

Empa
Überlandstrasse 129
8600 Dübendorf
Switzerland
T +41 58 765 11 11
F +41 58 765 11 22
www.empa.ch



Materials Science & Technology

The Powder Company
Mr. Alexander B. Zurkinden
Postfach 326
8840 Einsiedeln
Switzerland

Test Report No. 457154/01

Test assignment:	Tribological investigation with talcum powder on razor shaving heads
Customer:	The Powder Company
Object of investigation:	Razor shaving heads of various manufacturers
Client reference:	Mr. Alexander B. Zurkinden
Your order from:	October 13, 2010
Receipt of object of investigation:	17 August 2010
Execution of the investigation:	January 17, 2011 to July 11, 2011
Number of pages:	18
Enclosures:	

Eidg. Materialprüfungs- und Forschungsanstalt, EMPA
(Swiss Federal Laboratories for Materials Testing and Research)
Dübendorf, 16. September 2011

Person responsible for the tests:
First name, last name


Sigfried Roos

Department Head:
first name, last name


Prof. Dr. Hans Josef Hug

Note: The test results are valid only for the tested object. Using the report for advertising purposes, merely making reference to it or publishing extracts from it require the permission of Empa (cf. Code of Practice). The report and all documents pertaining to it are archived for ten years. Without your instructions to the contrary, all samples are destroyed three months after completion of the tests.

Contents:

- 1. Test Objects**
- 2. Assignment**
- 3. Test Conditions**
- 4. Result**
- 5. Summary**

1. Test Objects

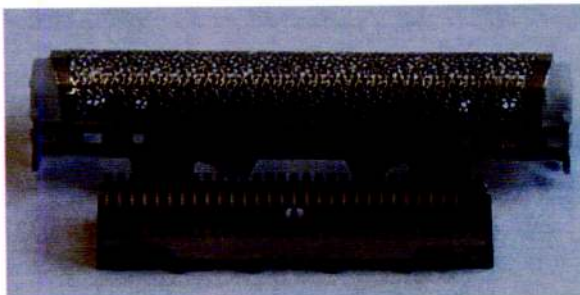


Illustration 1: Braun 32S

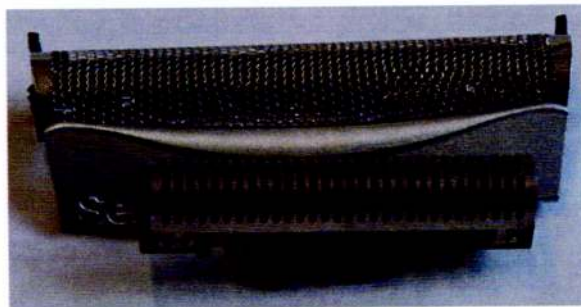


Illustration 2: Braun 51S

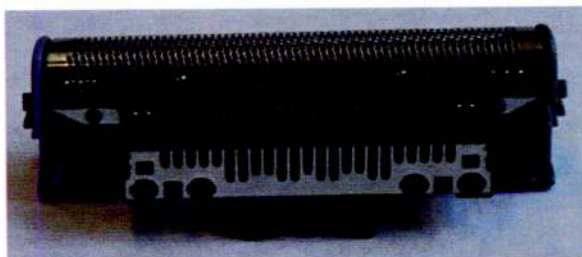


Illustration 3: Panasonic WES9007-1



Illustration 4: Remington MS5700

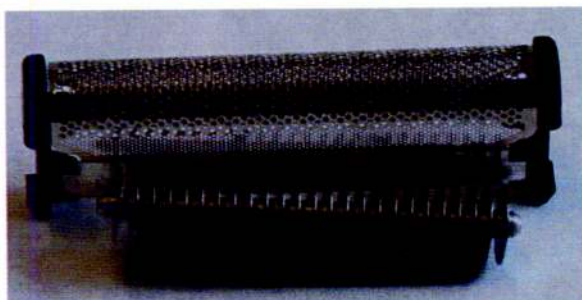


Illustration 5: Remington 360 (SP-290)



Illustration 6: Remington SP19

Used Powders

- Talcum powder "Bloc Men"
- Talcum powder "Dermabloc"

2. Assignment

Friction tests were carried out to establish the tribological properties arising in various razor shaving heads following the use of the two talcum powders "Bloc Men" and "Dermabloc". The focus is notably on the question whether the two talcum powders can be used for shaving without the risk of premature wear of the shaving heads.

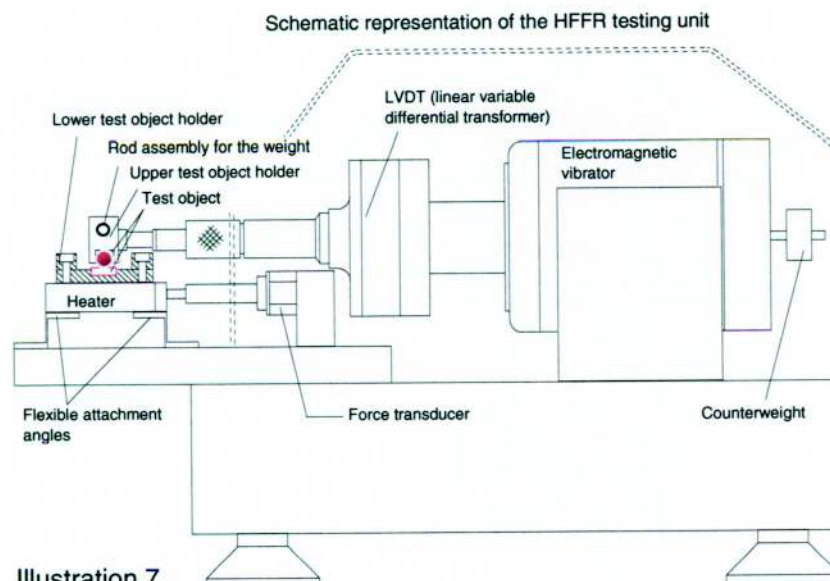
For the tests, only shaving heads with translatory oscillation movements were used, because the test equipment is not suitable for rotating oscillation movements. On some blades and shaver foils, the elements were additionally determined by means of the EDX method. After the friction experiment, the amount of wear caused was ascertained with a microscope.

3. Test Conditions

The tribological investigation was conducted with the HFFR device described below.

Description of the device: The centerpiece of the testing unit is an electromagnetic vibrator. This vibrator moves back and forth the upper test object, which is attached to a rod assembly. Between the vibrator and the test object holder, there is the linear variable differential transformer, referred to in short as LVDT. The frequency, length of stroke, temperature and test duration can be changed as desired. The test object holder additionally has a rod assembly onto which the test load can be attached.

The lower sample holder is screwed onto a heating block. The heating block in turn is attached to flexible supports which are vertically and laterally stiff, but axially flexible. In longitudinal direction, the heating block is held by a piezoelectric force transducer which determines the force generated between the two friction partners. The upper test object holder is electrically isolated from the rest of the machine. This means that the electric potential can be used as a percentage measure for the lubrication film thickness. The whole structure is in turn attached to a heavy steel block in order to prevent unwanted vibrations. Operation of the HFFR system is adjusted and monitored with a PC. The device allows determination of the friction value and the thickness of the lubrication film as a percentage.

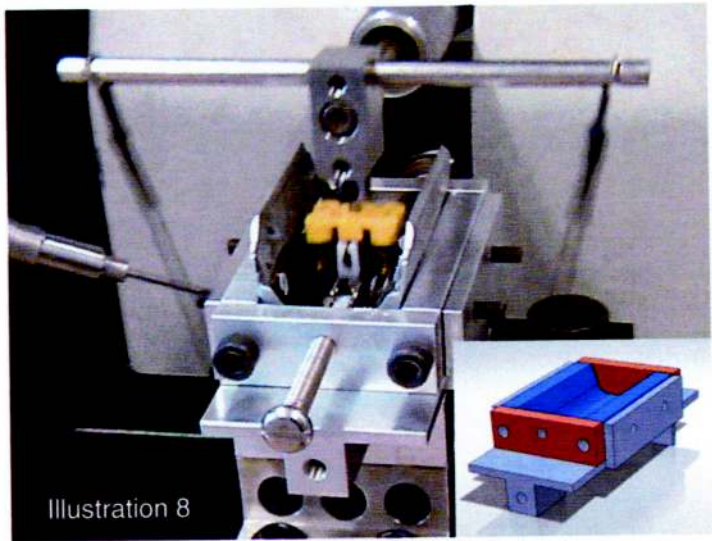


Additional modification on the device

To attach the shaving heads, special holders had to be constructed to ensure that the two friction partners could be installed in the device.

All experiments were conducted under normal atmospheric conditions, at room temperature and a relative humidity of 50%.

The ideal conditions for the actual series of experiments were established by means of a preliminary investigation.



Conditions of the tests

For each tested shaving head type, one measurement was taken without any powder, one with Bloc Men and another one with Dermabloc.

