continuous efforts are being made to optimize these algorithms, both to expand their robustness across all processing stages and to close the gap on the remaining few percent.

This module is fully automated and requires no operator intervention to ensure unit traceability throughout the tannery workflow.

Moreover, this device is a powerful enabler for quality improvement initiatives: at the tanned stage, the unique animal ID can be precisely linked to defects visible on the hide surface, making it possible to implement targeted corrective actions at the level of breeding operations, slaughterhouses, or logistics.

Fourth module: ALIS Tracking

The fourth and final module continues the logic of leather manufacturing processes. While the industrial vision system used to read unique laser markings performs well, it faces limitations at the finished leather stage. During finishing, various coatings are applied — such as color, gloss, grain embossing, etc. — which fill in and obscure the laser markings, making them unreadable by the vision system.

Given the wide diversity of leather finishing techniques, it would be unrealistic to adapt both the imaging setup and the algorithms for each individual finish.

To address this challenge, CTC is developing a RFID-based solution to transfer the traceability data from the laser marking. This approach involves affixing an RFID tag to the hide (typically at the leg) and linking the unique number read by the ALIS Reading system to the RFID tag's serial number. This association ensures that traceability is preserved through to the leather goods manufacturer and the cutting table.

Currently, we have RFID tags that withstand leather finishing processes, and the solution is undergoing industrial testing.

By integrating these systems into a Manufacturing Execution System (MES), it becomes possible to enable real-time production quality monitoring and targeted process deviation analysis, bringing a new level of control and optimization to leather production.

3. Results and Discussion

This solution is mature and proven, having been deployed in several French slaughterhouses and tanneries since 2017 in full industrial mode.

To date, we have designed and deployed more than 10 laser marking units across slaughterhouses and tanneries.

Similarly, regarding automatic reading at the tanned leather stage, we have 5 fully operational systems that have been in industrial use for over 7 years in tanneries.

We are currently finalizing the development of the RFID systems for the finished leather stages, to complete the end-to-end traceability solution.

4. Conclusion

This project conducted by CTC at the request of the French leather industry has provided the trade with various industrial tools to ensure

reliable, simple and economically viable traceability. These tools are undeniably a necessary support for the implementation of corrective actions aimed at improving hide quality and of quality charters allowing hide supply sources to be guaranteed and secured.

The implement of this solution outside France is now possible to provide all players with a reliable and secure technology for the traceability of raw materials, which is a crucial issue for our industries.

5. Acknowledgements

We thank our industrial partners and system integrators who contributed to the co-development and industrial implementation of the laser marking and vision technologies.

We also thank the tanneries and slaughterhouses who trusted us to pilot and deploy this solution in real production environments since 2017.