

## New forensic aspects of vehicle identification labels



### **Petra Kolitschova**

*Bc., Master's degree Student  
of of Criminalistics and Forensic Science  
The University of Finance and Administration,  
Prague, Czech Republic*



### **Roman Rak**

*Prof., Ing., PhD.  
Department of Criminalistics and Forensic Science  
The University of Finance and Administration,  
Prague, Czech Republic*

**Annotations** The paper discusses the problems of vehicle identification, especially the assorted identification labels (homologation, data, type, equipment labels, secondary identification labels), their history and security using various security elements (micro-text, optical variable elements (OVE<sup>1</sup>), elements that are visible only under ultraviolet light, etc.) against forging or alteration.

**Keywords** *Vehicle identification, identification label, homologation label, security elements, micro-text, UV elements, optical variable elements*

### **Introduction**

Together with the technical development of the vehicles themselves, the areas of security and protection of their identification markings are also developing. The objective is to prevent the forging and alteration of the vehicle identity, which is typical for all activities related to efforts at hiding the real identity of the vehicle that originates from speculative or criminal activity, and for all sorts of reasons.

We can register changes on the part of the manufacturer in the identification markings both in terms of protection of the key identifier VIN (*Vehicle Identification Number*), also in the protection of all sorts of labels on the vehicle, which among other things carry other (significant) information and information about the identity of the vehicle or information about the technical or administrative

<sup>1</sup> OVE – *Optical Variable Element(s)*

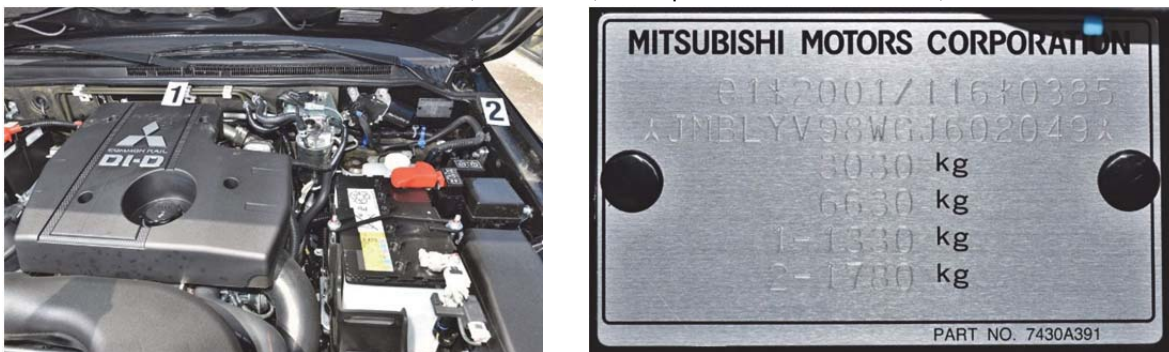
characteristics closely related to a specific type of vehicle. Based on this information, it is then possible to identify the vehicle in terms of make (type) or individually. If we know the primary production method of the identification marks (labels, stickers, "stamped" serial identification numbers, etc.), including their security elements, we can express qualified opinions about their genuineness or potential forging or alteration.

### History and present

Technological design of the identification markings of a vehicle have developed (and continue to develop). Design (manufacture) of the identifiers is mainly influenced by the following factors:

- security requirements for durability and permanence (unmistakeability) of the identification markings;
- location on the vehicle;
- manufacturing technologies (including security elements);
- material used and its properties;
- price;
- possibility of automatic processing, quick scan technologies for verification of the originality of the identification markings during diverse checks;
- availability of these technologies to the professional workplaces;
- aesthetic appearance;

Historically the first material used in vehicle identification was metal, then paper, plastics, glass, and in the last decade the digital environment (the identification and information markings are stored in the electrotechnical elements (memories), components of the vehicle).



**Fig. 1 Demonstration of a metallic identification label (on the right side), found at position "2" (image on left side).**

### Security elements of the identifiers – VIN on the vehicle body

In the past, vehicle identification markings were also realised by means of stamped or engraved VIN. In terms of security of the VIN worked directly into the bodywork of the vehicle, their security against forging or alteration were ensured by

- manufacturing technology;
- letter font (shape);
- letter dimensions;
- spaces between the so-called delimiters (limit, dividing marks) of the VIN;
- shape, appearance of the delimiter;
- protective lacquer;
- protective cover foil;
- hidden identifiers.
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According to the international norms, a chassis-frame-cum-body or frame of the vehicle must be marked with a VIN in a manner that makes the VIN their inseparable components. The VIN is stamped or engraved directly into the metal.

