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VIRGO

OUTGASSING TEST OF AN ORIENTAL MOTOR UHV COMPATIBLE MOTOR

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In this note we briefly report the results of the outgassing tests performed with an UHV compatible motor manufactured by Oriental Motor. The test apparatus and the measurement method are described in detail in the note VACPISA 025.

1 - System performances

We performed a baking of the test chamber at 250^{0}C for 96 hours:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
after	33	4.2×10^{-8}	8.4×10^{-9}	6.7×10^{-7}

The main components of the outgassing after baking were H_2, H_20, N_2/CO, CO_2. The internal surface of the chamber is 2500 cm^2.

2 - Measurement of the outgassing flow of the motor

The sample was a UHV compatible stepper motor manufactured by Oriental Motor, Japan, model UPH 569 with five phases, step angle 0.36^0, maximum available torque 0.76 Nm. The casing material is SUS416 stainless steel. The ball bearings are Ag ion implanted. The windings are made of class H polyimide insulation cabling. The cabling to the air-vacuum feedthrough is made with Teflon insulation cabling. The motor can be baked up to 180 ^{o}C.

The motor was put inside the vacuum chamber as nominally cleaned from factory. We monitored the evolution of outgassing (time is measured from beginning of the test through the whole paper):

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
19.5	33	1.1×10^{-5}	6.0×10^{-6}	1.0×10^{-4}
25	32	1.0×10^{-5}	2.0×10^{-6}	1.6×10^{-5}
92.5	33	5.0×10^{-7}	1.1×10^{-7}	7.8×10^{-6}
97	33	5.9×10^{-7}	1.2×10^{-7}	9.4×10^{-6}

The spectrum taken after 97 hours is shown in Fig. 1.

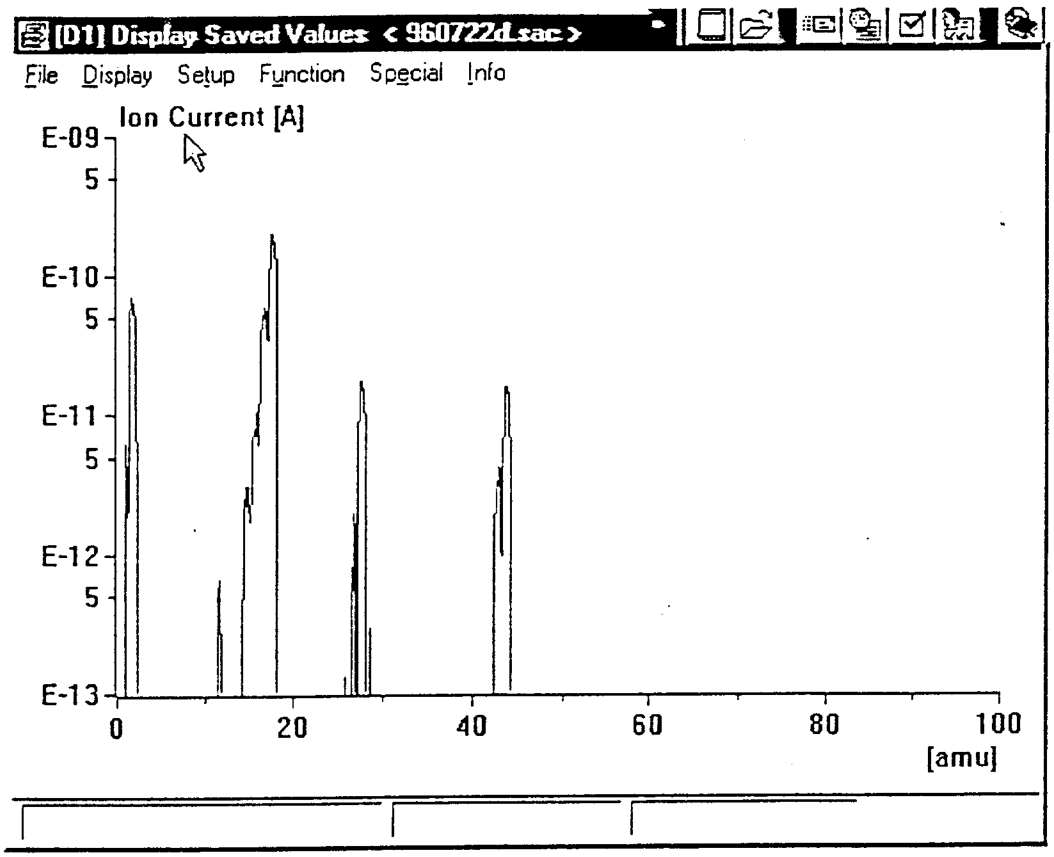

Fig. 1 Outgassing spectrum at room temperature after 97 hours pumping

The peaks in the figure belong to H_2, H_20, N_2/CO, CO_2.