The tests were performed under the following conditions:

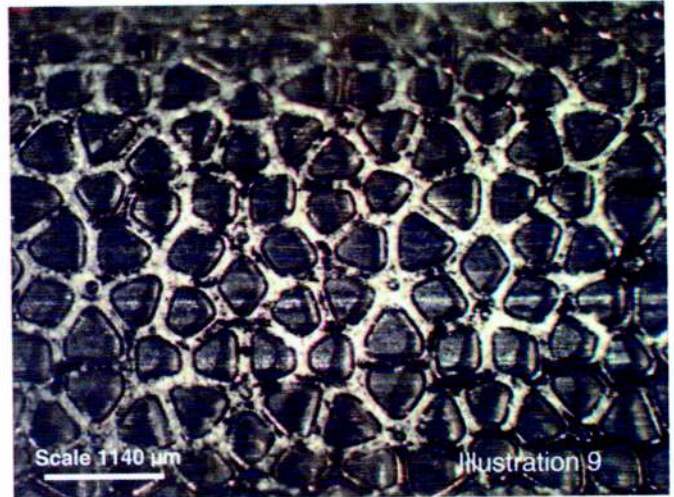
Test load	Length of stroke	Frequency	Cycles	Test duration	Temperature	Medium
3 N	2 mm	50 Hz	360000	2 h	25°C	Air

4. Result

In all measured shaving head models, the tribological investigations with the two powders Dermabloc and Bloc Men show a reduction of the friction coefficient compared to the tests without powder. However, the friction coefficient is not influenced by the use of the powder only. Rather, the materials as well as the construction of the shaving heads predetermine a "standard friction coefficient". This becomes clear when the friction coefficients of the tests conducted without any powder are analyzed. Even though the same test conditions applied throughout, they vary to a great extent.

With the exception of the Remington 360 (SP-290) shaving head (Chart 4) which has a friction coefficient μ of about 0.4, the friction coefficients of the shaving heads for Braun32S, Braun 51S, Panasonic WES9007 and Remington MS5700 are, all measured with Dermabloc or Bloc Men, around 0.2 μ to 0.3 μ . The Panasonic WES9007 shaving head has, at 1.4, an unusually high friction coefficient without powder.

In the visual wear assessment, no clear difference could be established between the shaving heads measured without any powder and those measured with the powders Dermabloc and Bloc Men. The reason for this is probably that in this tribological test, the two friction partners typically do not assimilate 100 percent. This lack of assimilation can result in locally confined pressure points which can be subject to increased levels



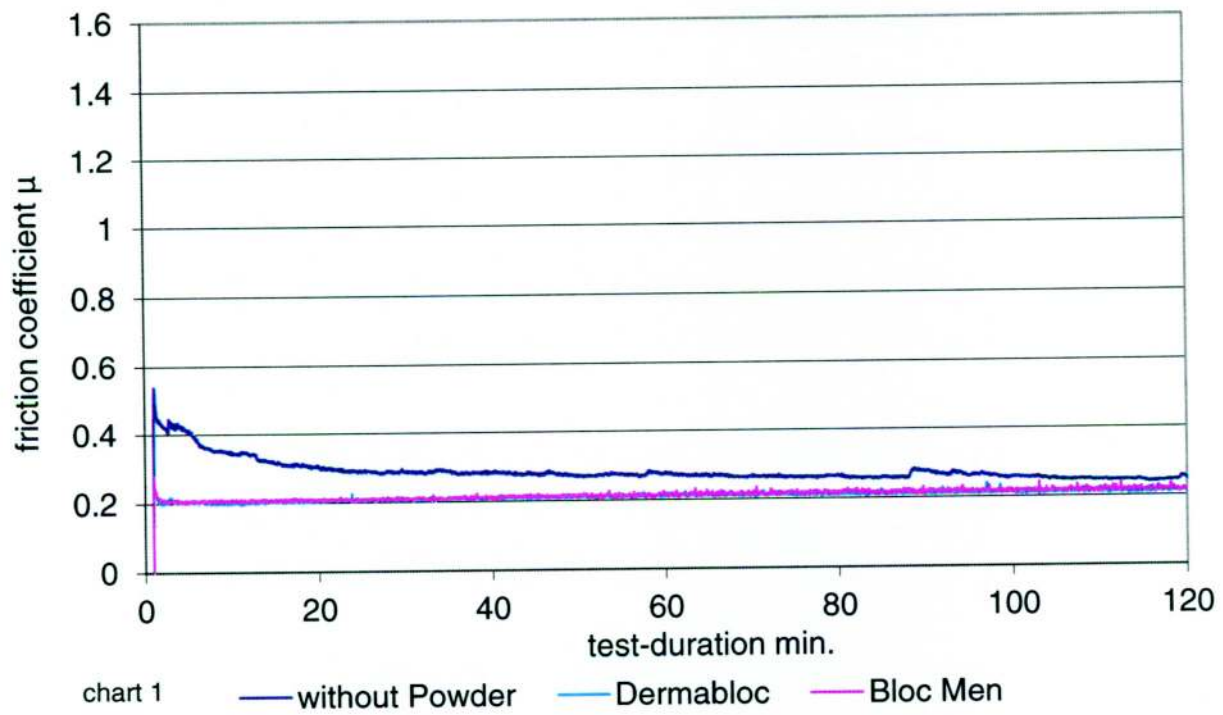
of wear. The profile depressions of the shaver foils (Illustration 9) were filled up with the powder after the test. As a comparison, Illustration 25 (REM illustration) shows the inside of the same shaver foil in unused condition. The profile depressions are largely clean. What effect the filling up of these depressions with powder has in practice was not investigated.

Of the shaving heads for Braun 32S and Remington MS5700, both with oscillating blades, and of the shaving head for Remington SP19 with rotating blades, scanning electron micrograph images were taken and EDX analyses (identification of elements) conducted. They provide useful information on the materials used and / or their coatings. For the remaining shaving heads no REM / EDX tests were conducted, since they do not permit any conclusions with regard to the tribological properties of the friction partners and were therefore not the focus of this investigation.

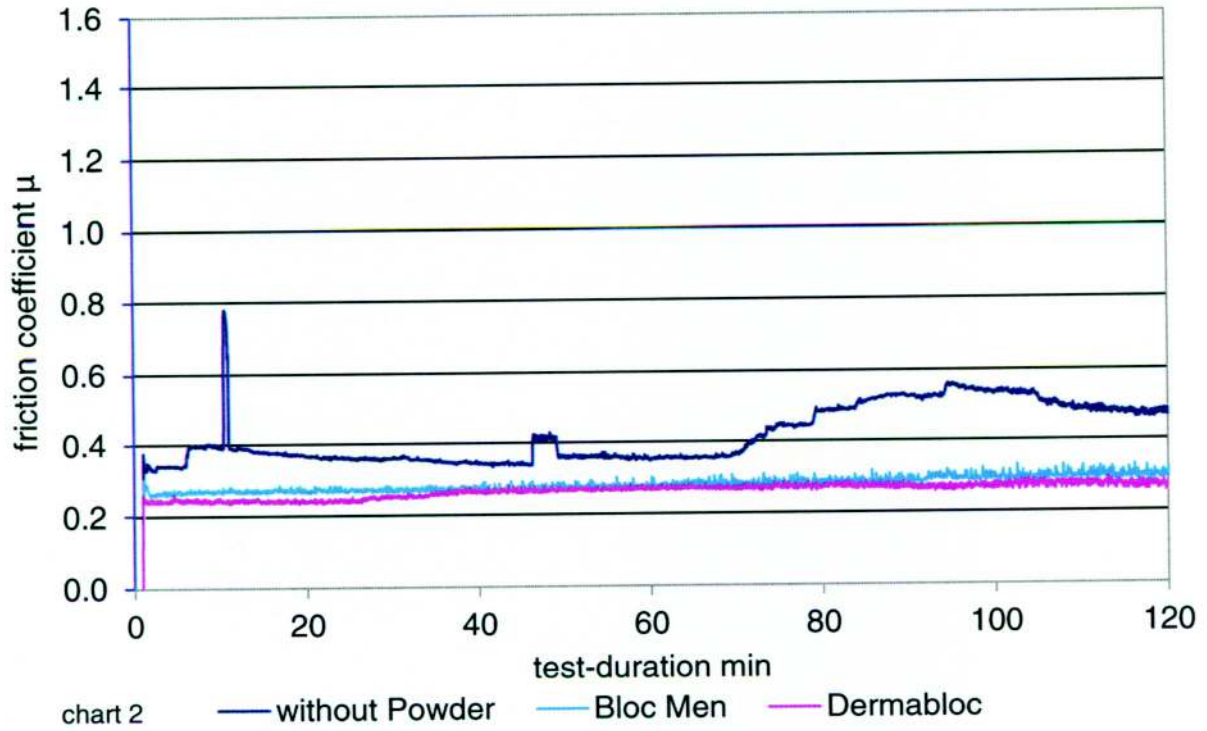
5. Summary

In conclusion, the wear behavior of the powders Dermabloc and Bloc Men did not have any negative effects in this tribological test. It must be pointed out that the results obtained from laboratory investigations of this type cannot usually be equated to the actual application. The reduced friction coefficients resulting from the use of the two powders Bloc Men and Dermabloc may well have a positive effect on the energy consumption of the electric razor, since the friction coefficients are in some cases significantly lower than they are without powder. As a general rule, a lower friction coefficient also leads to less wear, although this is not true in all cases.