According to the international norms the manufacturer must place a dividing mark, the so-called delimiter before and after the VIN. Its appearance, shape, method of stamping is in itself a

protective element, but also the spacing of the centres between these delimiters (which carry the significant values – marks, i.e. numerals and letters) is fixed for most manufacturers, for example, 100 mm.

In terms of surface finishes, several procedures exist that may complicate the forging process for VIN forgers. The VIN may, for instance, be engraved over the final surface finish (such that the metallic appearance of the numerals and letters is visible in the sheet metal), or on the contrary, the VIN is covered with different layers of paint after stamping or engraving, including, for example, also the final clear coat, protective coat, which protects the metallic paint. This depends on the manufacturer. In many cases (usually the German motor vehicle manufacturers) stick transparent foil over the VIN, which protects it from corrosion, but also has the properties of a protective element against forging or imitation.

Different parts of the bodywork and vehicle components may also be marked with the VIN and some of them may have the character of secret places whose position is unknown to the layman public.

### **Security elements of the identifiers – metallic labels**

For homologation and data (type) labels, metallic labels technology was used in the past (usually aluminium), located in the engine compartment and fastened with rivets, which could have a basic protective element – unusual decorative design of the rivet head, including for instance the manufacturer's name, logo, etc.

Thanks to the non-aesthetic appearance of the metallic labels and their method of attachment to the vehicle, they were usually located in the engine compartment. The metallic labels in themselves did not have any security elements and were easily forged, respectively, a large number of private companies exist that are capable of making the label of any manufacturer for whatever vehicle model.

Currently, the metallic identification labels are used at minimum only for some Japanese brands (for example, Mitsubishi). They were replaced by self-adhesive stickers.

### **Advantages of self-adhesive identification stickers**

Self-adhesive identification, information labels have many advantages as compared to metallic labels:

- they are thinner;
- they are lighter;
- they are cheaper;
- they can be manufactured in different shapes and colour designs;
- they have a better aesthetic appearance;
- they can be installed anywhere;
- they can be attached to the vehicle in larger numbers;
- they are easier to hide;
- it is possible to use the same material processing method (including protective marks) to make several types of identifiers for one type of vehicle;
- the stickers can be made using self-destructive technologies, which prevent removal of the sticker and its transfer to another vehicle;
- the sticker can be made with various security elements, which prevent its alteration or forgery;

Modern homologation, type or data or information labels on the vehicles in the form of self-adhesive stickers can be made with various security elements in very high quality, which prevent their forgery or alteration.

It generally applies that the more expensive the vehicle, i.e. the higher its class, thus made in smaller series than middle or lower class vehicles, the higher the attention devoted to its protection against various forms of automotive crime. The identification labels contain more security elements. In terms of manufacturing costs, these labels are however comprehensively also slightly more expensive.

Different manufacturers, who secure the identification labels with various security elements that use various technologies or security principles. For lower class vehicles made in large series for reason of lower cost, the requirements for security of the identification labels may be lower from the manufacturer's viewpoint. Protection against forging or alteration of various identification labels thus exclusively depends on the policy and priorities of the manufacturer of a given type of vehicle.

### Security elements of the self-adhesive motor vehicle identifiers

From the viewpoint of creation and ensuring the protection of elements and access to the identification labels, we can classify them as follows:

- self-destructive stickers;
- optical variable elements (OVE);
- micro-texts;
- UV security elements;
- protective transparent cover foils;
- logical, information relationships;

#### Self-destructive stickers

The identification, type or information label is made to resist the action of forces, which are generated during normal operation and maintenance of the vehicle, for example, washing, etc. At the same time, it is designed in such a manner that it is not possible to abuse it and use it on another vehicle. In practice this means that the label (in the form of a sticker) is self-destructive, and gets torn, deformed upon attempt to transfer it to another location (usually on another vehicle), such that it self-destructs (tears) upon human action on it. It is possible on an undamaged identification label (at present usually in the form of a sticker) when lighted from the side to observe a structure in the form of hexahedrons (with the semblance of a honeycomb) or waves. The individual parts of the identifiers thus get torn along these curves. At the same time, we can see the cut edges around the perimeter of the label (sticker), which also function as the beginnings of the self-destructive forces.



