



Forensic and scientific methods

An objective and detailed examination is our top priority.

For this purpose, various forensic methods are regularly used during our investigations.

It is not the size of our “halo” that should be the yardstick for the quality of our investigation, but comprehensible, scientific, objective findings represent the foundation of our reports.

Your business doesn't stop at the limit! Not ours either!

We operate worldwide and cover all countries in which German investors are traveling. We maintain personal contacts with partners abroad and can integrate the right partner if necessary!

We stand by our work! *We are insured for our activities, including in the case of assets, and are therefore fully liable for our work (on the back of our report does not say "Only for the insurance"!)*

Frequent questions and methods at a glance - Verification of originality using forensic and scientific methods:

Does my GFK / CFK body have the first paint? What is the condition of the units? Is the embossing of the chassis number original? Has the engine been properly and professionally overhauled? Are the tube dimensions on the frame manufacturer-compliant? Is the material of the epoch „old“ (body / frame) and therefore genuine? How original is my vehicle? What value does the condition reflect? The punch digits of the embossed markings (engine, transmission, chassis and body number) are these manufacturer-compliant?

- *Magneto Optical method for checking embossed markings*
- *Ultrasound: material thickness testing*



- *Spectroscopy: analyze material composition*
- *Etching examination: Metallographic etching to check authenticity*
- *3D and 2D scans for taking measurements, comparing quality and checking authenticity*
- *Analysis of the welds and manufacturing processes of the vehicle manufacturer*
- *Compliance check*
- *Material analysis of welding consumables*
- *Testing of the materials according to the forming process of the manufacturer (deep drawing, etc.)*
- *Creation of a digital model geometry using original photo files and subsequent comparison with the 3D scan data of the examination vehicle in the frame and body area.*
- *Oil analysis to describe the condition of units*
 - *engine*
 - *transmission*
 - *differential*

In the following we would like to introduce our various forensic methods to authenticate vehicles for their originality. Starting off with spectroscopy, we move over to ultrasonic, the magneto optical method, oil analysis, paint thickness measurement, 3D-scanning and x-ray, microscopy and our engine examinations:

1 Spectroscopy – mobil and non-invasiv -



Spectroscopy is used to determine the composition of the material, including the elements in percentage that make up the material. Following the analysis it is possible to determine the manufacturing process and the decade it was produced in. Further are able to compare the analysis with our data from the archive and make a statement regarding the originality of the material (e.g. frame, chassis, body...). Spectroscopy, as a forensic and scientific method of checking the authenticity of materials, has been used in our engineering office since 1988. For 9 years now, we have



been able to determine the composition of materials on sight, at the car, not needing to send material into a stationary laboratory. Therefore we are able to analyse the material in an almost non invasive way at any time, any where in the world. To date, we have been traveling across the world to inspect many cars from UK, Italy, Switzerland, Netherlands, Belgium, Sweden, Norway, Denmark, Austria, Spain, Portugal, over North and South America, South Africa, Russia, Japan and China.

NOTE: You want to use XRF? X-ray fluorescence is a method to analysis the elemental composition of materials. However, XRF has limitations on the elements that can be measured... Optical Emission Spectroscopy (the spectroscopy we use and is the only one providing the information necessary in order to be able to „date“ the material) is an optical method that can be used to detect almost all types of Elementes, especially the ones which are crucial for our analysis and „dating“ —> the XRF can NOT detect these elements! The information you 'll gain is not very helpful! The OEM is non-destructive and Portable too so absolutely no need for an XRF which then doesn 't provide the Information needed – so please be careful here!

Follow the link for a video on the procedure:

<https://youtu.be/k-OpKHSZYU8>

2 Ultrasonic for wall and coatthickness measurement of paint or body / frame panels

There are essentially 3 measuring methods to carry out non-destructive layer thickness measurements, for example of frame material or body sheet or paint thickness measurements on car bodies:

- The magnetic-inductive measuring method for measurements on ferritic substrates such as sheet metal
- The eddy current method for measurements on non-ferrous substrates such as aluminum
- Ultrasound for substrate-independent measurements or multi-layer measurements.