Braun 32S



Braun 51S



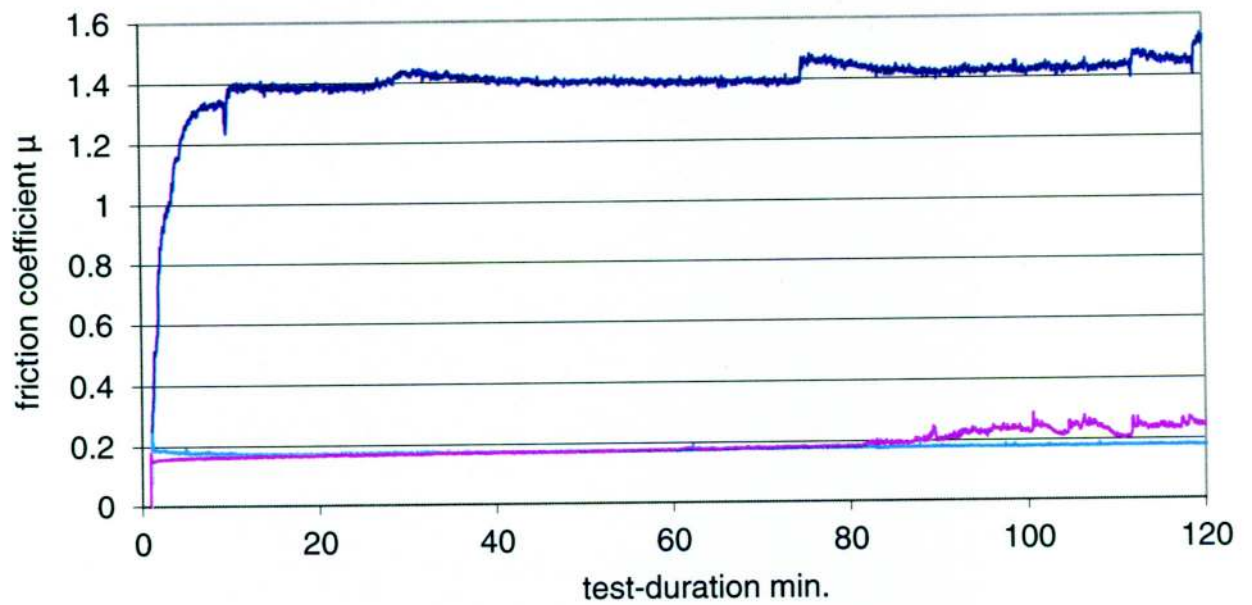
Panasonic WES9007

chart 3

— without powder — Dermabloc

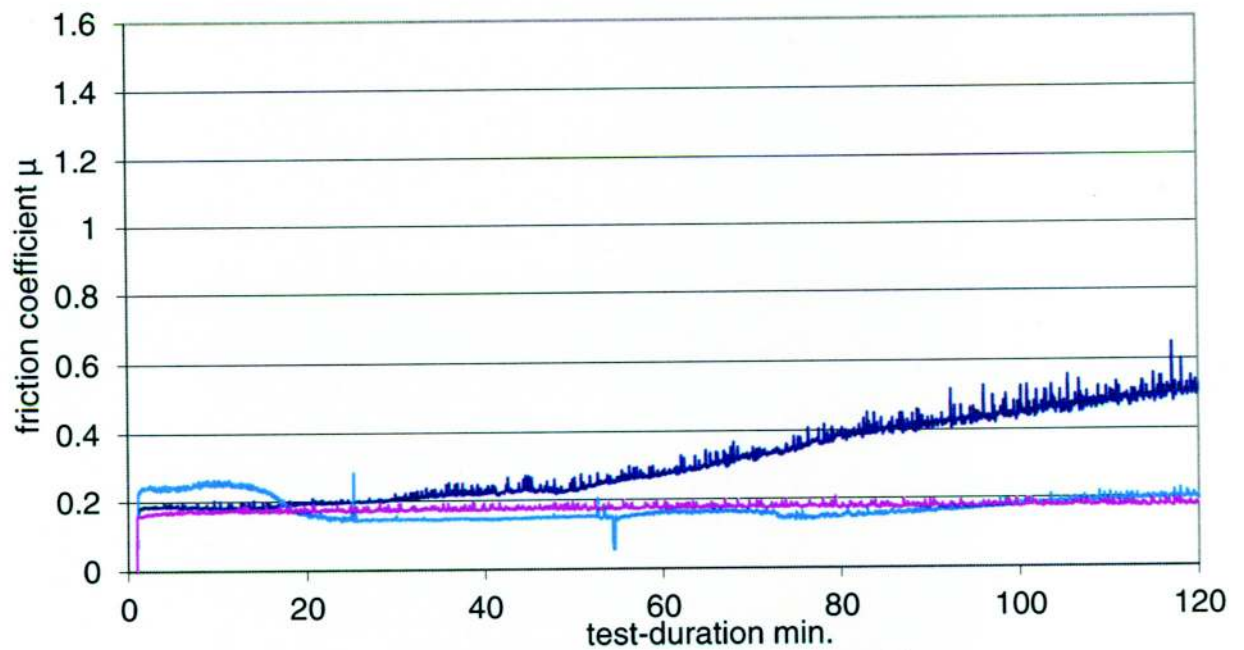
Remington MS5700

chart 4

— without Powder — Dermabloc

Remington 360

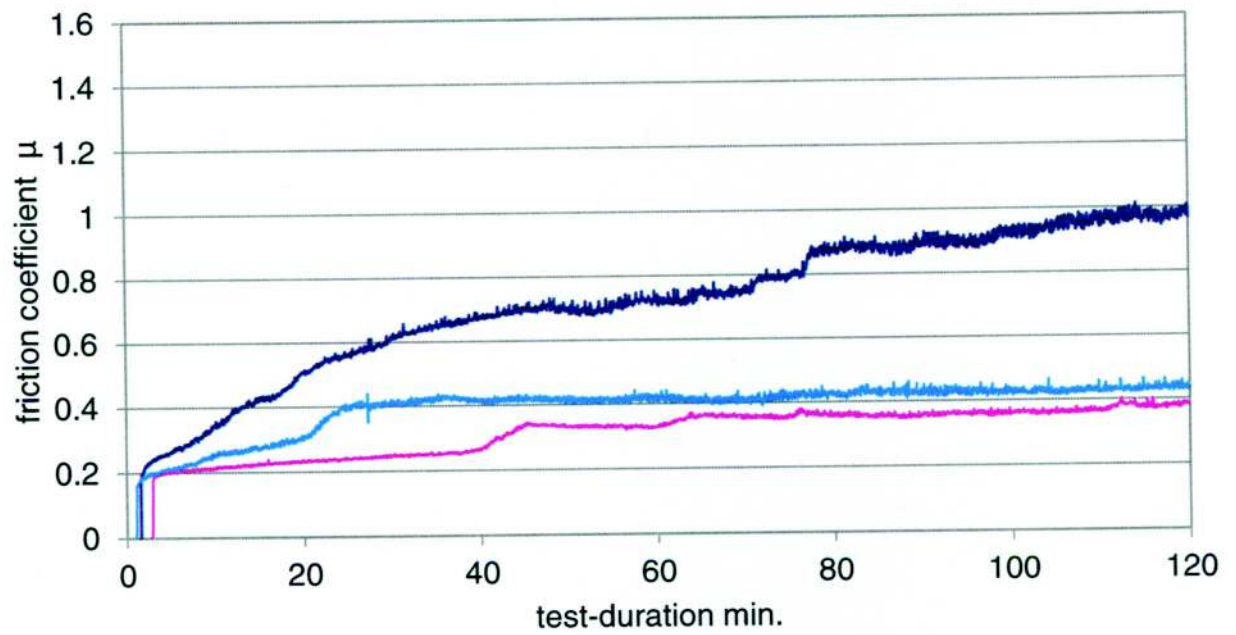


chart 5

— without Powder — Bloc Men — Dermabloc

Element identification with EDX (energy-dispersive X-ray spectroscopy) in delivery condition (i.e. new)

Braun 32S-1 (shaver foil)

Element	Wt %	At %
C K	17.23	50.44
NiL	82.77	49.56

Braun 32S-2 (blade)

Element	Wt %	At %
MoL	01.71	00.99
CrK	18.87	20.13
FeK	79.42	78.88

Remington MS5700-1 (shaver foil)

Element	Wt %	At %
TiK	02.50	03.04
NiK	97.50	96.96

Remington MS5700-1 (blade)

Element	Wt %	At %
SiK	00.70	01.37
CrK	16.99	17.94
MnK	01.42	01.42
FeK	74.66	73.43
NiK	06.24	05.83

Remington SP19-2 (shaver foil)

Element	Wt %	At %
C K	02.97	12.01
O K	02.05	06.21
NiL	04.61	03.81
MoL	03.70	01.87
CrK	13.34	12.44
FeK	73.33	63.67

Remington SP19-6 (blade)

Element	Wt %	At %
NiL	04.03	03.85
AlK	00.56	01.16
MoL	04.32	02.52
TiK	01.04	01.21
CrK	12.72	13.71
FeK	77.32	77.55

Remington SP19-4 (shaver foil)

Element	Wt %	At %
C K	06.45	24.00
FeL	39.70	31.76
NiL	09.67	07.36
AlK	01.80	02.97
MoL	07.90	03.68
TiK	09.08	08.47
CrK	24.35	20.92
MnK	01.04	00.85

Remington SP19-7 (blade)

Element	Wt %	At %
C K	32.98	65.20
O K	06.08	09.02
FeL	19.75	08.40
MoL	07.36	01.82
TiK	03.02	01.50
CrK	30.80	14.07

Remington SP19-5 (shaver foil)

Element	Wt %	At %
AlK	00.43	00.89
SiK	00.39	00.78
MoL	04.01	02.34
TiK	00.94	01.09
CrK	12.74	13.70
FeK	73.56	73.65
NiK	07.93	07.55

Remington SP19-8 (blade)

Element	Wt %	At %
C K	09.50	33.04
MoL	04.06	01.77
TiK	01.28	01.12
CrK	11.41	09.17
FeK	66.36	49.64
NiK	07.40	05.27

Microscopic images taken after the tribological friction experiments

Illustration 10: Braun 32S blade (without powder)

