Fraunhofer Technologie-Entwicklungsgruppe

Project report:

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Test of the validity of RVS-technology® gel

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2 Summary

Initial situation

Oy RVS Technology Ltd. (“RVS”) in Finland is the manufacturer and owner of the Patent rights and Trade Mark rights of RVS Technology® gel and other RVS Technology® products.

This gel can be used to revitalize petrol engines. Revitalization in this case implies alterations to the material of the treated components.

Project goal

This project was intended to study the functionality of the RVS-technology® gel on a test vehicle. RVS-technology® gel is designed to revitalize the friction surfaces of components by forming a ceramic layer on the crystal lattice of the treated metal surface.

Summary

Fraunhofer Technology Development Group was appointed to test the functionality of the RVS-technology® gel.
For this purpose, the engine of a test vehicle selected in agreement with “RVS” was treated by the company with RVS-technology® gel. After that, the vehicle was examined for any changes resulting from this treatment. Examinations consisted of engine tests as well as investigations of the engine block's surface, conducted before and after application of the gel. Treatment of the test vehicle with RVS-technology® gel was performed carefully and professionally by qualified personnel from RVS under the supervision of the Fraunhofer Technology Development Group.

The procedures employed by the Fraunhofer Technology Development Group as part of this study were based on experiences gathered in a large number of projects for developing customer-specific product solutions.

A systematic and step-by-step approach - including release of a specification list by “RVS” - ensured that the company remained updated on current developments at all times.

3 Procedure

Pre-examination

In the pre-examination phase, a test vehicle was selected from a large number of different candidates. This decision-making process took place in close cooperation with the client, who was ultimately responsible for the selection.

This phase of the study involved compression measurements performed by the Technical Control Board of Böblingen. Furthermore, the engine block was removed and its surface investigated.

The measurement data obtained during pre- and post-examination together from the basis for evaluating the RVS-technology® gel as part of this project.

As part of the preliminary study, the client also obtained a certificate of roadworthiness for the test vehicle.

Treatment

Treatment of the test vehicle with RVS-technology® gel was performed by qualified personnel from “RVS”.

Test journey

Following application of the RVS-technology® gel, the vehicle was driven on a test journey of 2000 kilometres. This journey was meticulously logged and implemented by the client under the supervision of the Fraunhofer Technology Development Group. No modifications to the engine were permitted during this period.

Post-examination

The post-examination phase of this study again involved compression measurements by the Technical Control Board of Böblingen, as well as a removal of the treated engine block and investigations of its surface.

The measurement data obtained in the post-examination phase were used as a basis for comparing the measurement data obtained during the pre-examination phase.

Engine operation without oil

In a subsequent phase, the engine's idling properties without oil were investigated to evaluate the effects of treatment with RVS-technology® gel.

Optical measurements on casts

The Fraunhofer Technology Development Group also performed an optical measurement, beyond the specified scope of the study. In this process, casts of each cylinder were prepared using polysiloxane vinyl PROVIL®novo made by Heraeus Kulzer. These casts permitted qualitative comparisons of surface properties before and after application of the RVS-technology® gel.

Compression test on an additional vehicle

The Fraunhofer Technology Development Group also measured changes in compression on an additional vehicle, beyond the specified scope of the study: The compression characteristics of a Ford Fiesta were examined outside the original test series.

4 Measurement results prior to treatment

4.1 Compression measurement

4.1.1 General vehicle data

Manufacturer	Ford	Engine type	Spark ignition engine
Vehicle type	Escort 1.4	Power	refer to the measurement log kW / min^{-1}
Identity number	WFOAXXGCAALS51024	Cubic capacity	1368 cm3 (refer to the vehicle registration)
Transmission	M	Empty weight	875 kg

Figure 4-1: General data of the test vehicle

Figure 4-2: Ford Escort test vehicle, made in 1990 (vehicle on left, engine on right)

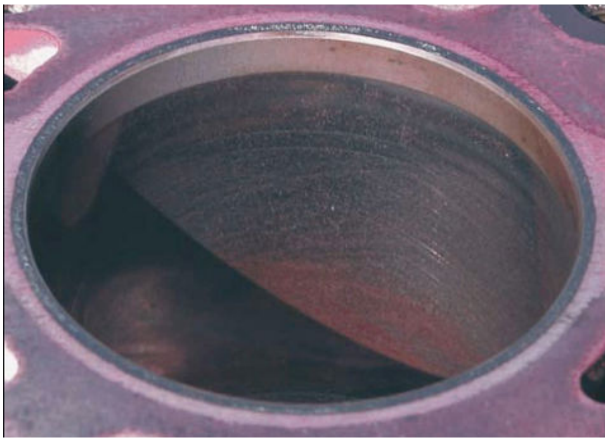

Figure 4-3: Digital recording of Ford Escort's engine block before treatment (honing marks on the cylinder surfaces are evident here)

