Franklin Institute Research Laboratory, Inc.
A Subsidiary of The Franklin Institute
Philadelphia, PA

Subject: PetroLon [redacted] TFE Resin Coating Research Results Project 031-A5465-01

Franklin Institute Research Laboratory, Inc.
A Subsidiary of The Franklin Institute

March 31, 1981

Mr. Dennis Gernert
Energy Independence Associates
325 West Swedesford Road
Exton, Pennsylvania 19341

Subject: FIRL, Inc. Project 03I-A5465-01 (1731)
Petrolon [redacted] TFE Resin Coating

Dear Mr. Gernert:

We selected a wrist pin from the engine parts you sent us. The pin was sectioned into three parts with a cut off wheel. One part was cleaned in an ultrasonic cleaner and then nickel coated, another uncleaned part was also covered with nickel, while the third part's surface was studied with no preparation.

All three parts were studied in the Scanning Electron Microscope. The uncleaned, uncoated section is shown in Micrographs 1, 2, and 3. The TFE treated surface is seen in the upper part of the Micrograph. The uncleaned nickel coated sample was studies next. An elemental x-ray line scan was run on the interface between the nickel and the steel where the coating should be found. Micrograph 4 shows the general area where the analysis was run. Micrograph 5 shows the results of the analysis. The bright straight line near the center of the micrograph is the exact area that was analyzed. The upper trace represents the relative amount of the element, which in this experiment, will show where the edge of the sample is located. The lower trace, which is nickel, shows the location of the coating relative to the surface of the steel. The space between the peak iron reading and

and the peak nickel reading represents the space in which the Petrolon [redacted] coating must be. The measured distance represents the thickness of the coating. Micrograph 5 was at 10,000X; therefore, 1 micron is measured as 1 CM, which is the approximate distance between the nickel and the steel part.

The third sample which was ultra-sonically cleaned for about one quarter of an hour to remove any surface material that may have been on the surface was studied next. The reason for the surface cleaning was to remove any unexpected material from the surface before the nickel coating was applied. We actually expected the Petrolon [redacted] TFE Resin Coating to also be removed, but later found it was still there. Micrograph 6 shows the same relationship as Micrograph 5; the thickness of the coating again measuring 1 to 2 microns.

The above experiments show that the coating is 1 to 2 microns thick and bonded to the surface.

Thank you.

Sincerely,

H. Thomas Tucker

H. Thomas Tucker
Electron Microscopist
Physical and Life Sciences
Department

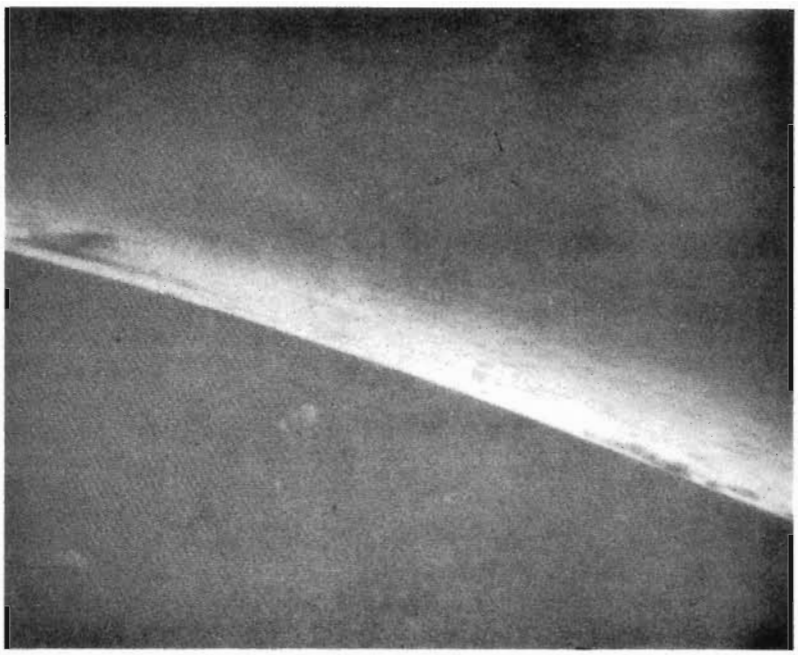

Figure 1
Micrograph of TFE treated engine part. TFE treated surface in upper part of Micrograph.
(Magnification 100X)