We use ultrasonic to determine the material thickness, including aluminum and steel sheet. In the body and frame area we use this method frequently to compare the material thicknesses with the technical drawings of the vehicle manufacturers. The important thing here is that we can measure the sheet metal skills without measuring lacquer, filler or other materials and of course in a non-invasive way! How does it work? The speed of sound of each material varies



and therefore we can differentiate each material and measure the exact thickness using the speed of sound of the material in question, calibrating the ultrasonic machine and receiving a result in mm.

We can also determine the paint layer thickness or any type of material thickness. Ultrasound is used in particular to examine the thickness of the paintwork on glass and carbon fiber, so we can also identify a first paint vehicle here!

With the ultrasonic method you are material independent in all cases! It can also be layer thicknesses on different substrates such as metals, plastics, wood or GRP or. Measure CFRP! In addition, not only the total thickness, but also the individual layer thicknesses can be measured in just one measuring process – which is an enormous advantage over electromagnetic methods!

Follow the link for a video on the procedure:

<https://youtu.be/4c-G0L2cILY>

3 Oil analysis

We perform an oil analysis on units such as the engine, transmission and differential in order to get a better overview of the state of the units. The analysis results are meaningful and can e.g. be an indication that the head gasket has to be replaced or that there is bearing damage.

On the left the values of a fresh oil sample and on the right the engine oil sample of the test vehicle:

Iron is greatly increased, but copper and aluminum are also slightly increased. Lead / copper typical bearing materials. Silicon is high and indicates dust / dirt, which has an abrasive and therefore wear-promoting effect. In addition, potassium / sodium

Diagnose der aktuellen Laborwerte

Verschleißmetalle sind nur in vernachlässigbarer Konzentration vorhanden. Es ist daher kaum abrasiver oder korrosiver Verschleiß ersichtlich. Die Additivierung weicht von der Frischölsreferenz in unserer Datenbank ab. Möglicherweise sind die Werte durch Reste der vorherigen Ölfüllung beeinflusst. Der Kraftstoffgehalt ist vernachlässigbar gering. Sie sollten die weitere Veränderung anhand der nächsten Analyse beobachten. Ich rate Ihnen: Senden Sie uns die nächste Probe bei Ihrer nächsten Wartung oder anlässlich der üblichen Inspektion zu einer Beobachtung des Trendverhaltens.

Anne Simon, M. Sc. (MLA II)

Gesamtbewertung

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Hinweis

ANALYSENERGEBNISSE		Aktuelle Probe	Frühere Untersuchungen
LABORNUMMER	4426250	4325685	
GESAMTBEWERTUNG			
Untersuchungsdatum	13.11.2020	20.07.2020	
Datum Probenentnahme	10.11.2020	15.07.2020	
Datum letzter Ölwechsel	-	11.10.2019	
Nachfüllmenge seit Wechsel	-	-	
Laufzeit seit Wechsel	-	13000	
Laufzeit gesamt	-	74000	
Öl geschleift	-	ja	
VERSCHEISS			
Eisen	Fe	mg/kg	1
Chrom	Cr	mg/kg	0
Zinn	Sn	mg/kg	0
Aluminium	Al	mg/kg	0
Nickel	Ni	mg/kg	0
Kupfer	Cu	mg/kg	0
Blei	Pb	mg/kg	0
Mangan	Mn	mg/kg	0
PO-Index			< 25
VERUNREINIGUNG			
Silizium	Si	mg/kg	4
Kalium	K	mg/kg	0
Natrium	Na	mg/kg	1
Silber	Ag	mg/kg	7
Wasser	%		< 0.10
IR-Glykol	%		negativ
IR-Dieselruß	%		< 0.3
Biodiesel	%		< 0.3
Rußgehalt	%		< 0.1
ÖLZUSTAND			
Viskosität bei 40°C	mm ² /s		50.75
Viskosität bei 100°C	mm ² /s		10.02
Viskositätsindex			183
Oxidation	Atom		1
Nitration	Atom		0
Sulfation	Atom		0
IR-Index			36.40
Schutzstragervermögen	%		33
ADDITIVE			
Kalium	K	mg/kg	1084
Magnesium	Mg	mg/kg	3
Bor	B	mg/kg	250
Zink	Zn	mg/kg	544
Phosphor	P	mg/kg	472
Barium	Ba	mg/kg	0
Molybdän	Mo	mg/kg	461
Schwefel	S	mg/kg	1826

Probe und Deckel

Infrarot-Spektrum

CCD-Tüpfel



increases what can come from the coolant, since it is often used as an additive in the coolant. Fuel is slightly increased and not the primary problem here.