4.1.2 Measurement results prior to treatment

Measurement series 1:	Prior to treatment
Mileage:	19,441 kilometres
Power:	54 KW

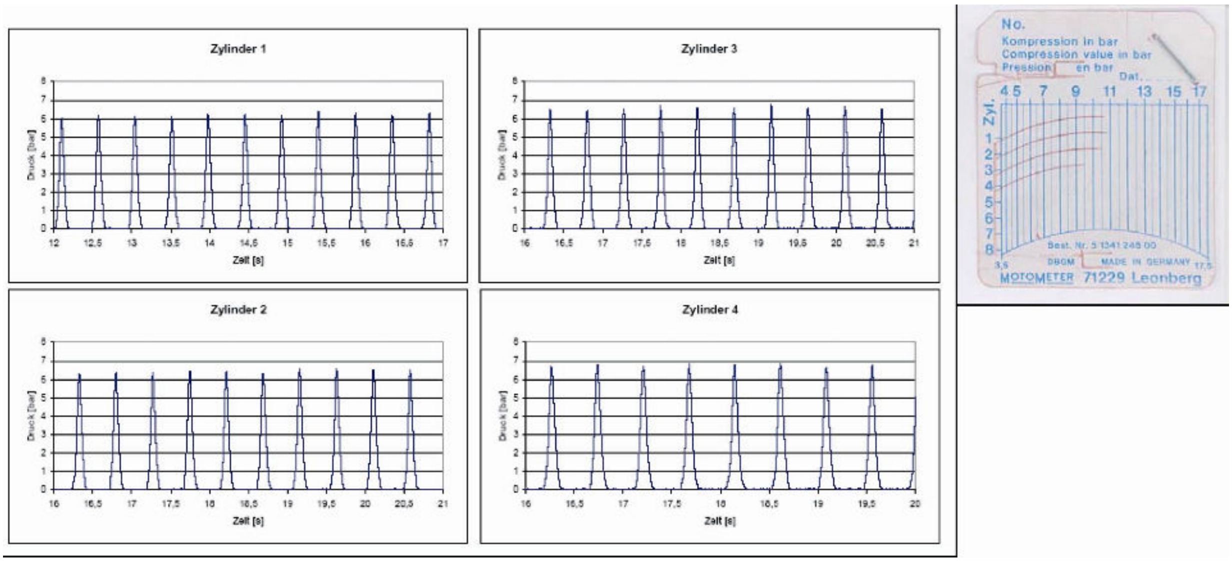

Figure 4-6: Results of compression measurement (digital measurement on left, analogy measurement at top right)

Compression measurements by the Technical Control Board of Böblingen prior to application of RVS-technology® gel at a mileage of 19,441 kilometres yielded the compression characteristics shown in Figure 4-6. The average peak value lies in the region of 6.5 bar. The differences between the results of the two measurement techniques are attributable to the nature of the techniques. However, both of them are a tried and tested means of evaluating characteristics.

4.2 Surface measurement results prior to treatment

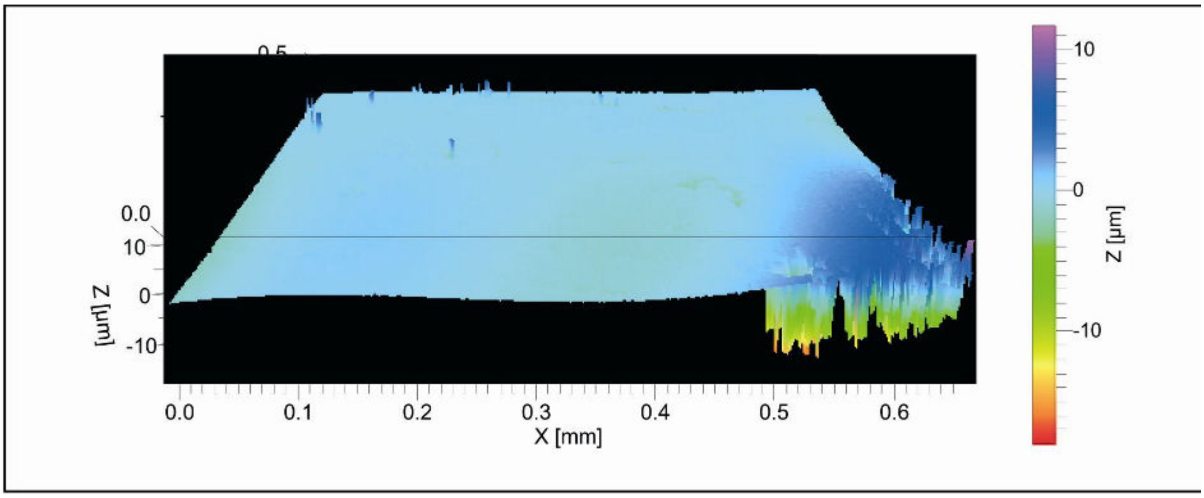

Figure 4-7: 3D recording of a cylinder wall using a white-light interferometer

Figure 4-7 provides a 3D representation of a cylinder surface section scanned by means of a white-light interferometer. Figures 4-8 and 4-9 provide a top view of the scanned section, without and with artificial illumination respectively.

