 https://doi.org/10.34836/pk.2021.313.2

# Registration of fingerprints with TrasoScan System

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## Summary

The continuous development of methods of trace visualization entailed the development of new, specialized trace registration devices. In recent years, the TrasoScan System for registration and processing of forensic traces: traseological traces, fingerprints or documents has appeared on the forensic market. Currently, this device is most often applied to traseological examinations. Notwithstanding the above, it can be successfully used to register fingerprints on dactyloscopic films, silicone casts, those secured together with a surface, or traces revealed by chemical methods. This article presents the broad spectrum of TrasoScan's capabilities for registering fingerprints of various types.

**Key words:** TrasoScan, fingerprints, trace fluorescence

### Introduction

For over a century, dactyloscopic examination has been considered one of the most effective methods of individual identification owing to the three fundamental properties of fingerprints: invariability, indestructibility and uniqueness (Grzeszyk, 1992; Moszczyński, 1997). Nowadays, fingerprints are not only used in forensics to determine the crime perpetrators, but also find their way into biometric documents such as passports. They are also used in securing access to smartphones, laptops or door locks. For several decades, dactyloscopy, which originally dealt mainly with the identification of fingerprint depositions, has developed a specialty related to revealing traces (Białek, 2009). At the beginning of the 20th century, only dactyloscopic powders were used for trace visualization and their effectiveness was limited to "fresh" (a few days old) fingerprints. The second half of the 20th century saw significant advances in technology that enhanced the ability to reveal traces. In the 1970s, the revealing methods based on chemical reactions have been developed (Champod et al., 2004; Lee, Gaensslen, 2021; Rogoża, 2009). Appropriate chemical compounds, reacting with specific components of the traceable substance, resulted in colored products, making visible the fingerprints left on various types of surfaces (Champod et al., 2004; Lee, Gaensslen, 2021; Moszczyński, 1997; Pękała, Rybczyńska, 2006; Bleay et al., 2021; *Fingermark*…, 2014). In the late 20th century, fluorescence-based methods were introduced (Champod et al., 2004; Lee, Gaensslen, 2021; Moszczyński, 1997; Pękała, Rybczyńska, 2006; Bleay et al., 2021; Moszczyński et al., 2008; *Fingermark*…, 2014). In this group of methods, the reaction products of a chemical compound with a traceable substance exhibit fluorescence when excited with light of a specific wavelength. Currently, visualization of traces is shifting its focus towards the use of up-conversion, or time-resolved delayed luminescence, i.e. the traces "glow" after the excitation light source has been removed (Drabarek et al., 2021). The continuous development of methods of trace visualization has also resulted in the developments of new, specialized devices for registration thereof. In recent years, the specialized TrasoScan System from LIM LABORATORY IMAGING has appeared on the forensic market.

TrasoScan (Fig. 1) is a universal system for recording and processing forensic traces: traseological traces, fingerprints or documents. Currently, this device is most often applied to traseological examinations. Notwithstanding the above, it can be successfully used to register fingerprints on dactyloscopic films, silicone casts, those secured together with a surface, or traces revealed by chemical methods. Objects up to 22 cm high can be scanned with the close-up lens. Images of objects up to 107 × 71 mm can be displayed on the screen in real time. Larger objects, up to 395 × 210 mm, are scanned at a high resolution of 1000 DPI. Flat objects can be flattened perfectly using the vacuum table, minimizing surface distortion and reflections. TrasoScan's integrated software allows not only image capture but also image archiving, comparison and reporting. The system is controlled by Forensic LUCIA software, which offers the options of live imaging, large image scanning or instant HDR and EDF scanning. HDR (High Dynamic Range) mode increases the range of spread between dark and light tones, making it possible to capture the details of the registered image. The EDF mode, on the other hand, allows to align and sharpen the image. Image descriptions and their masks can be stored in separate layers. The software includes a wide range of image enhancement and measurement tools, a set of 2D and 3D modes, a preview of all open images and image comparisons, as well as an image organizer. Image capturing parameters can be saved as defaults for later use. High illumination versatility is provided by three pairs of multispectral LED panels illuminating the platform at 12°, 45° and 60°. For high objects, the LED panel drive guarantees well-defined and uniform illumination. Diodes emitting light at wavelengths: 453, 505, 520, 590, 617 nm, allow visualization of fluorescent fingerprints. Polyspectral panel with diodes emitting light at wavelengths: 365, 405, 447, 480, 567, and 850 nm, also includes the ultraviolet (UV) and near-infrared (NIR) spectra. It is also possible to connect a fiber optic cable and use an external light source, such as a Polilight illuminator, to extend the range of fluorescence excitation wavelengths.