We tested the motor at the speed of 1 step/s for 7 minutes. The peak value of the outgassing flow was 8.4×10^{-4} mbar l/s. The components with the steepest rise of the partial pressure were H_2, H_2O, N_2/CO, CO_2 and to a minor extent mass 58.

We performed a baking at 150 °C for 192 hours. We report some values measured during the baking:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
98.75	150	1.6×10^{-5}	4.0×10^{-6}	2.4×10^{-4}
100	150	2.4×10^{-5}	5.3×10^{-6}	3.7×10^{-4}
121	150	1.4×10^{-5}	1.4×10^{-6}	2.5×10^{-4}
290.5	150	1.9×10^{-6}	2.3×10^{-7}	3.3×10^{-5}

A spectrum measured during the baking is shown in Fig. 2.

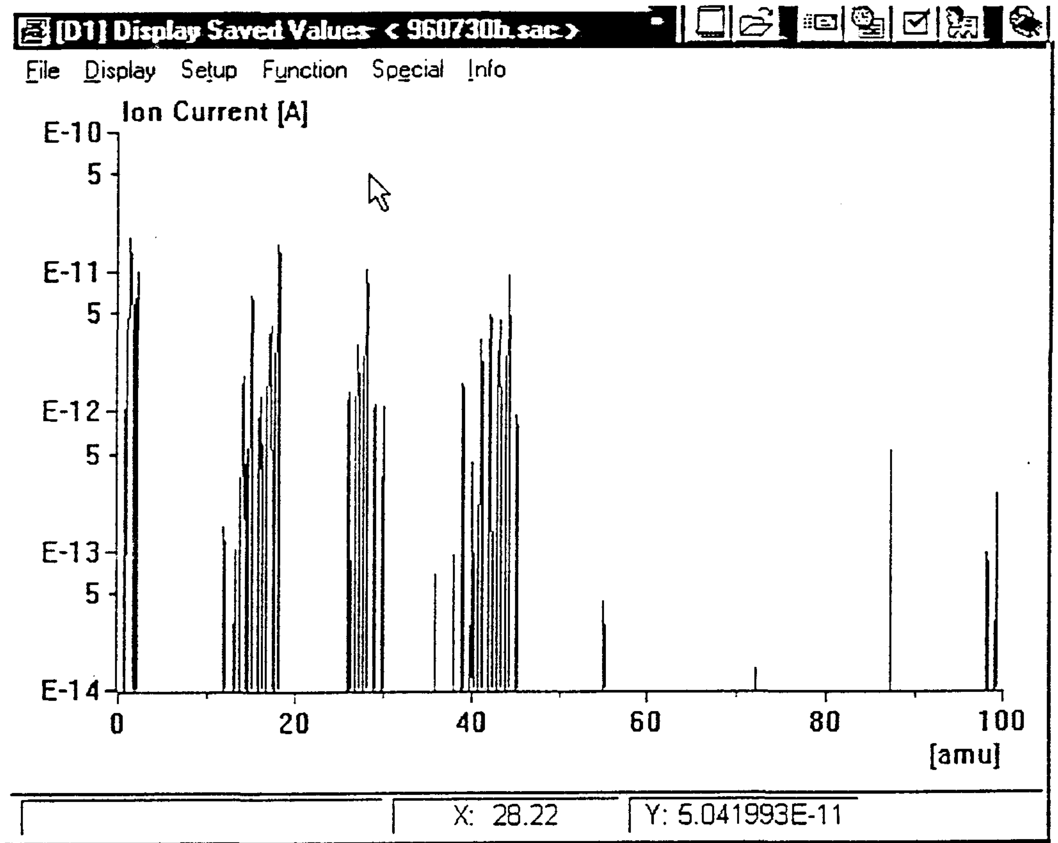

Fig. 2 Outgassing spectrum during baking at 150 ^{0}C

There are some low mass organic fragments around 40 and peaks at 87, 98, 99. There was no contamination beyond mass 100.