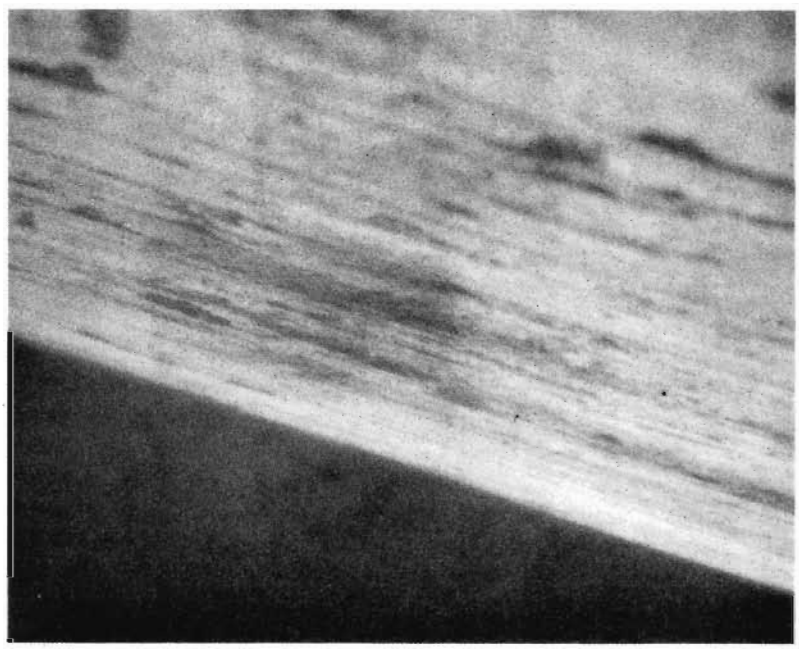

Figure 2
(Magnification 1000X)

Figure 3
TFE treated surface of the uncleaned, uncoated engine part.
(Magnification 10,000X)

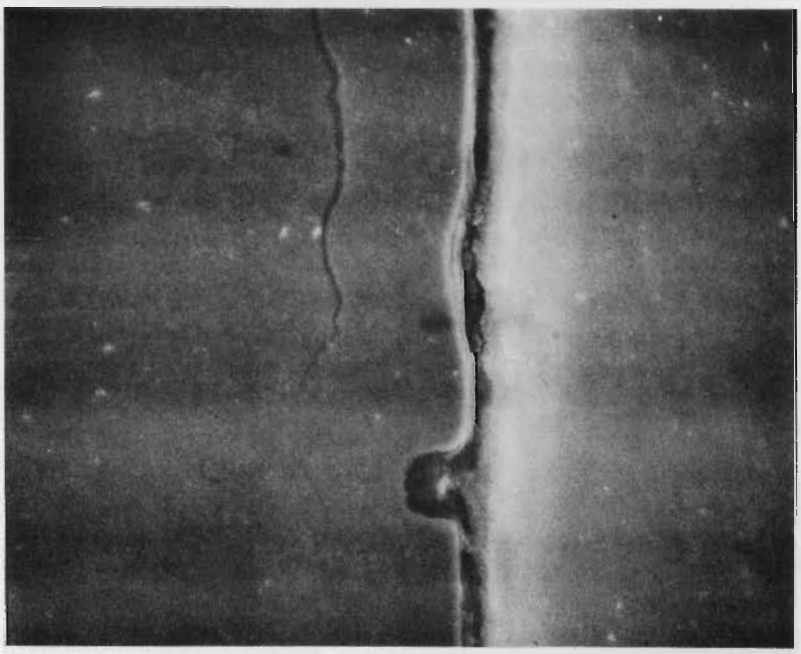

Figure 4
Analysis area of the TFE treated, nickel coated sample.
(Magnification 1000X)