**Fig. 2** In the right side section of the image, we see the self-destructive lines along which the homologation label tears upon attempt to transfer it to another vehicle.

#### Optical variable elements (OVE2)

Optical variable elements are generally protective images, logos of the manufacturers, or wholly invisible texts at first sight, which are visible only under light falling at given angle on the identification label at the location of the optical variable elements. The optical variable elements have different sizes and may be combined with micro-texts located in individual OVE images (in the manufacturer's logo, text name of the manufacturer, etc.)

<sup>2</sup> OVE – Optical Variable Element(s)





**Fig. 3 Demonstration of an optical variable element – Hyundai logo, which is visible only under a certain light angle. In the logo (right leg of the letter H), an additional “micro-text” element is also used, which contains the word “Hyundai”.**

### Micro-texts

The micro-texts are made of very small font on the legibility limit. They are sharply printed and still properly legible. On the other hand, the micro-text is made in such a manner that copying it (without its debasement – for example, its fusion or blurring) is not trivial or print it using lower quality printing techniques. The micro-texts are usually located as the base text of the identification sticker, or around the perimeter of the sticker or in the images of the various elements – manufacturer’s logo, name, etc.

### UV security elements

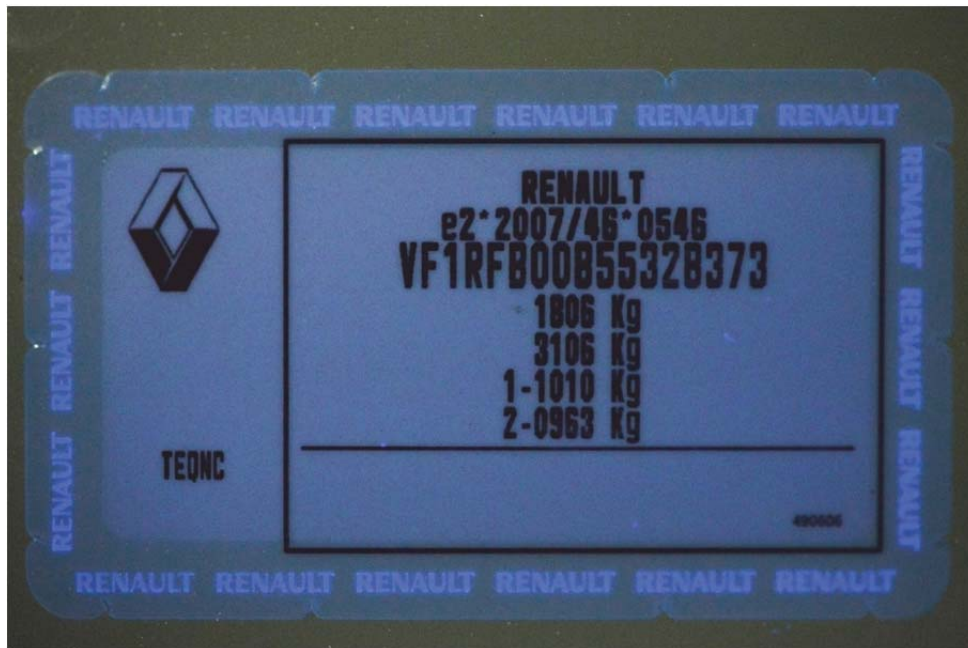
The use of hidden security elements, which are visible under ultraviolet light (UV) started about ten years ago. When verifying vehicles, which operate only within the imaginary inner boundaries of the individual EU countries, they are used mainly by the alien police units, which mainly check the travel documents of the vehicle crews. UV lamps are also used to verify the authenticity of the documents so it is no longer necessary to also simultaneously check the authenticity/originality of the identification labels in a complicated manner; and hence also extend the check to the vehicle.

The UV protection elements are made for illumination using UV light with a wavelength of 365 nm. The security elements are variegated depending on the manufacturer’s requirements and customs. The following graphics and text elements are usually visualised in UV light:

- perimeter lines of the labels;
- texts inside the labels, which carry information about the vehicle (the label is fully legible in daylight as well as UV light);
- manufacturer’s name;
- manufacturer’s logo;
- optical variable elements (OVE) are also readable under UV light;
- various dots, commas, special characters, which at first appear to be print errors, noise during manufacturing of the label.

UV protection elements are typical for French, German and Japanese manufacturers, particularly for more expensive, higher luxury middle and higher-class vehicles.