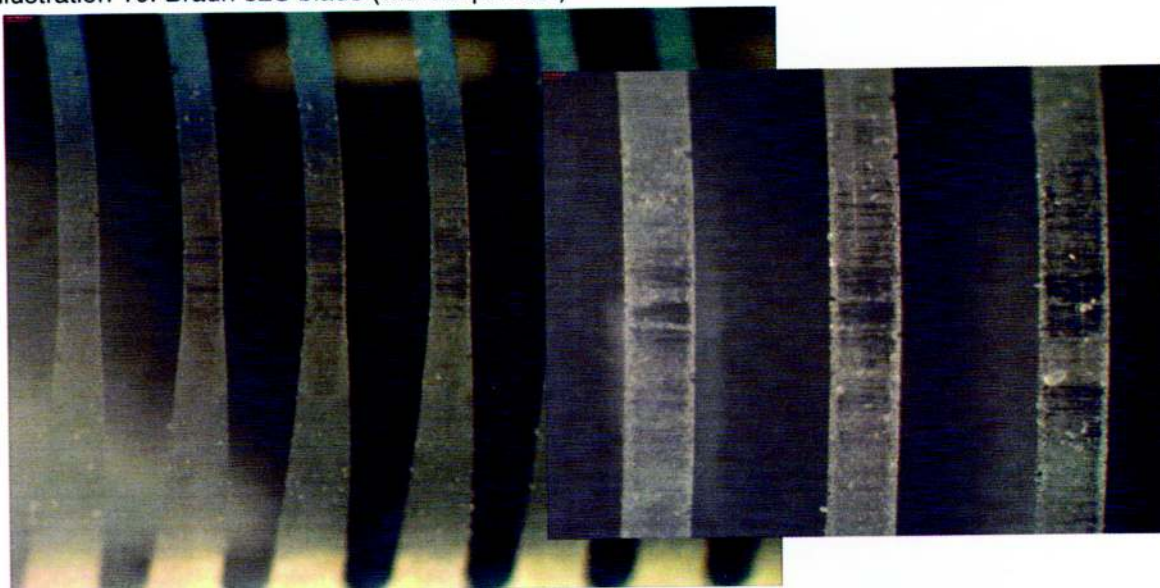


Illustration 11: Braun 32S blade (with Bloc Men)

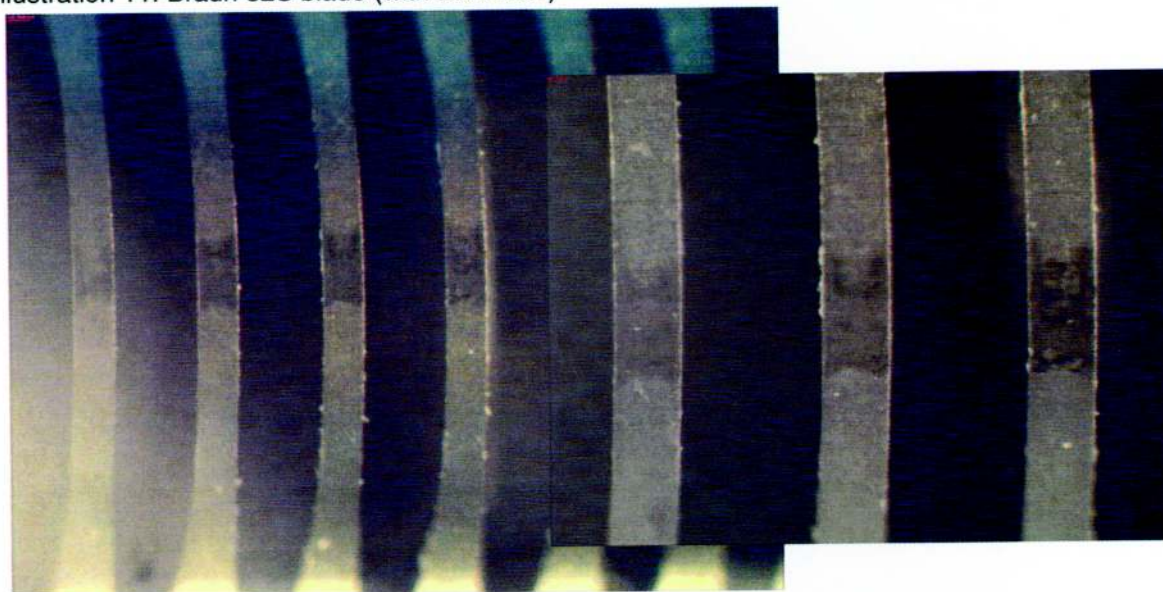


Illustration 12: Braun 32S blade (with Dermabloc)

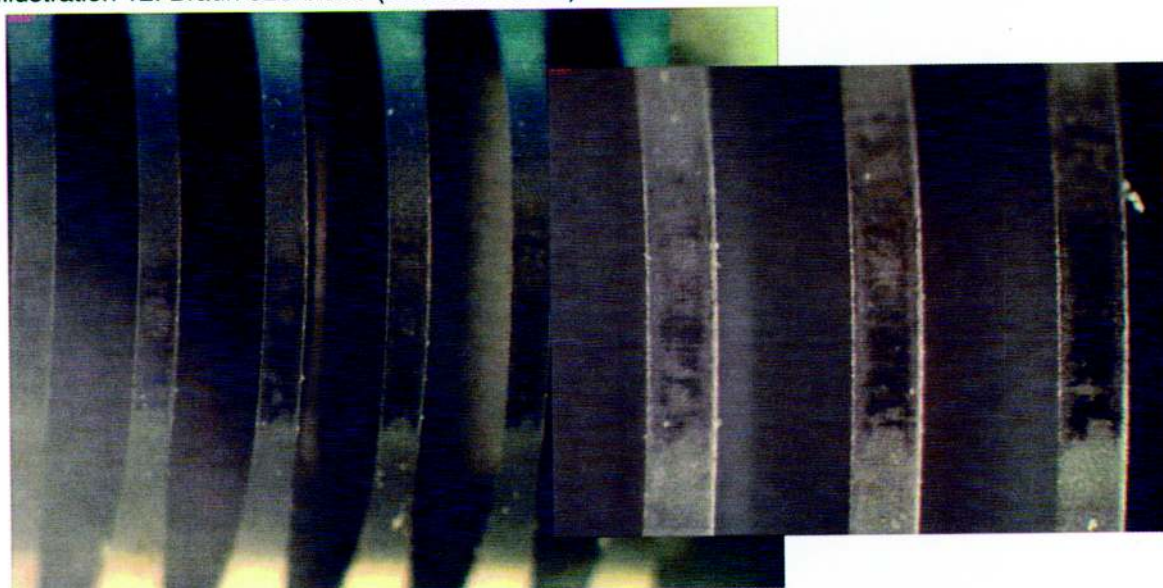


Illustration 13: Braun 51S blade (without powder)

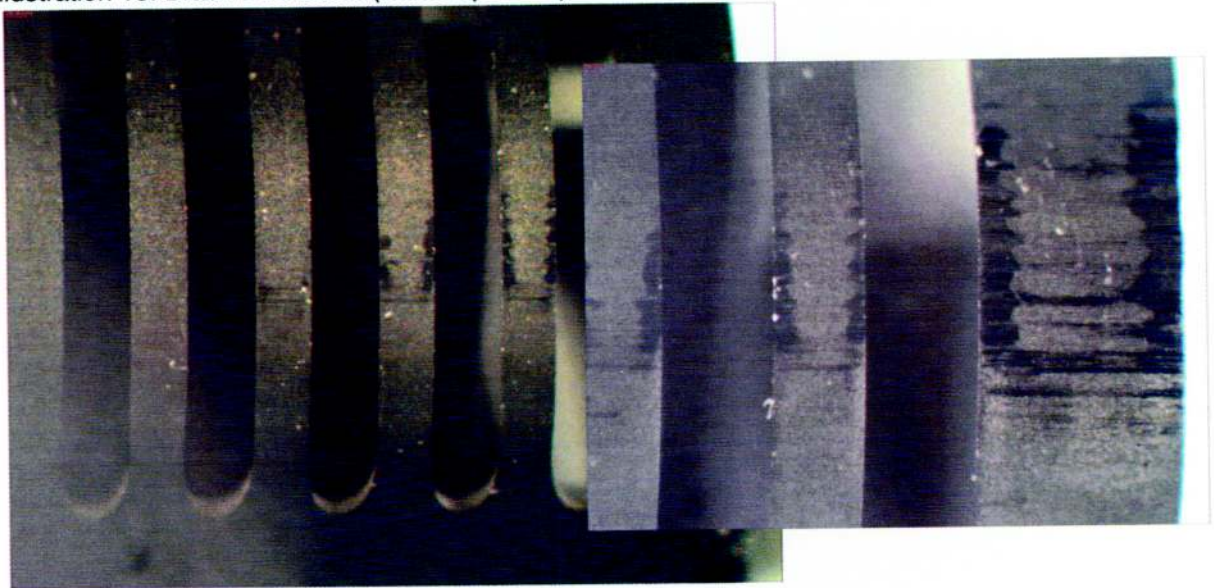


Illustration 14: Braun 51S blade (with Bloc Men)