Follow the link for a video on the procedure:

<https://youtu.be/x2Z8Rz-dlcA>

4 Magneto Optical Methode (MRT): non-invasive method to analysis matching numbers

The magneto-optical method is used to replace the Fry etching method, an invasive acid method, in order to be able to examine the stampings on the car in a non-destructive way which can be performed continuously. This resonance method is using magnetic energy and helps us to have the embossed markings on a vehicle analysed for hidden digits, double taxes, grinding marks and more. The invisible is made visible.



For almost 7 years we have been able to NON-INVASIVE examine the embossed markings on vehicles and in 95% of the cases we have a meaningful result. Otherwise we use the Fry etching method, which allows us to determine further knowledge in a destructive manner. An exciting method, despite the destruction! [This way to an exciting case from the beginning of 2000 and the investigation of an „SSK“ – have a look! We used this method here too.](#)

Follow the link for a video on the procedure:

<https://www.youtube.com/watch?v=8n3V50DPHMk&t=31s>

5 3D-Scan – mobil und non-invasiv -

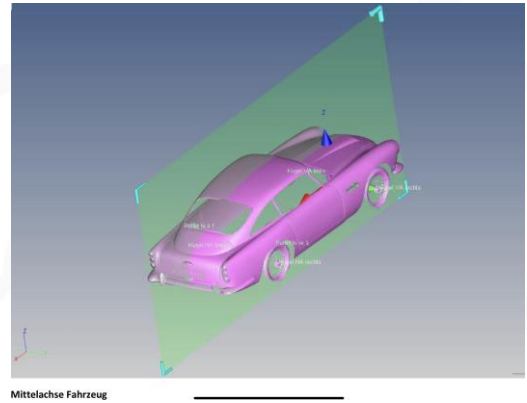
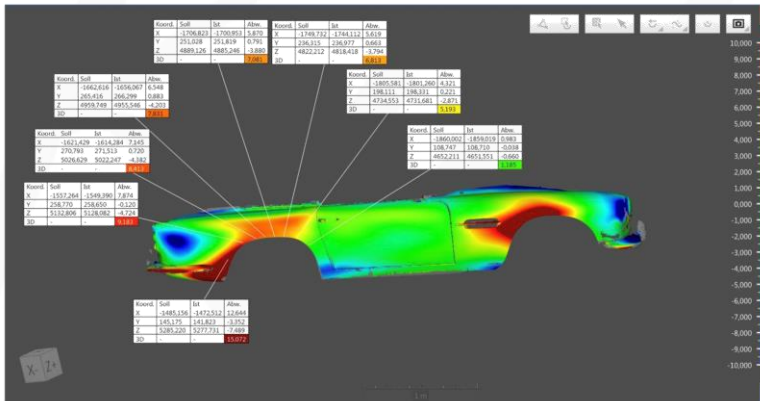
The three-dimensional recording of the body and frame helps to answer certain questions, in particular with regard to authenticity, restoration evaluation, freedom from damage and originality.

3D scanners are used that use the active triangulation process and achieve a measurement accuracy of up to 0.01 mm. A 3D scan can be helpful in the area of technical examinations and appraisals as well as damage reports. Possible areas of application:

- *Checking the dimensional accuracy of a body or a frame after a restoration*

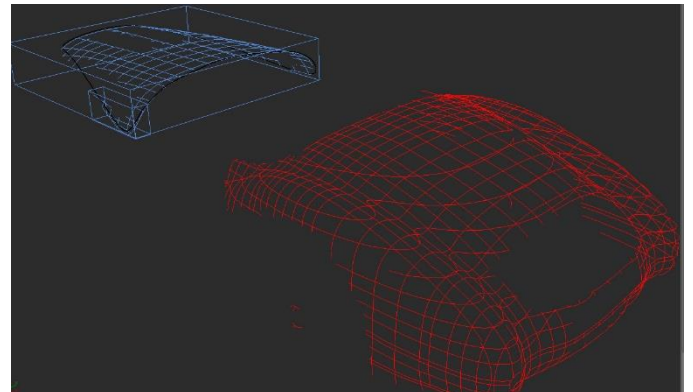
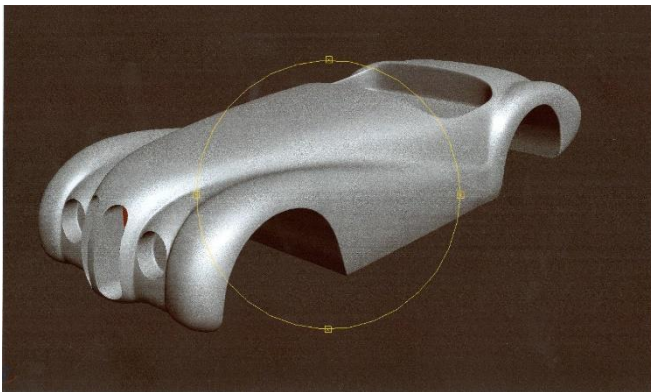


- Comparison of the results with the manufacturer's specifications
- Checking the body and the frame for torsion and / or compression after an accident
- Reverse engineering process of spare parts that are no longer available but required



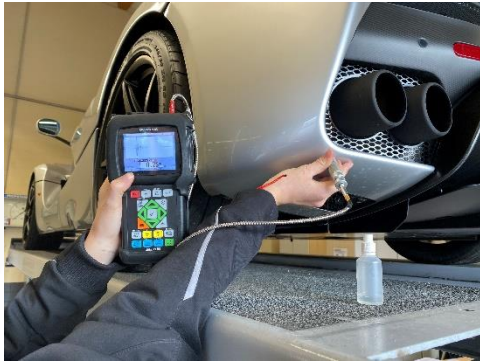
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To check the authenticity of a vehicle, it is possible to compare a previously created 3D model with historical photos. For this purpose, a 3D grid structure is placed on historical photos using photogrammetric methods. Based on this comparison, the previously scanned body can be checked for authenticity and originality.





6 Lackschichtdickenmessung



Now a "must do" for every rating!

You get to know the car in detail in the paint and body area.

With the help of the paint layer thickness, it is easy to find out where the examined vehicle was repainted and, under certain circumstances, also repainted. This can provide information on previous damage and is

decisive for the value of the vehicle.

Using the latest technology, such as the use of ultrasound, we are able to measure the paint film thickness on aluminum and steel, but also on GRP and CFRP

Follow the link for a video on the procedure:

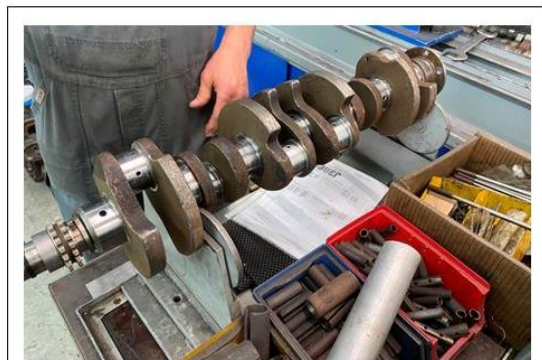
<https://www.youtube.com/watch?v=RvpYc0ZmA2c>

7 Motoren Untersuchung

Below are excerpts from our engine reports as an example



8.5.1.7.3.10.2 Vermessung Kurbelwelle



Kurbelwelle Vermessung

8.5.1.7.3.8.9 Vermessung Kolbenhemd



Vermessung Kolbenhemd

8.5.1.7.3.8.9.1 Kolbenhemdmaße

Zylinder	1	2	3	4	5	6
Hemd	84,955	84,94	84,94	84,945	84,94	84,95
Hemdausleger	84,95	84,94	84,94	84,945	84,94	84,95

Die unteren Ölabbstreifringe hängen teilweise.