The French manufacturers favour the use of transparent cover foils, which are stuck over the homologation labels. Two reasons exist for this approach: A transparent cover foil protects the homologation label. This is clearly apparent at first sight. In reality, we find protective UV elements in the perimeter part, which does not optically infringe upon the homologation label.



**Fig. 4 Demonstration of protective transparent cover foil over the white homologation label. Under UV light, the inscription RENAULT is visible around the full perimeter of the label at the edges of transparent foil. At the same time, we can see triangular “cuts”, which trigger the destruction of the label at its contact point upon attempt to transfer the label to another vehicle.**

In the case of the TPCA (*Toyota Peugeot Citroën Automobile*) concern, these are the logos, brand names, or the texts (“TPCA”, “SN”, etc.). It is interesting that for some models this applies to the logo/name of one manufacturer, for others the logos/names of two manufacturers, which are stated together. This procedure depends on the manufacturing plant where the vehicle is made or whether the given model is sold under various business names (two or more brands – Peugeot, Citroen, DSA). It may technically concern the same type of vehicle that however carries a different brand name – for example, Peugeot Boxer/Citroen Jumper etc..

Similarly, we also need not be surprised at the UV protective text “Nissan” that is on the Renault vehicle label because it is primarily a vehicle model/type, which is designed by Nissan for its vehicles and is subsequently manufactured under the Renault brand (as well as other brands); or a Renault vehicle manufactured in a Nissan manufacturing plant. Recently, we often encounter various forms of co-operation between various brands in the global environment for the purpose of survival. This results in the creation of various groups of manufacturers, concerns, etc., which is manifest also in the identification of the vehicles in the form of transferred standards, customs, etc.

### **Protective transparent cover foils**

Security transparent foils generally have two uses.

They primarily protect the identifier (VIN, homologation label) of the vehicle from penetration of water, corrosion, physical or chemical damage, soiling, etc. These transparent stickers are made in such a manner that they also fulfil the security function to counter forging or alteration of the identifier itself. They may be of self-destructive design, made of transparent material with difficult to copy features, shape (circumferential curves, rounding of edges, thickness, adhesion power, etc.).

The protective transparent cover foils of some brands (especially the French, German manufacturers) contain a hidden images, lines or texts, which are visible in the UV spectrum (usually of wavelength 365 nm, which is standardly used in lamps for inspection of documents and banknotes/securities).

Most of the transparent cover foils in time lose their plastic and optical properties, harden, become fragile, may become yellowish, in a similar manner as applies to photographs processed using the classic wet method. If we know (we have a reference database) that an identifier should

have cover foil and security elements, and any of these items is missing, we have a clear signal of manipulation with the vehicle identification.



**Fig. 5 Demonstration of the protective transparent cover foil of a stamped VIN identifier of a Range Rover vehicle.**

The transparent cover foil over the identification, especially homologation labels apart from protection against mechanical damage and the security function with the aid of the UV elements also include the option to protect the label against its illegal transfer to another vehicle. The protective transparent cover foil is thus self-destructive. We can recognize this according to the fact that the perimeter of the transparent protective foil has triangular cuts. Upon attempt to remove the foil, it tears and disintegrates at these points.

#### **Logical and information markings**

We can find a large number of variegated (alphanumeric sequence) codes on the homologation, identification, data and type labels of motor vehicles, which are in terms of information related to specific characteristics of the manufactured vehicle (its colour, type or engine power, gearbox, design, individual vehicle equipment components – dual-zone air-conditioning, audio-system, homologated type, etc.). If an offender who is changing the identity of the vehicle illegally and thoughtlessly transfers these identification markings to another vehicle, he disrupts the logical harmony between the characteristics of the vehicle and the characteristics on the labels, which should correspond to the real condition of the vehicle. Based on knowledge of the content and production method of the identification labels, we can thus uncover illegal manipulation.

#### **Conclusion**

For us to be able to efficiently identify forged or altered identifiers, homologation, type or data labels, we should have a reference database of original specimens available. During systematic inspection, we use the above-stated knowledge base, knowledge of the typical procedures of the individual vehicle manufacturers and our previous practical experience. The current approaches of the manufacturers to the identification of the vehicle, technologies, materials, etc. usually change within a period of 3-5 years, and are usually identical, typical for the vehicles in a specific class – for example, the homologation label, type and data label, VIN under the windscreen – are made from identical pre-printed material), etc.

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