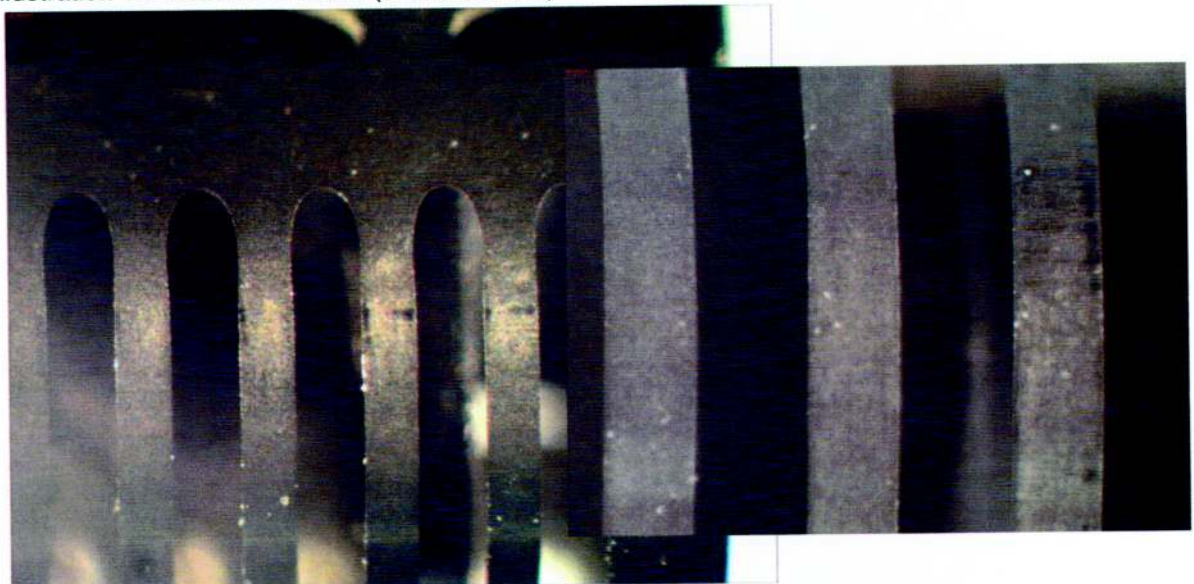


Illustration 15: Braun 51S blade (with Dermabloc)

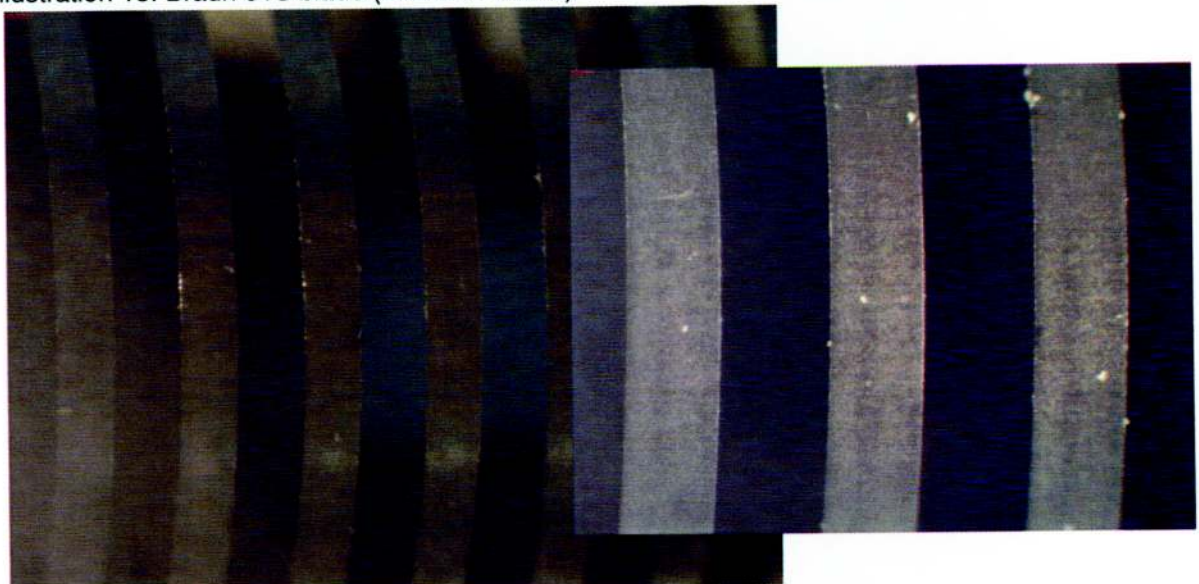


Illustration 16: Panasonic WES9007 blade (without powder)

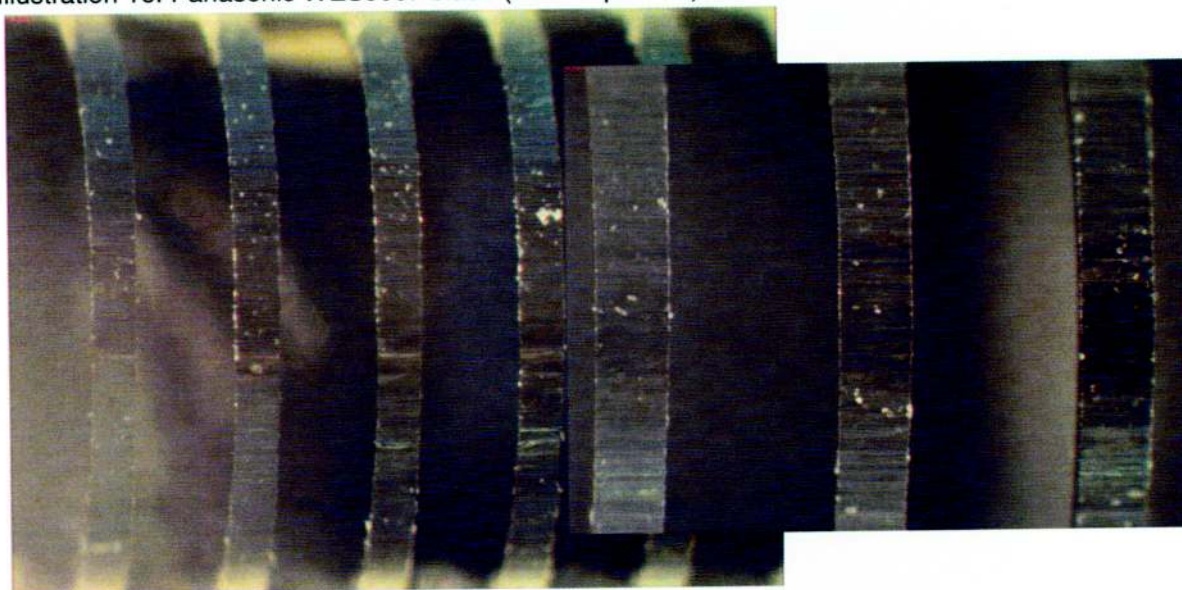


Illustration 17: Panasonic WES9007 blade (with Bloc Men)

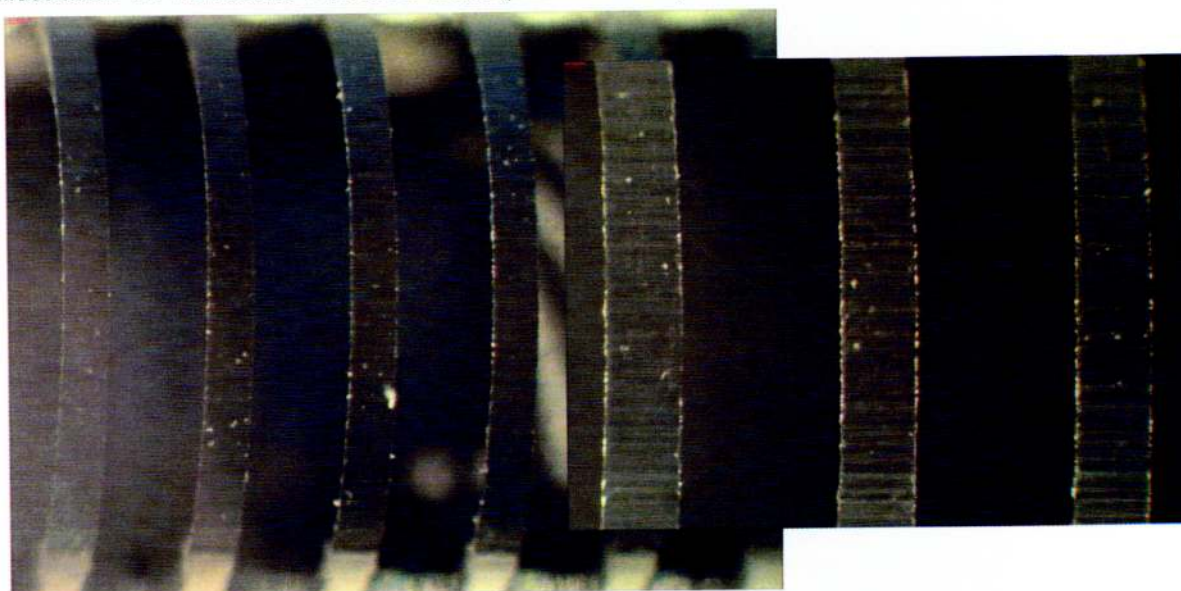


Illustration 18: Panasonic WES9007 blade (with Dermabloc)