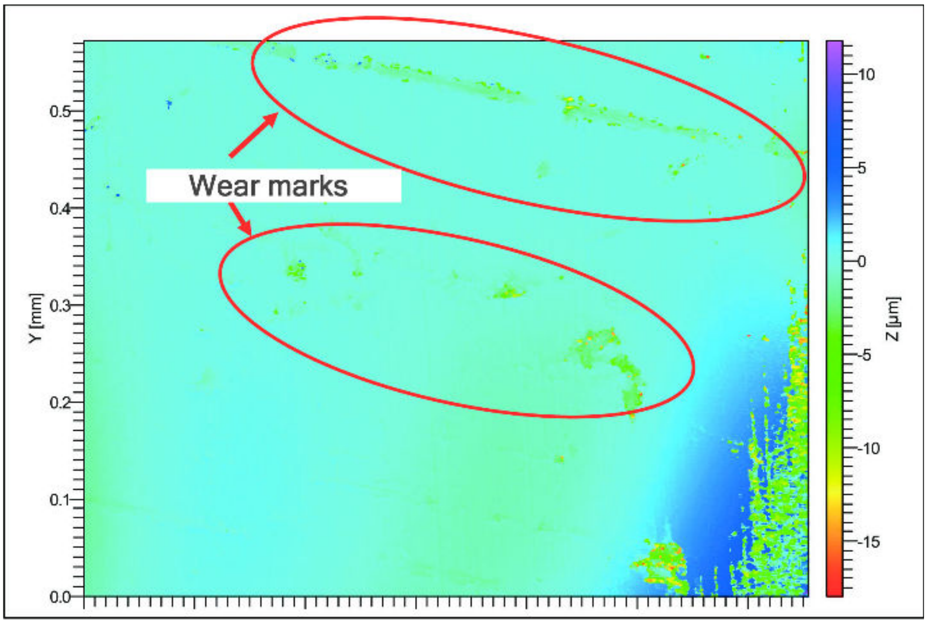

Figure 4-8: Recording (top view) of a cylinder wall by means of a white-light interferometer

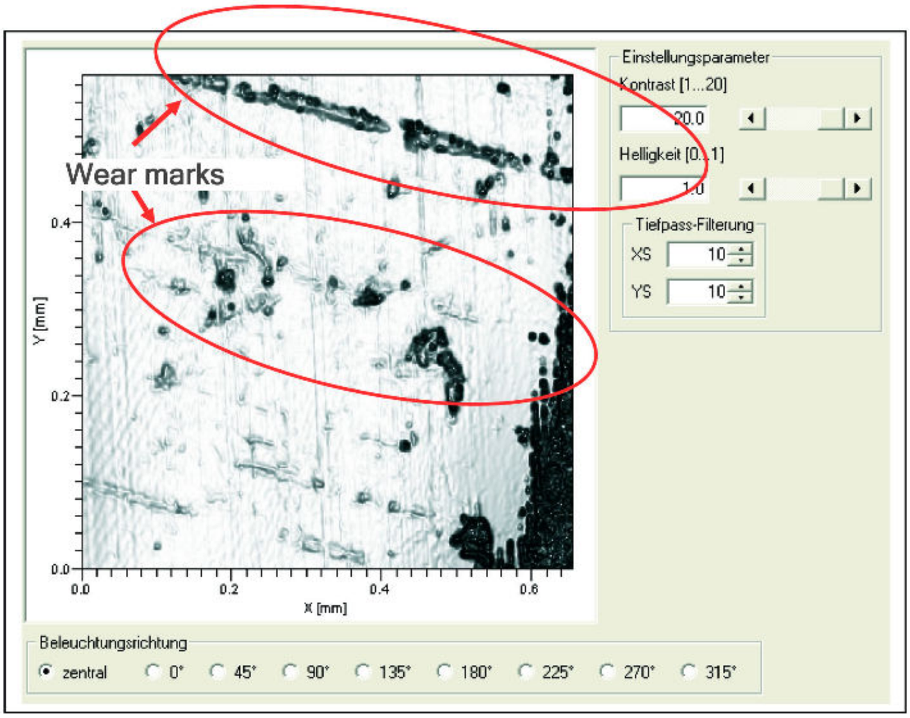

Figure 4-9: Recording (top view) of a cylinder wall by means of a white-light interferometer (with artificial lighting)

An optical analysis of the cylinder surface reveals no significant signs of damage. The cylinder wall is smooth, exhibiting a few wear marks in the form of axial grooves, this number lying within reasonable limits.