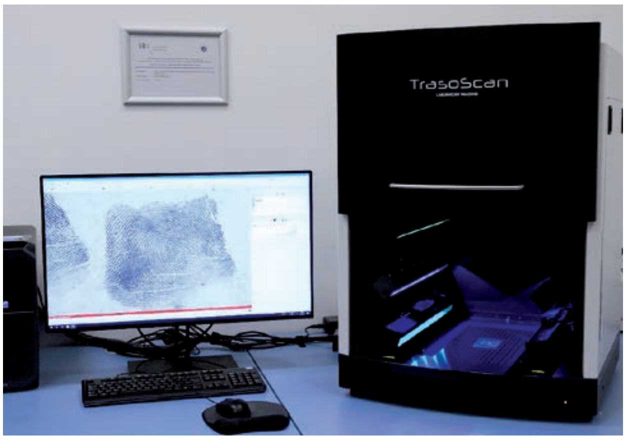


**Fig. 1.** TrasoScan System.

The aim of the study undertaken was to examine the possibility of registering various types of fingerprints with TrasoScan System.

## Research Methodology

Traces, which are difficult to register, for example due to deformation or reflectivity of the surface as well as luminescent traces, the photographing of which requires the use of an appropriate light source and specialized visual filters were selected for the study.

Fingerprints were applied to the surfaces and revealed by the techniques as specified below:

- white sheet of xerographic paper – traces revealed by the DFO technique;
- black stretch film – traces revealed using the cyanoacrylate polymerization technique and contrasted with Basic Yellow 40 fluorescent dye;
- CD – traces revealed with Magnetic Fluor Red dactyloscopic powder;
- deformed aluminum can – traces revealed with Magnetic Fluor Red fingerprint powder;
- fingerprints revealed in the dust and secured on black gelatin film.

## Results

*Scanning of fluorescent traces*

When scanning fluorescent traces, the combination of light wavelength and visual (color) filter is of key importance. This is because the effectiveness of illumination can vary depending on the type of surface. The selection of illumination conditions is best done experimentally. The more illumination panels are used, the shorter the exposure time. In the course of the study, the TrasoScan System was used to registister fingerprints revealed by the DFO technique on a white sheet of xerographic paper. Scanning was performed using LED panels emitting light at 505–520 nm and an orange visual filter attached to the camera lens (Fig. 2).

**Fig. 2.** Fingerprints revealed by the DFO technique and scanned with the TrasoScan System.

During fingerprint registration it was possible to use the software's auto-tuning feature to adjust scanning parameters or make changes manually to generate an user-satisfactory image. The advantage of TrasoScan is the ability to simultaneously register all the fingerprints with a single action. Thanks to the LED panels, the scanned surface is evenly illuminated and the fingerprints have a very good contrast with the surface. The software allows to insert scale into the image and transform it any way desired. Figures 3, 4, 5 and 6 present a fingerprint revealed by the DFO technique and registered with TrasoScan, followed by image transformations using Forensic LUCIA software.