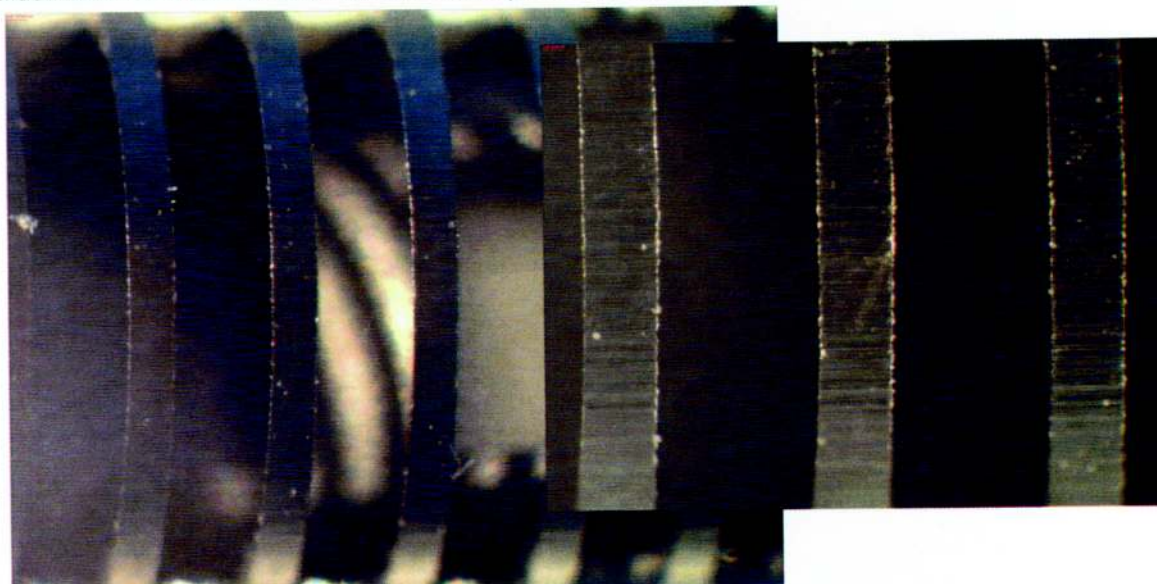


Illustration 19: Remington MS5700 blade (without powder)

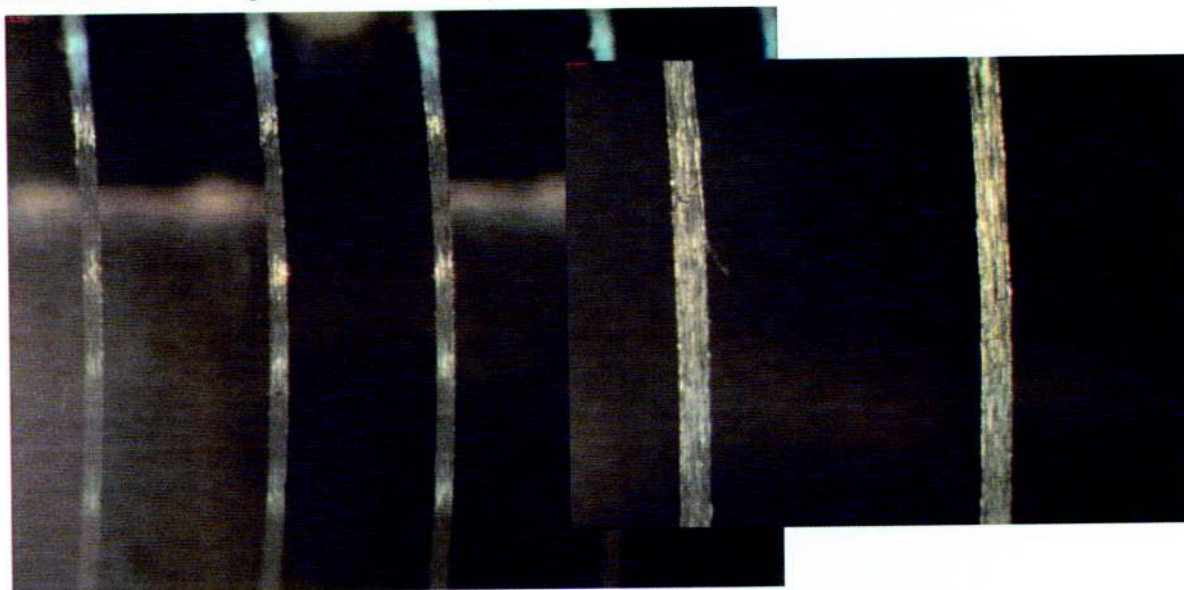


Illustration 20: Remington MS5700 blade (with Bloc Men)

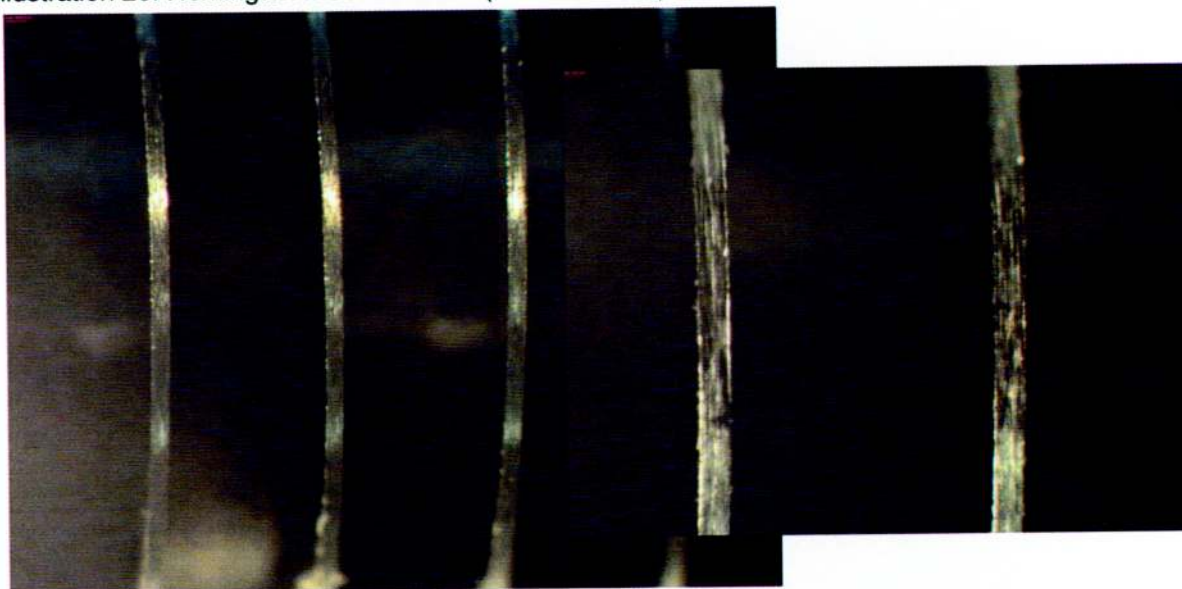


Illustration 21: Remington MS5700 blade (with Dermabloc)

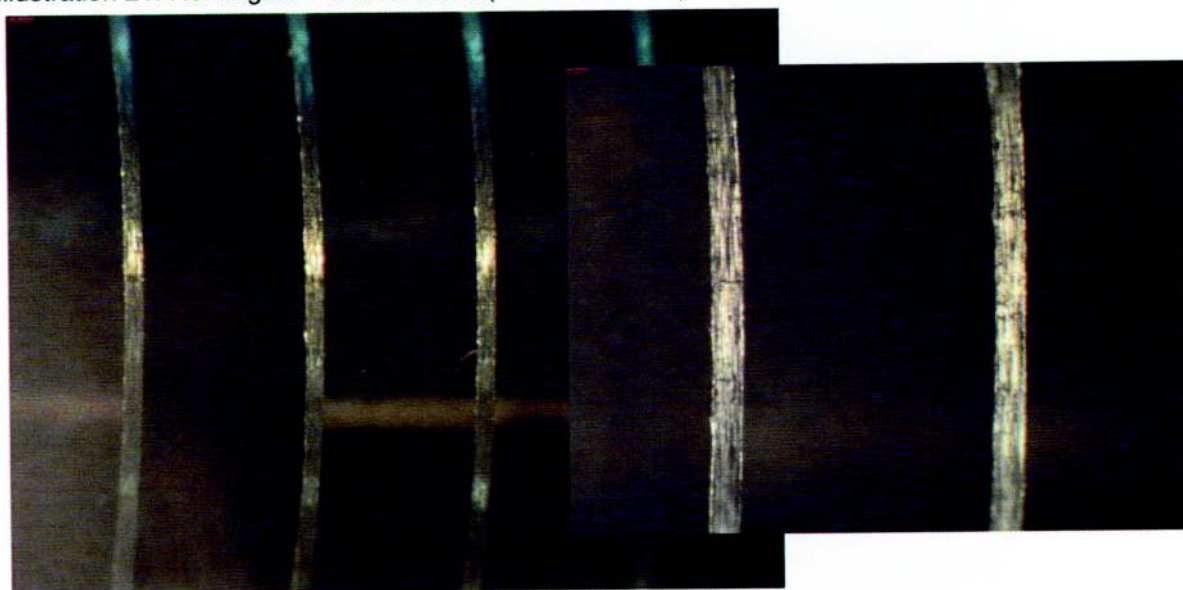


Illustration 22: Remington 360 blade (without powder)