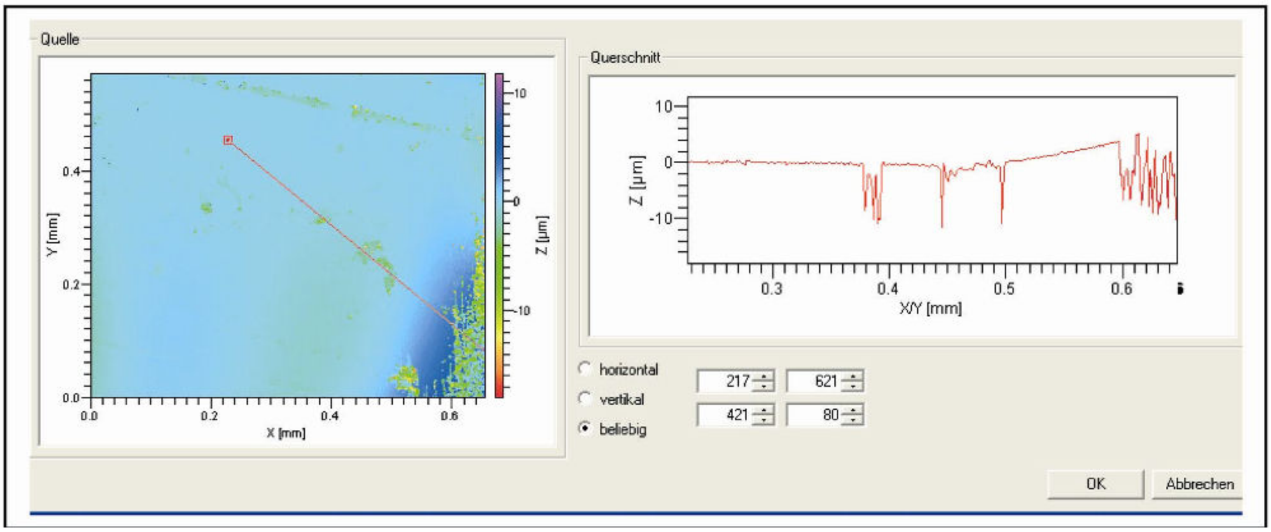

Figure 4-10: Recording of a cross-section by means of a white-light interferometer

Figures 4-10 and 4-11 provide explicit representations of a cross-section quantifying the structure and course of the marks. These marks have a real depth of up to 8 µm. Depths exhibited in excess of this value are attributable to the measuring inaccuracies (diffraction effects) of this technique (R_a = 6.6 / R_z = 0.83).

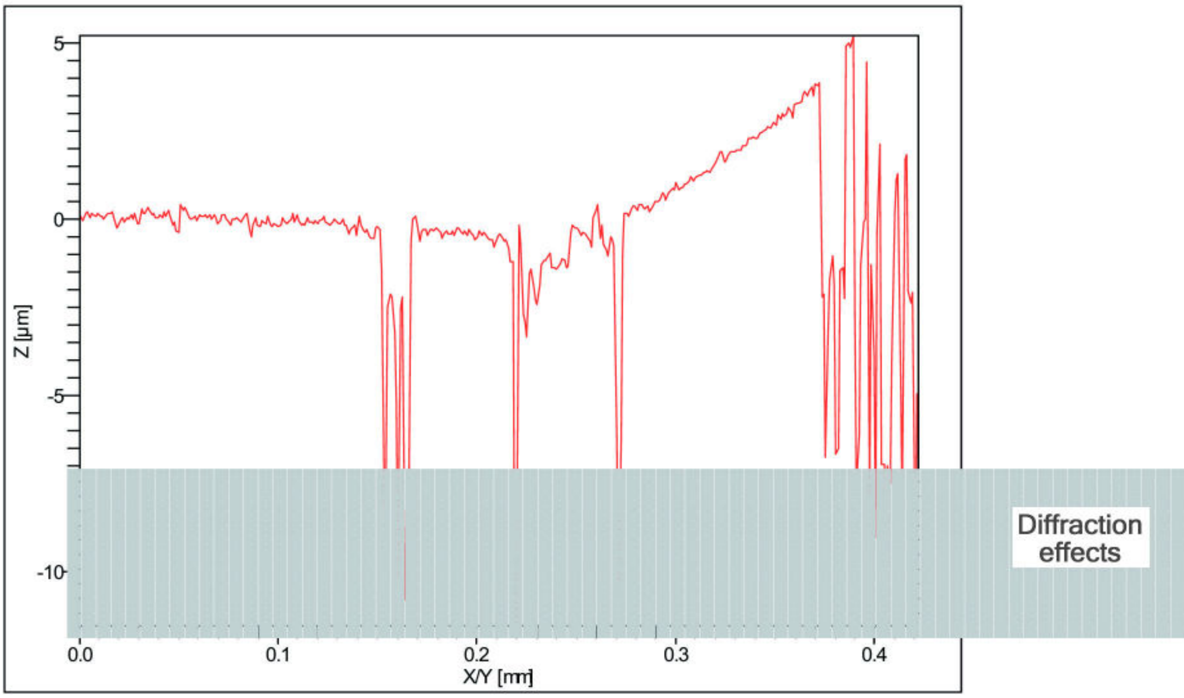

Figure 4-11: Recording of a cross-section by means of a white-light interferometer (zoom)

Measurements performed with the white-light interferometer were confirmed by tactile measurements also carried out.