*Scanning traces revealed on black stretch film*

A stretch film, because of its elasticity, is a surface that is not conductive to fingerprint registration. TrasoScan is equipped with a vacuum pump that allows the surface examined to be flattened and kept in a stable position on the image scanning platform, so that the fingerprints can be registered freely, without the need for any additional procedures. Figures 7 and 8 show a stretch film containing fingerprints revealed with cyanoacrylate

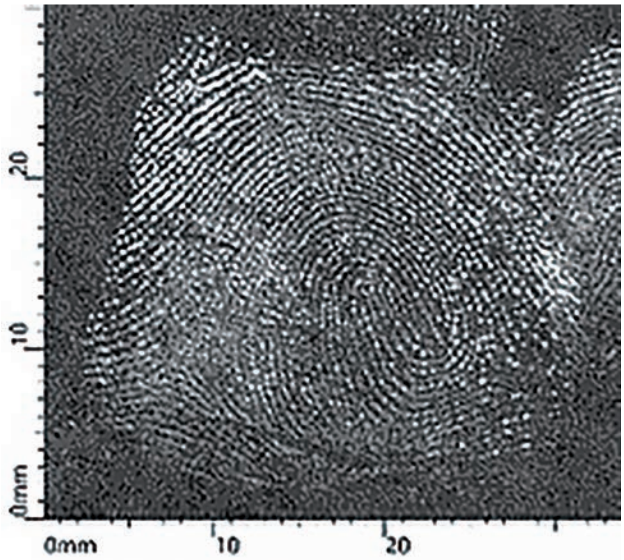


**Fig. 3.** A positive image of a DFO-revealed fingerprint.

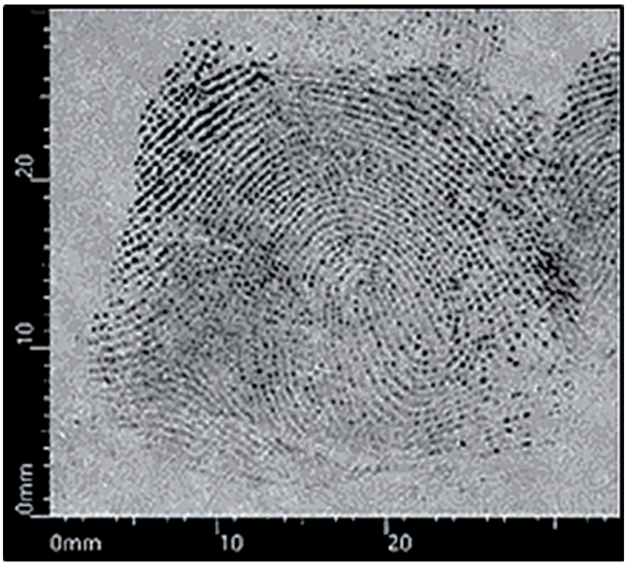


**Fig. 4.** A negative image of a DFO-revealed fingerprint.

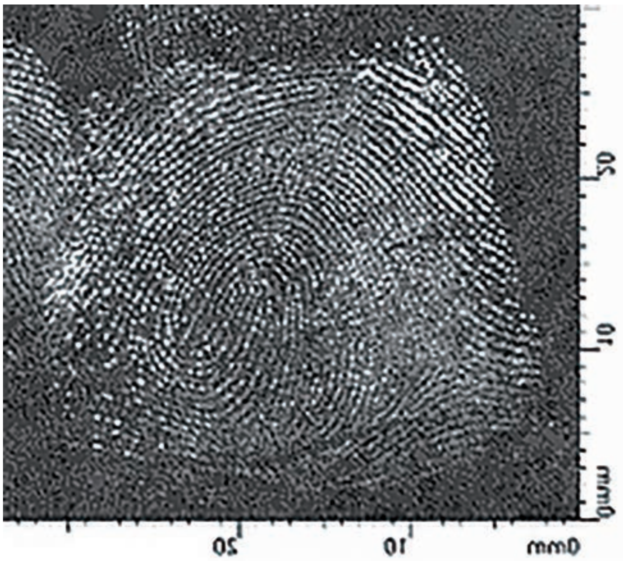

**Fig. 5.** Image of a DFO-revealed fingerprint positioned in the inversed direction.

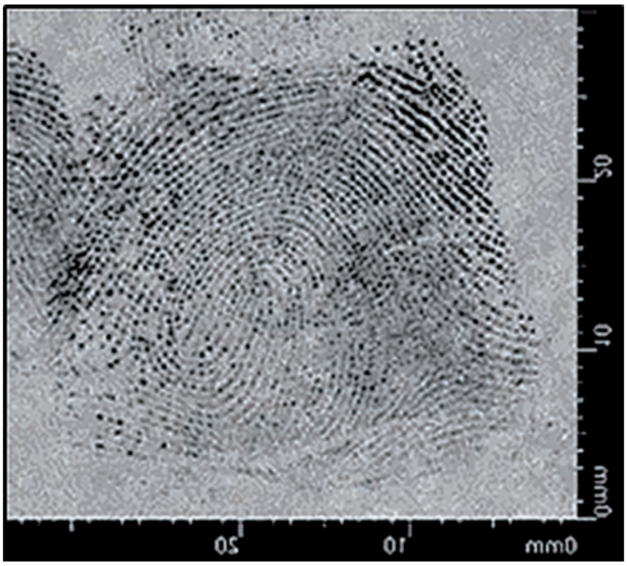

**Fig. 6.** Image of a DFO-revealed fingerprint positioned in the inverse direction and with inverted color.

and contrasted with Basic Yellow 40, photographed with a digital camera. Figure 9 shows the same film with fingerprints contrasted with Basic Yellow 40 and registered with TrasoScan.

*Scanning fingerprints revealed in the dust and secured on black gelatin film*