We switched off heating:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
291	120	1.3×10^{-6}	1.6×10^{-7}	2.3×10^{-5}
292	75	4.8×10^{-7}	7.7×10^{-8}	8.1×10^{-6}
293	55	8.7×10^{-8}	2.5×10^{-8}	1.2×10^{-6}
308	40	2.7×10^{-9}	2.4×10^{-9}	6.6×10^{-9}

After cooling down we tested the motor working at different speeds. The increase of partial pressures with motor in operation is shown in Fig. 3. Again the main components of outgassing were H_2, H_2O, N_2/CO, CO_2. The outgassing increase flow was proportional to the speed of the motor and decreased to the initial value after the motor was switched off. The peak value of the outgassing was 6.1×10^{-6} mbar l/s.

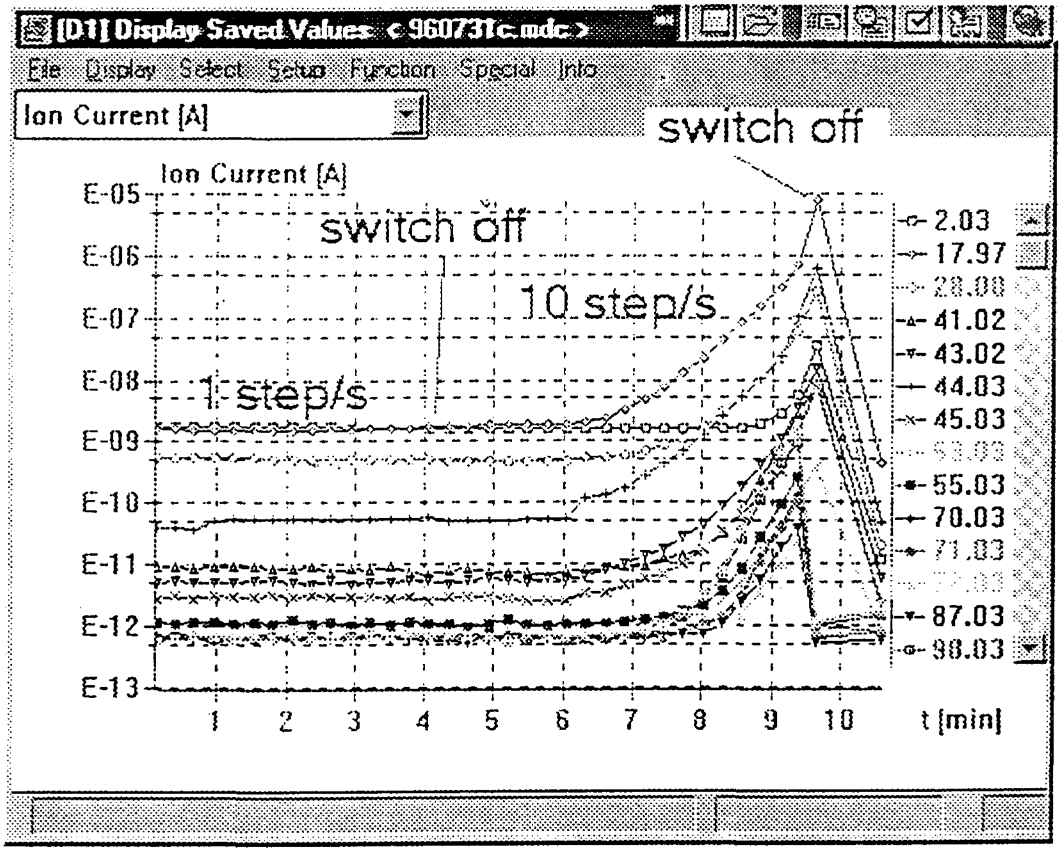

Fig. 3 Increase of some selected partial pressures with motor working at different speeds after vacuum baking at 150 ^{0}C

After the above tests we continued pumping:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
332	35	3.0×10^{-9}	2.6×10^{-9}	8.0×10^{-9}

The spectrum measured at the end of the test is shown in Fig. 4.