5 Measurement results following application of RVS-technology® gel

5.1 Compression measurement

5.1.1 General vehicle data

Manufacturer	Ford	Engine type	Spark ignition engine
Vehicle type	Escort 1.4	Power	refer to the measurement log kW / min^{-1}
Identity number	WFOAXXGCAALS51024	Cubic capacity	1368 cm3 (refer to the vehicle registration)
Transmission	M	Empty weight	875 kg

Figure 5-0: General data of the test vehicle

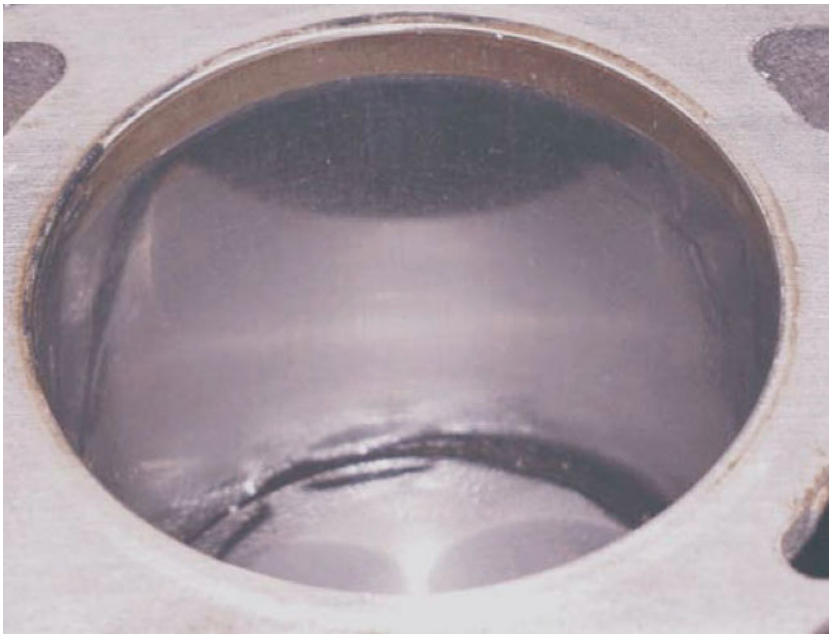

Figure 5-1: Digital recording of the Ford Escort's engine block following treatment (alterations to the surface are clearly visible)

5.1.2 Measurement results following treatment

Measurement series 2:	Following treatment and continuous operation over roughly 2,000 kilometres
Mileage:	21,623 kilometres
Power:	54 KW

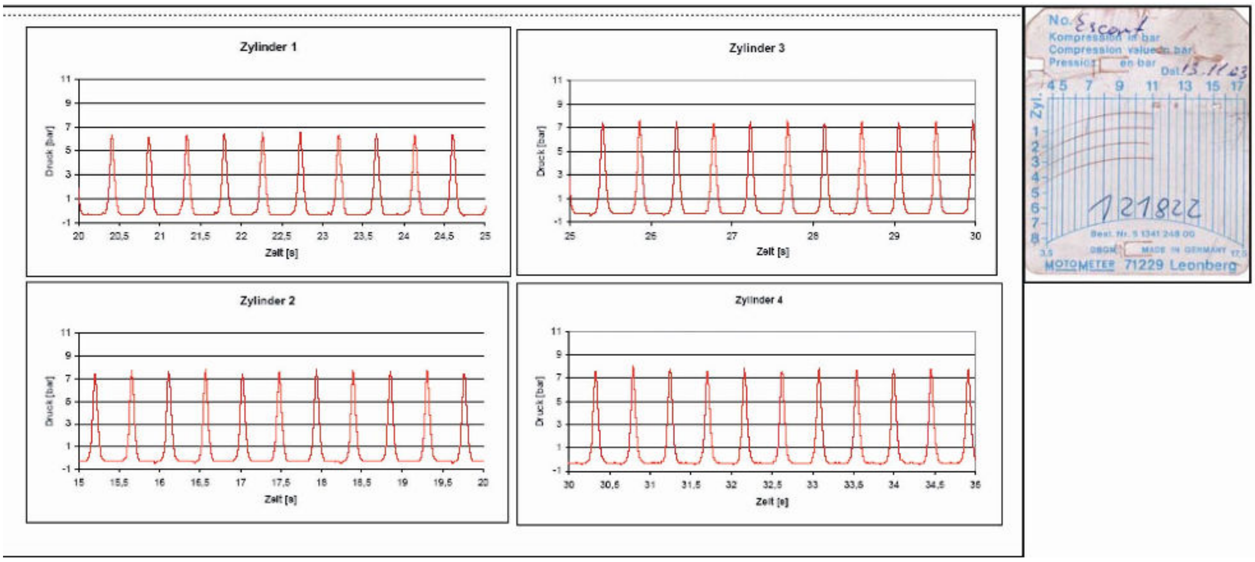

Figure 5-2: Compression measurement results

Compression measurements by the Technical Control Board of Böblingen following application of RVS-technology® gel and continuous operation at a mileage of 21,623 kilometres yielded the characteristics shown in Figure 5-2. The average peak value lies in the region of 7.3 bar, indicating a notable improvement in compression, An increase of about 12% can be assumed here. This is confirmed by the analog measurement results. The differences between the results of the two measurement techniques are attributable to the nature of the techniques. However, both "before/after" comparisons indicate improvement as a result of treatment.