Using TrasoScan for scanning of fingerprints secured on dactyloscopic films begins with the selection of defined options for different types of gelatin media. The first step is to select the size of the film (13 × 37 cm, 18 × 37 cm, A4), then the type of film (transparent, black, white), and the illumination to be used with a specific film. Scanning fingerprints revealed in the dust is something of a special case. Frequently, the cover needs to be removed from the film to make the trace visible. This often causes the film to roll and any attempt to straighten it manually may cause contact marks to appear on the surface, such as glove marks, fibers, etc. The TrasoScan vacuum pump allows the uncovered film to be immobilized on the scanning platform. Angled illumination can be used to capture the details of the dust fingerprints. Figures 10–15 show fingerprints deposited in the dust, secured on black gelatin film and scanned with TrasoScan System, followed by image transformations performed using Forensic LUCIA software.

*Scanning traces on reflective surfaces*

Another very helpful feature of TrasoScan is the ability to scan traces deposited on reflective surfaces. Lower LED panels are used to eliminate the reflection effect. For

**Fig. 7.** A black stretch film containing fingerprints revealed with cyanoacrylate fumes, photographed with a digital camera.

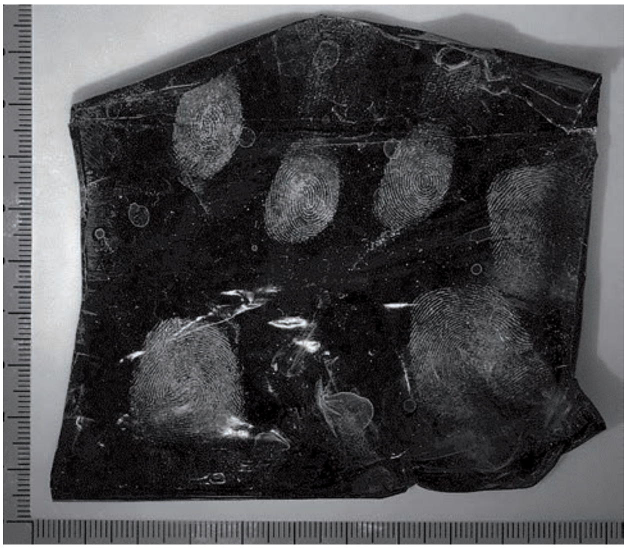

**Fig. 8.** A black stretch film containing fingerprints revealed with Basic Yellow 40, photographed with a digital camera.