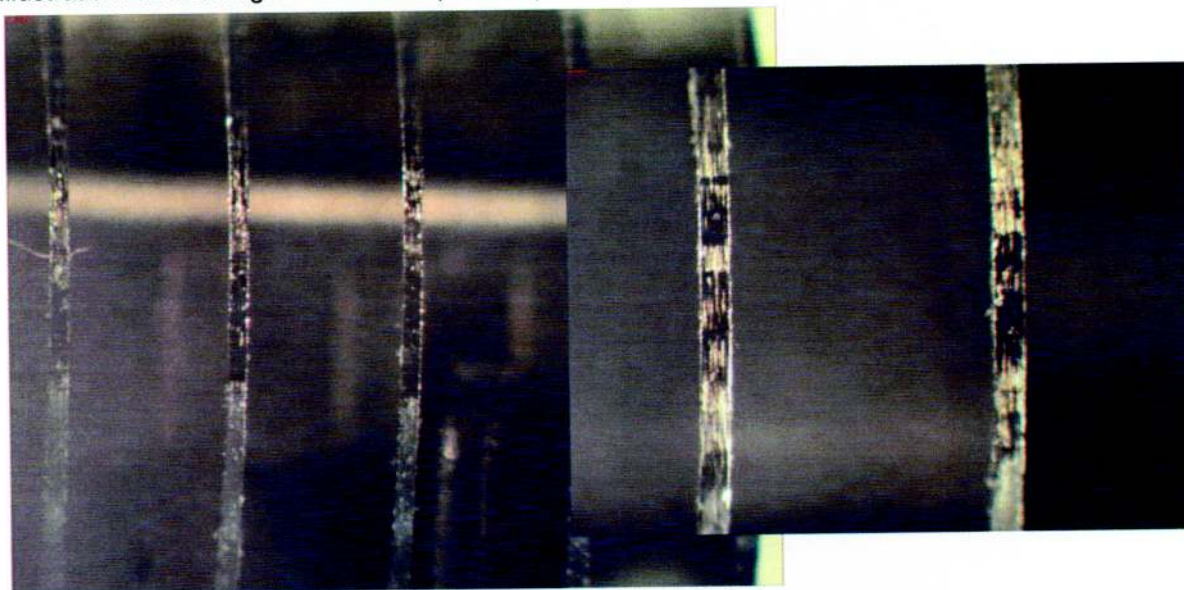


Illustration 23: Remington 360 blade (with Bloc Men)

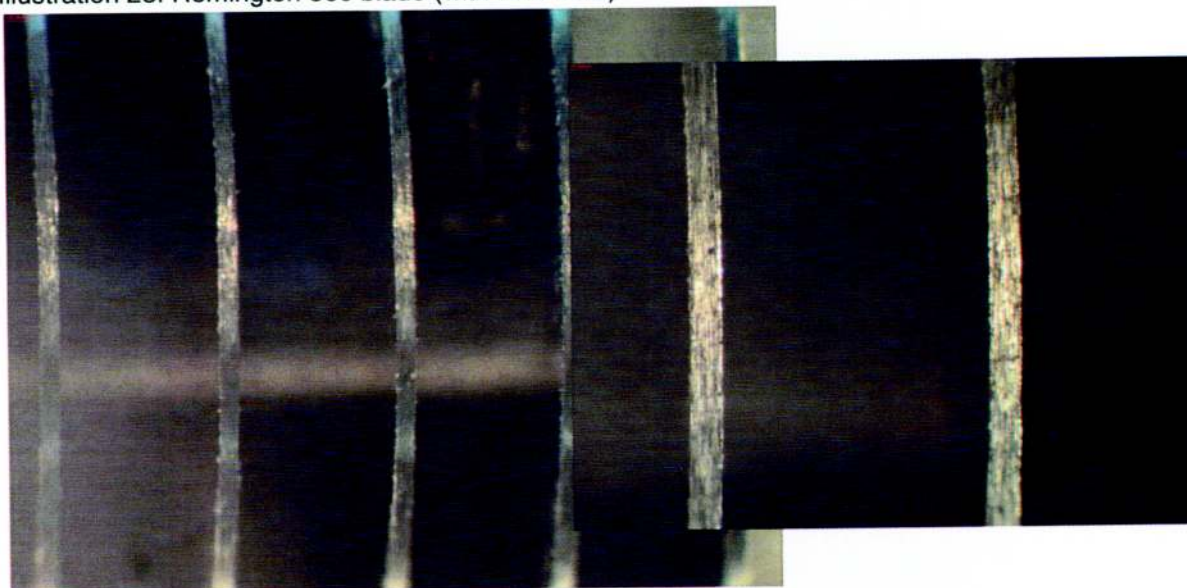
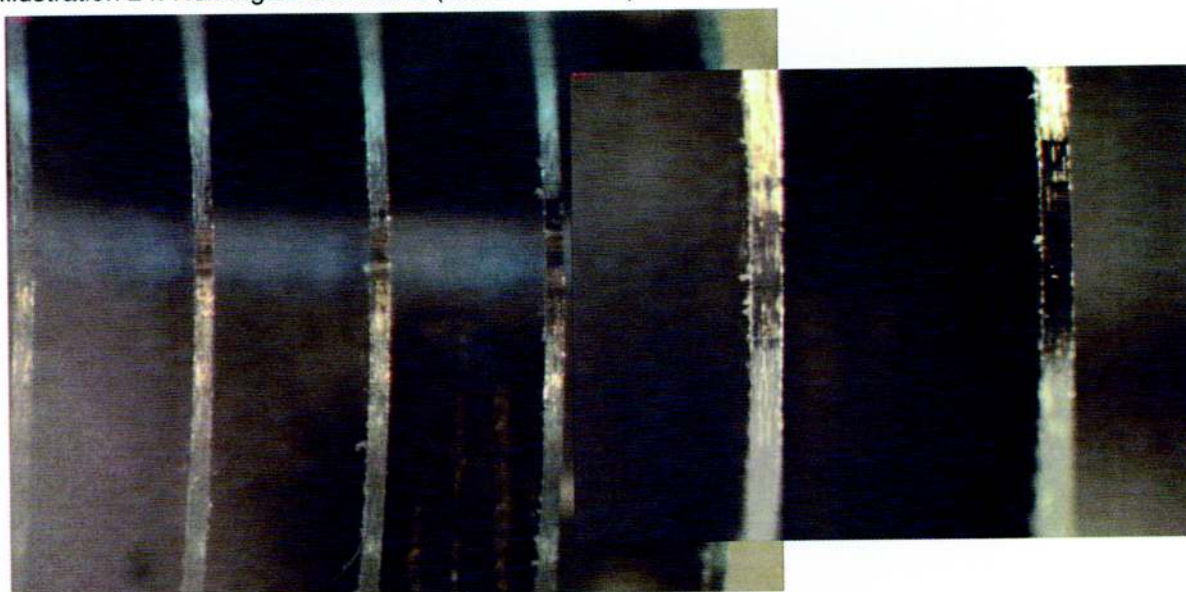


Illustration 24: Remington 360 blade (with Dermabloc)



Scanning electron micrograph images in delivery condition (i.e. new)

Illustration 25: Braun 32S-1 (shaver foil)

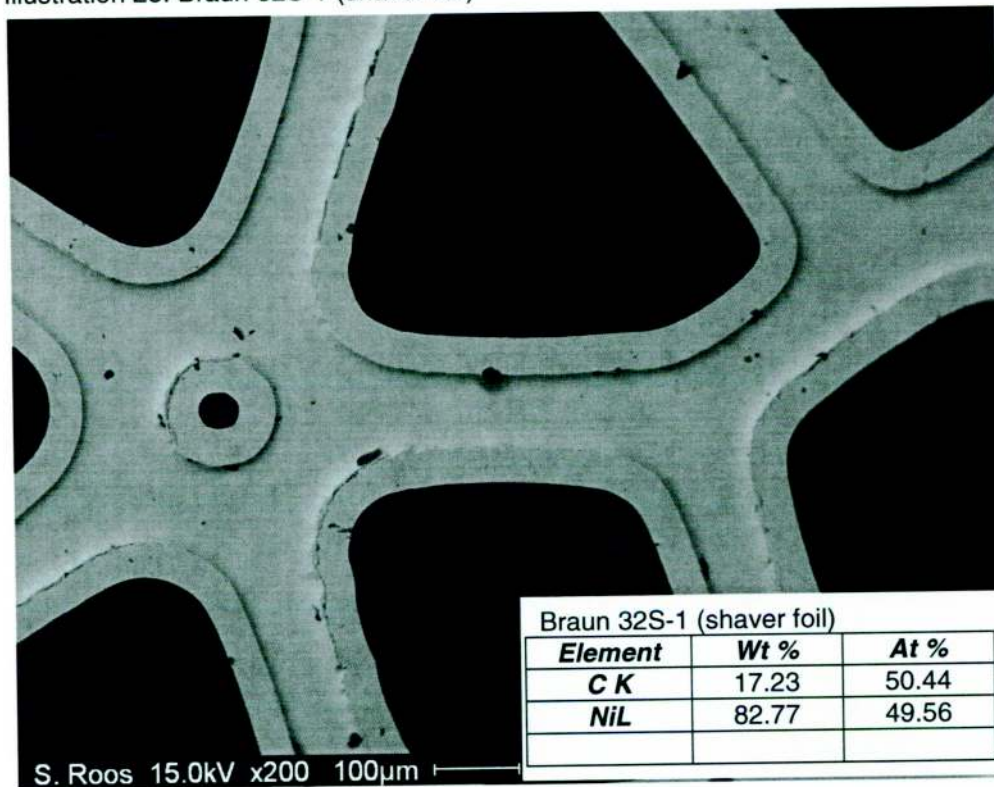


Illustration 26: Braun 32S-5 (blade)