5.2 Surface measurement results following treatment

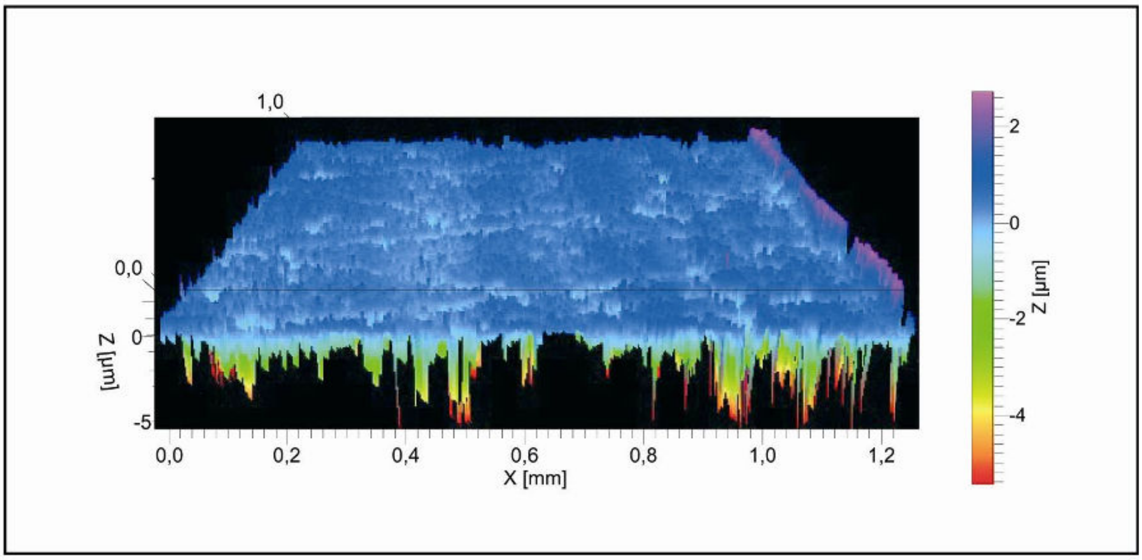

Figure 5-3: 3D recording of a cylinder wall using a white-light interferometer

Figure 5-3 provides a 3D representation of a cylinder surface recorded by means of a white-light interferometer. A corresponding top view of the surface is provided in Figure 5-4.

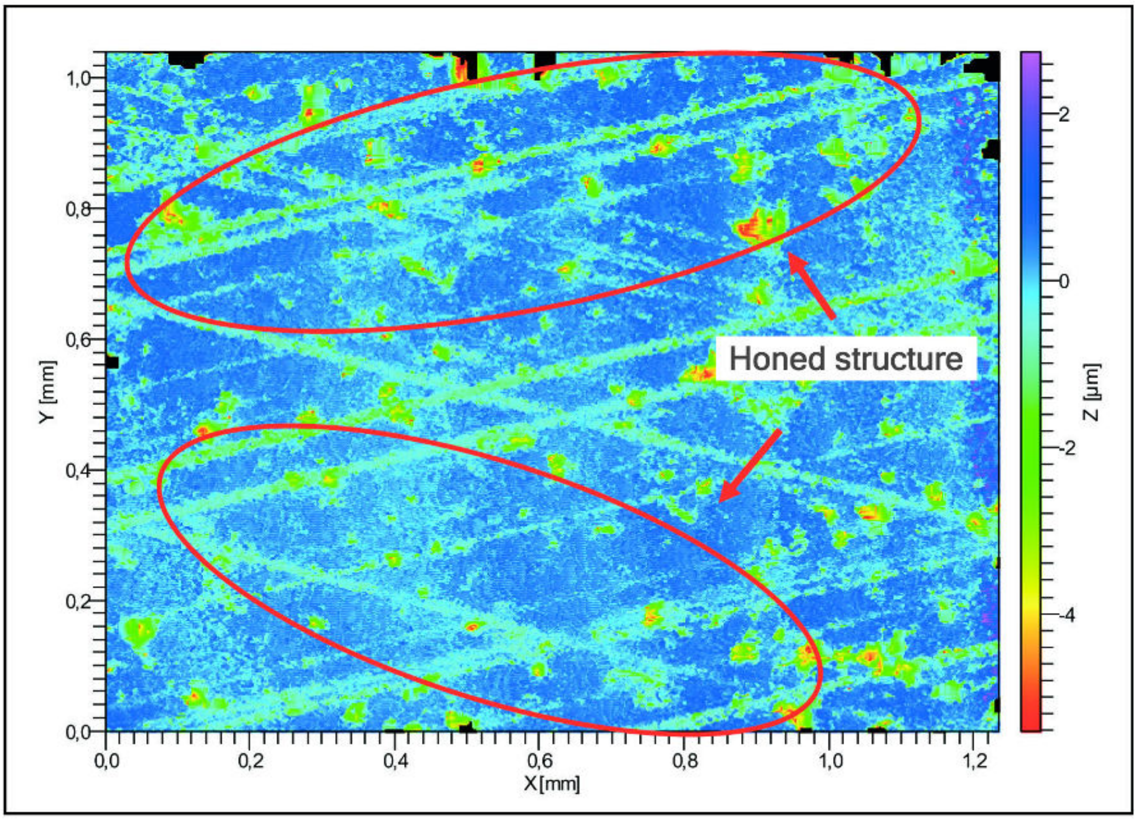

Figure 5-4: Recording (top view) of a cylinder wall using a white-light interferometer

These recordings show the structure of the cylinder surface. Evidently, the surface has a typical, honed texture.