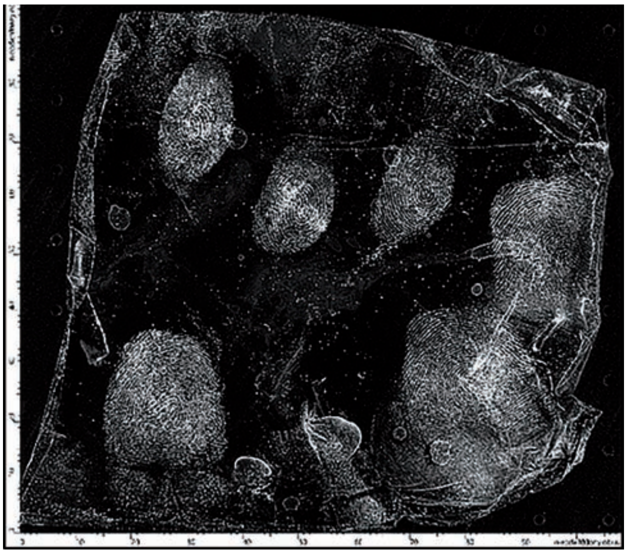

**Fig. 9.** A black stretch film containing fingerprints revealed with Basic Yellow 40, scanned with TrasoScan under 447 nm illumination and using a yellow filter.

this type of scanning it is recommended to set a shorter light exposure time. HDR (High Dynamic Range) tool, which allows for achieving better contrast between the trace and the surface, may also be considered. In addition, the scanned image is uniform does not contain underexposed or overexposed areas. Figure 16 shows a CD with fingerprints revealed by Magnetic Fluor Red powder, and Figure 17 shows an exemplary image of one of the traces revealed.

*Scanning traces on deformed surfaces*

Scanning traces on deformed surfaces presents a great difficulty due to their location at different heights. It is also common for light to be reflected in areas of surface folds. TrasoScan's software has an EDF feature that can be used to align and sharpen images. Figures 18 and 19 show a crumpled can with two fingerprints revealed with Magnetic Fluor Red powder, and Figures 20 and 21 show the fingerprints registered with the use of the EDF feature.

**Summary**

Featuring a wide range of scanning options using special LED illumination panels, TrasoScan System can register even the most difficult traces on a variety of surfaces, such as traces on deformed or reflective surfaces, fluorescent traces and traces secured in the dust.

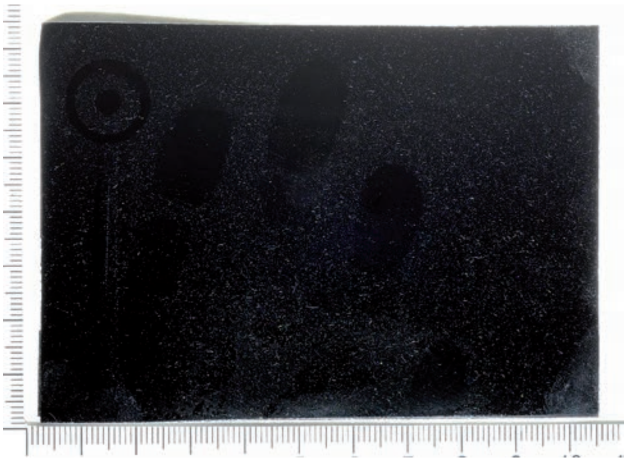

**Fig. 10.** Gelatin film with the cover removed, containing fingerprints secured in the dust, photographed with a digital camera.

**Fig. 11.** Gelatin film with the cover removed, containing fingerprints secured in the dust, scanned with TrasoScan System.