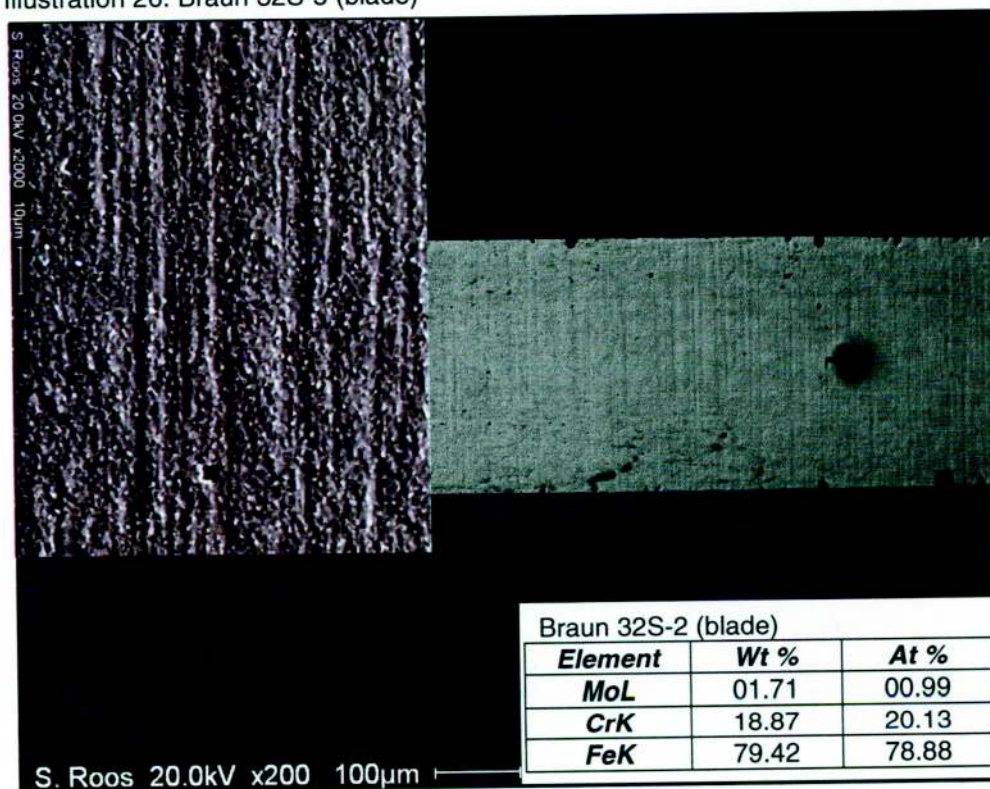


Illustration 27: Remington SP19 (shaver foil)

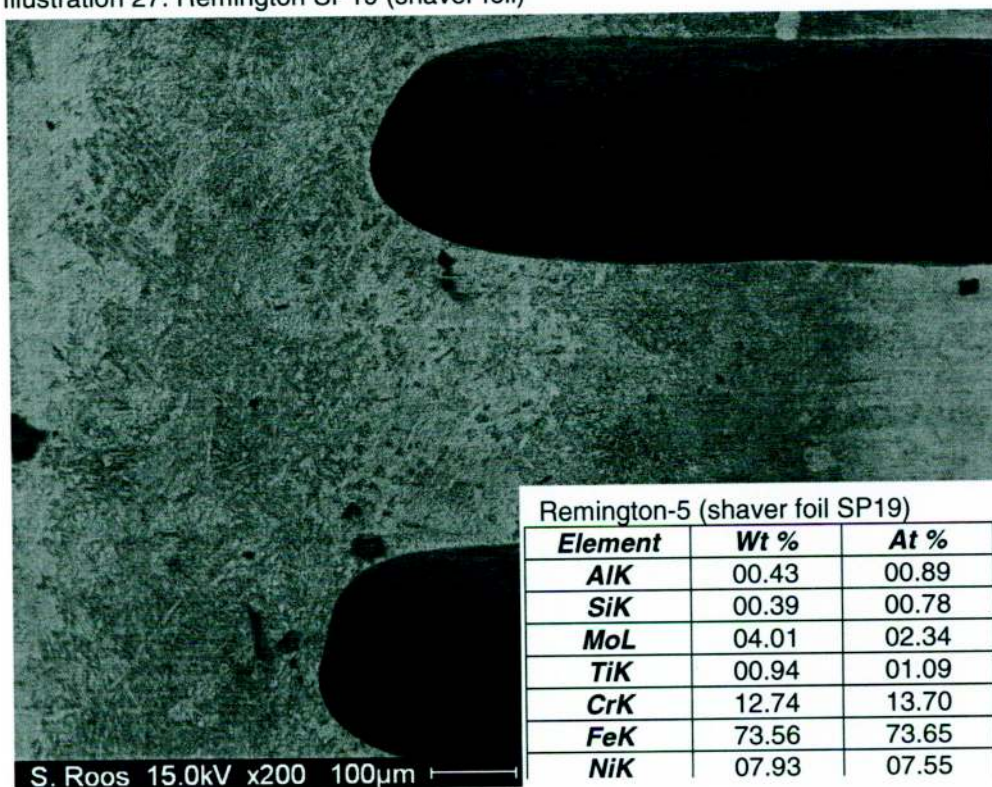


Illustration 28: Remington SP19 (blade)

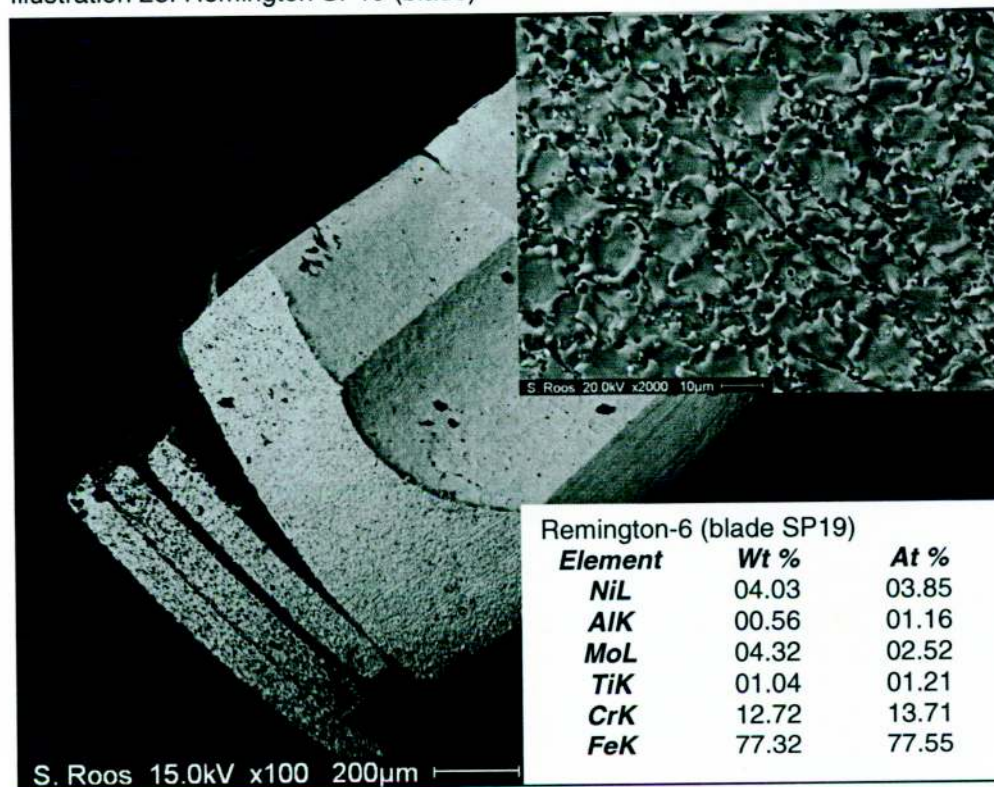


Illustration 29: MS5700 (shaver foil)

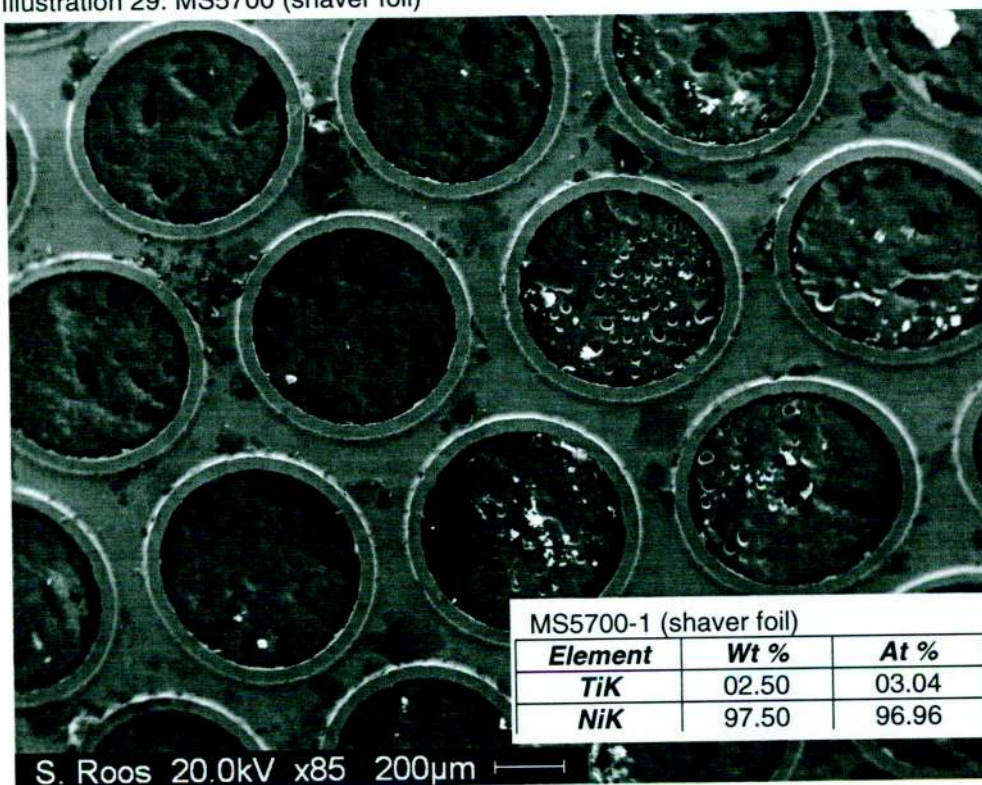


Illustration 30: MS5700-1 (blade)