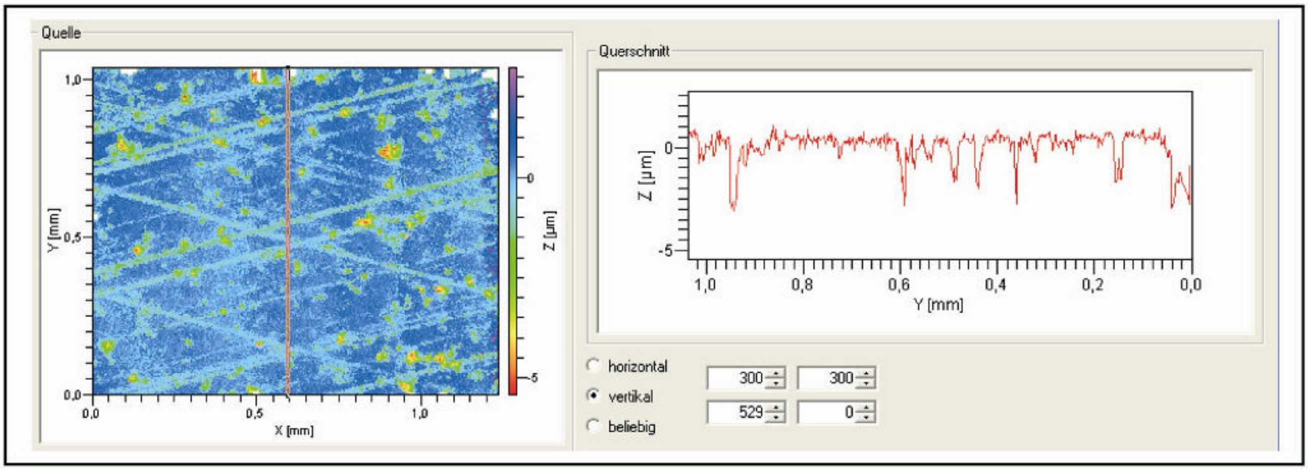

Figure 5-5: Recording of a cross-section by means of a white-light Interferometer

Figures 5-5 provides an explicit representation of a cross-section quantifying the structure and course of the marks. These marks have a depth of 2 - 3 µm (R_a = 1.2 / R_z = 0.12).

Measurements performed with the white-light interferometer were confirmed by tactile measurements also carried out.

A comparison between the measurement results in Figures 5-4 and 4-8 verifies the presence of a material layer of 4-5 µm. The colour scales indicate a maximum mark depth of 8-9 µm in Figure 4-8 and 3-4 µm in Figure 5-4. This difference is attributable to the application of RVS-technology® gel. A change in the scale of representation (based on the deepest mark) also reveals honed textures in the second measurement series.

5.3 Operation without oil

Engine operation without oil was also investigated as part of this study. On completion of the analysis phase, the test vehicle's engine was drained of oil.

The engine was made to idle without oil for a test duration of one hour.

During no-load operation over this hour, the engine exhibited smooth running and a constant temperature. This test therefore confirmed the existence of a metal-ceramic coating resulting from the application of RVS-technology® gel.

6 Additional measurement data

6.1 Optical measurements on casts

The Fraunhofer Technology Development Group also performed an optical measurement, beyond the specified scope of the study. In this process, casts of each cylinder were prepared using polysiloxane vinyl PROVIL®novo made by Heraeus Kulzer. These casts permitted qualitative comparisons of surface properties before and after application of the RVS-technology® gel.

Figures 6-1 und 6-2 show the four cylinder casts before and after application of RVS-technology® gel.

This test is exclusively intended for a qualitative evaluation of changes in surface structure. The cylinder surface exhibited improvement in the form of reduced wear marks.