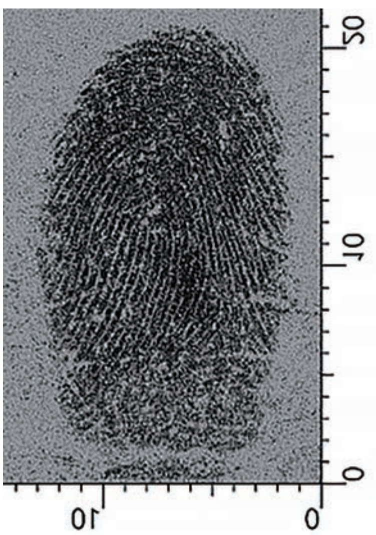

**Fig. 12.** Image of a fingerprint secured in the dust and scanned with TrasoScan System.

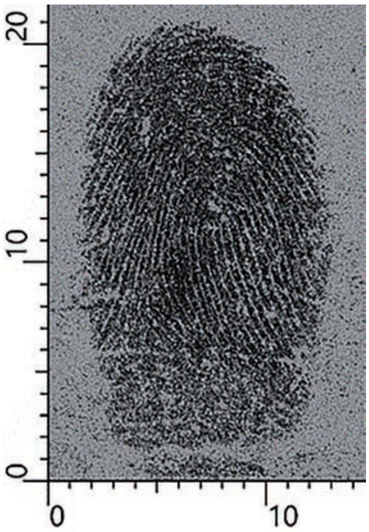


**Fig. 13.** Inverted image of a fingerprint secured in the dust and scanned with TrasoScan System.


**Fig. 14.** Negative image of a fingerprint secured in the dust and scanned with TrasoScan System.

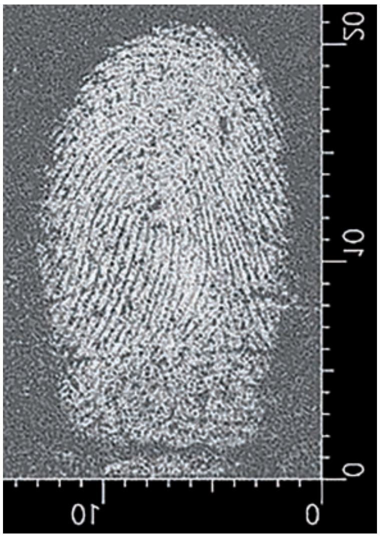

**Fig. 15.** Inverted and negative image of a fingerprint secured in the dust and scanned with TrasoScan System.

**Fig. 16.** CD with fingerprints revealed by Magnetic Fluor Red powder.

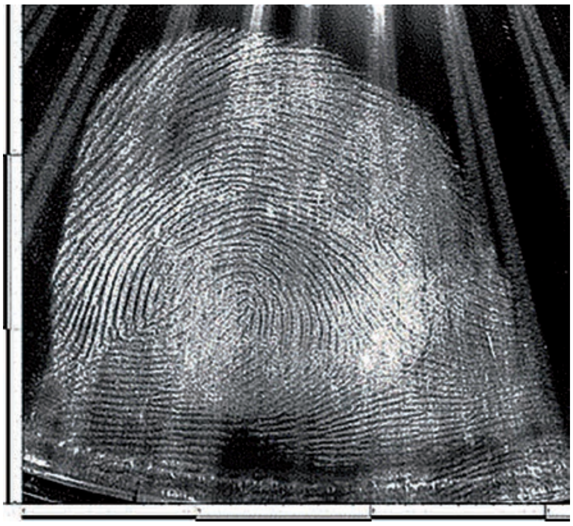

**Fig. 17.** Fingerprint revealed on a CD and scanned with TrasoScan System with simultaneous illumination at 505 nm and 590 nm emitted from the bottom panel of the system and using an orange visual filter.



**Fig. 18, 19.** A can with fingerprints revealed with Magnetic Fluor Red powder.

**Fig. 20, 21.** Fingerprints revealed on the can and scanned with TrasoScan System under 365 nm illumination and using a yellow visual filter.

In addition, the specialized *all-in-one* software supplied with the deice provides the ability to download, archive and compare images, and to generate reports. Images can contain descriptions and masks stored in separate layers. Image quality can be easily improved with a wide range of auxiliary tools. Image capture parameters can be saved as defaults for later use. TrasoScan supports all standard image formats, including RAW. Flat objects, such as gelatin films or paper, can be perfectly flattened using the vacuum table. Scanning wide or high objects is also easy to perform thanks to the conversion lens. The objects examined are scanned at a high resolution of 1000 DPI. TrasoScan meets the expectations of even the most demanding users. It is important to learn about its broad capabilities and how to put them to practical use.

**Sources of figures**
**Figures 1–21:** authors

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*Translation Hanna Wierzchosławska*

Narodowe Centrum Badań i Rozwoju

TrasoScan System was purchased as part of the implementation of the research and development project no. DOB-BIO9/08/01/2018 financed by the National Centre for Research and Development.