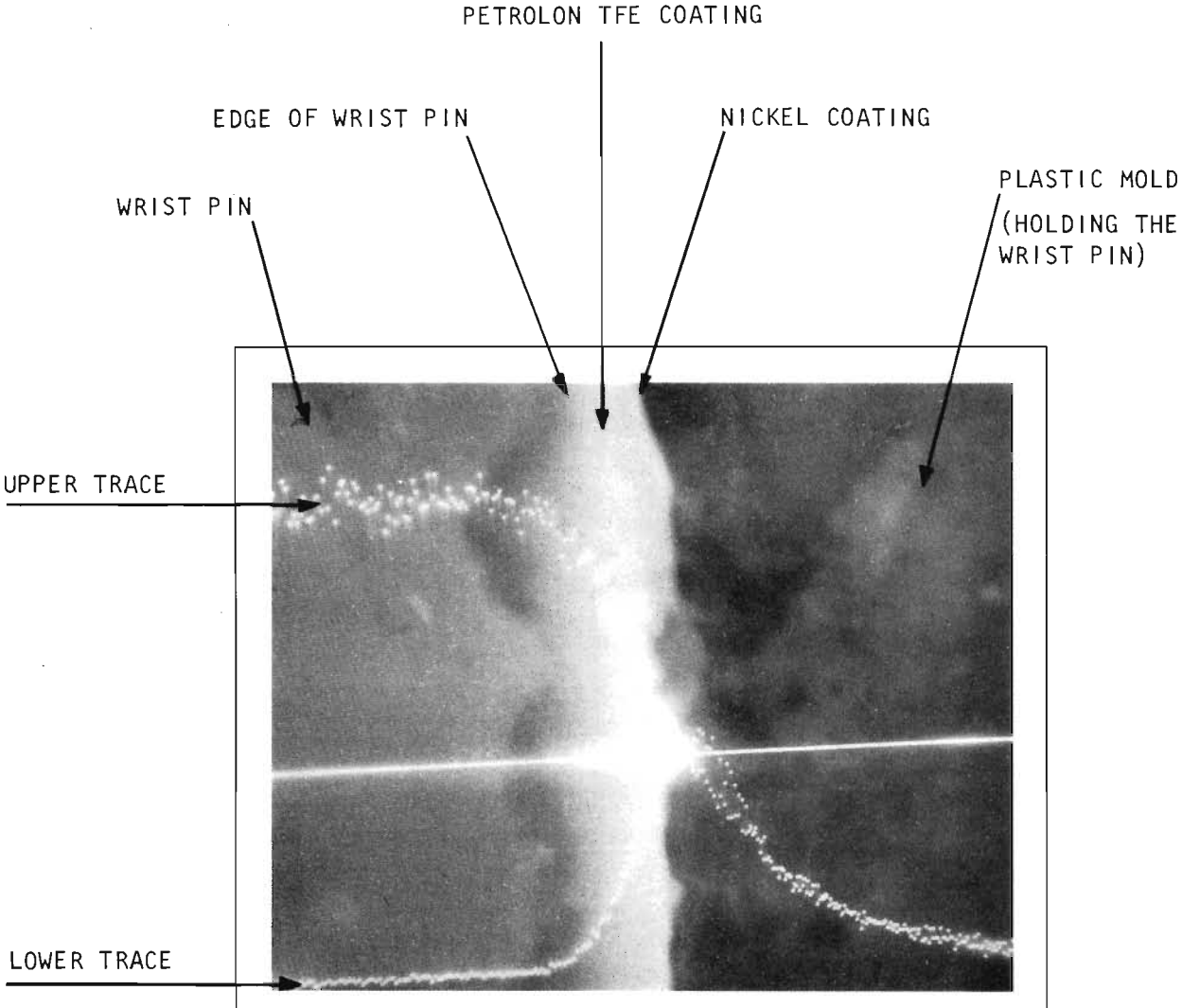

Figure 6
Micrography of ultra-sonically cleaned engine part. TFE treatment remained bonded to the surface.
(Magnification 10,000X)

[redacted] and TFE-Cote 2 are the same product

NOTE: This report is not considered to be an endorsement of PetroLon products by the Franklin Institute.

Energy Independence Associates
325 West Swedesford Road
Exton, PA 19341

Dear PetroLon Sales People:

After talking to many of you across the United States, I have decided to include this summary with the Franklin Institute Report. This will assist you and your people in using the research results and conclusions effectively.

It is important to realize that the most important part of this report is in the final two paragraphs which states:

> *"The third sample was ulta-sonically cleaned for about one quarter of an hour."*

Ultra-sonic cleaning is a very powerful cleaning process which actually stimulates the surface molecules of a material causing them to move around and release any surface material to be released unless that material has been very permanently bonded to that surface.

> *"We actually expected the PetroLon [redacted] TFE Resin Coating to also be removed, but later found it was still there."*

And finally, the conclusion made by the researchers that:

> *"The above experiments show that the coating is 1 to 2 microns thick and bonded to the surface."*

The micrographs within this report were generated by a Scanning Electron Microscope. Micrographs 1, 2 and 3, simply shows the surface of the wristpin that was examined at various levels of magnification. Micrograph 4 shows the edge of the wristpin on the right side and the plastic mold that was used to hold the wrist pin on the left. The vertical line is the fault line where the analysis was done.

Figure 5 is the exact area analyzed, which is denoted by the horizontal x-ray scan line.

Figure 6 shows the top view of the wrist pin on the left side and the plastic mold on the right side. Due to the fact that the scanning electon microscope needs a conductive material to register the electron beam, it is easy to see that as the upper trace (dotted line) moves from left to right, it falls off when it reaches the edge of the metal wrist pin. As the lower trace moves from left to right, it rises to a peak and then drops off. This rise is caused by the nickel coating (a conductive material) that was placed on the surface of the wrist pin. The distance A which is measured where the upper trace drops off and the peak on the lower trace, where the nickel coating is applied, is approximately 1 centimeter which is measured as 1 micron under 10,000 x magnification. This is the PetroLon [redacted] TFE Resin Coating which has been permanently bonded to the surface of the wrist pin.

Sincerely,

Dennis G. Gernert

Dennis G. Gernert