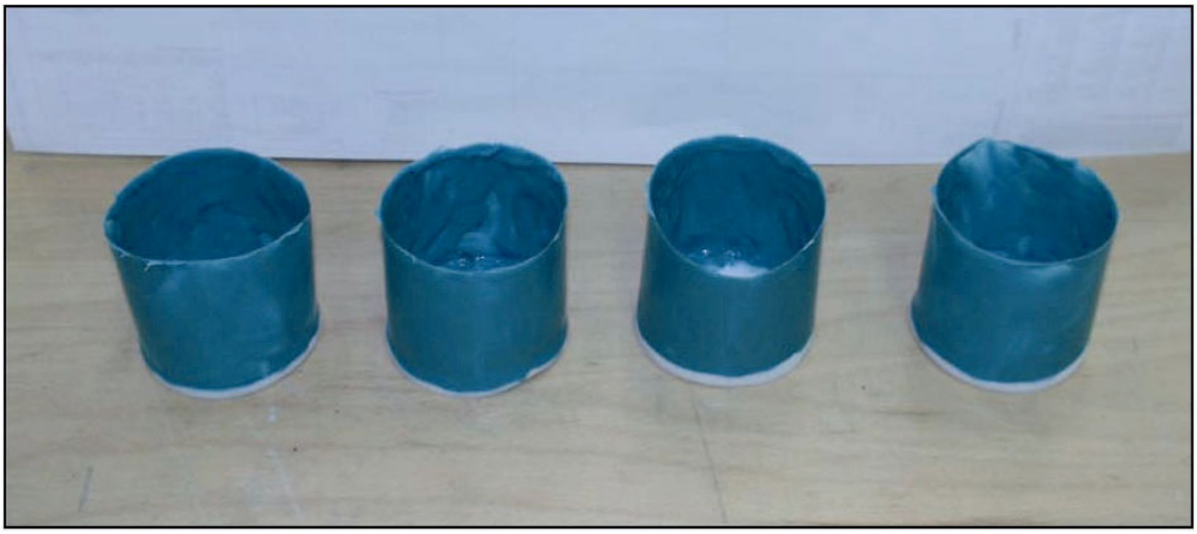

Figure 6-1: Cylinder casts before treatment

Figure 6-2: Cylinder casts after treatment

6.2 Compression test on an additional vehicle

The Fraunhofer Technology Development Group also measured changes in compression on an additional vehicle, beyond the specified scope of the study: The compression characteristics of a Ford Fiesta (date of manufacture: January 1988; cubic capacity: 1098 ccm; power: 36 kW) were examined outside the original test series.

This involved comparisons between the test vehicle's compression data obtained before and after application of RVS-technology® gel.

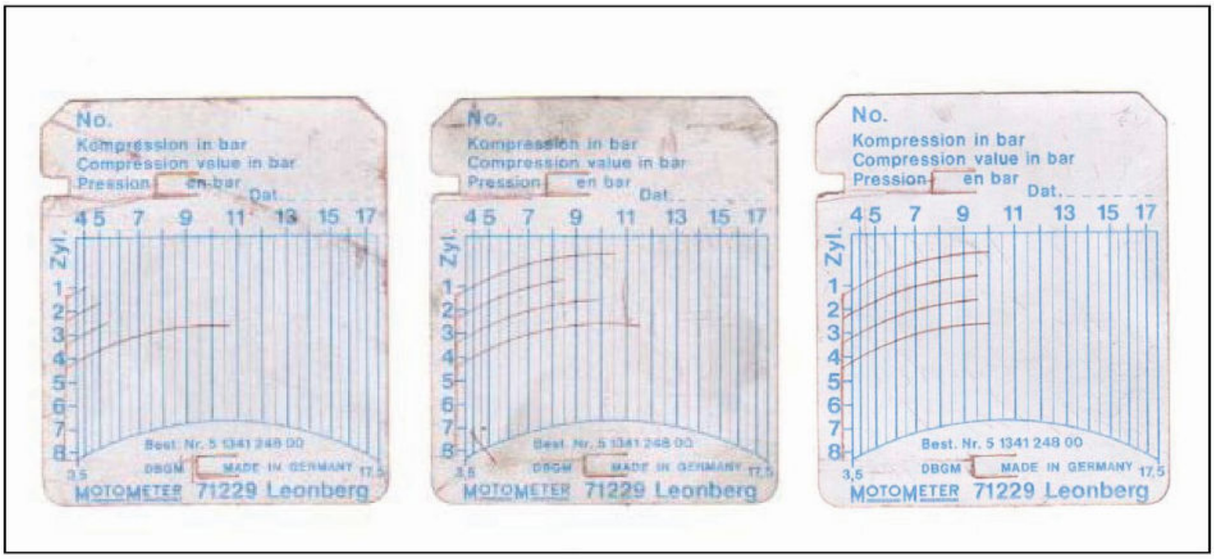

Figure 6-3: Compression data of a Ford Fiesta (left: prior to treatment; centre: following treatment; right: after 5000 kilometres)

The results of this test indicated a notable improvement in the test vehicle's compression resulting from RVS-technology® gel after just one hour of idling. The compression of cylinders 1-3 was raised from a factor of 4 - 6 to 8.5 - 10.5, which is tantamount to a significant improvement in the average compression of the four cylinders (centre diagram). A further rise in the compression of cylinders 2 and 3 as well as smoother operation of all cylinders in general are evident after a test journey of 5000 kilometres.

During this test journey, condensed water was observed to emerge from the exhaust.

7 Summary

The study by the Fraunhofer Technology Development Group allows the following conclusions:

- As part of revitalization using RVS-technology® gel during the test series, signs of wear are reduced by about 50% through a material application of roughly 5 µm. A glass ceramic surface layer is observable to the naked eye following application of the gel.

- Revitalization permits the engine to idle without oil for at least 1 hour (test duration selected as part of this study). The engine operates smoothly over this period. This test therefore confirms the existence of a coating resulting from the application of RVS-technology® gel.

- In terms of engine compression, application of RVS-technology® gel significantly improved the performance of a further test vehicle, notably higher compression values being attained by individual cylinders. The tests on this additional vehicle thus verified improvements to cylinder compression observed following application of RVS-technology® gel.