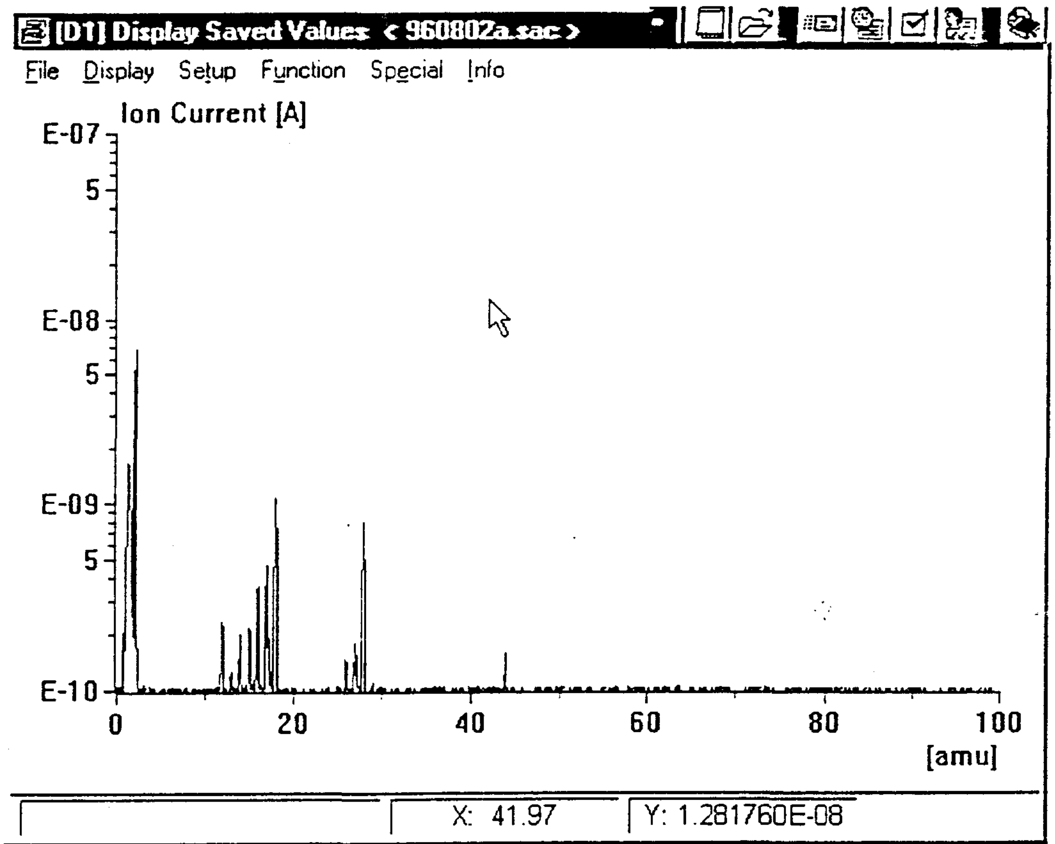

Fig. 4

Outgassing spectrum after vacuum baking at 150 ^{0}C

The outgassing flow evolution is summarized in Fig. 5.

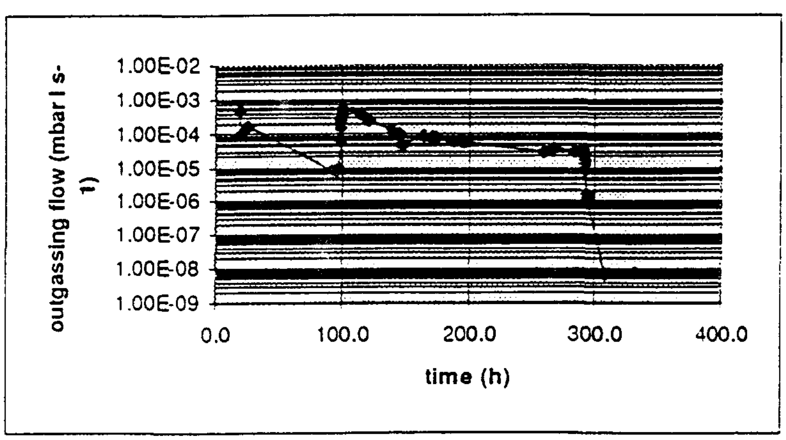

Fig. 5 Time evolution of the outgassing flow

3 - Discussion

The outgassing flow of the motor after baking at 150 ^{0}C was ~10^{-8} mbar l s^{-1}. This value is lower than the one measured for the AML B23.1 motors (see notes VACPISA025 and VACPISA041), despite the fact that this motor has a higher torque. There was emission of organic fragments during the baking: from the experience with other UHV motors, we think that they are due to the solvents used during cleaning. We think that the peak at mass 58 can be explained with acetone used for cleaning. The other peaks at 87, 98, 99 should come from the Teflon insulation of the cabling going to the feedthrough, which could be replaced in future samples. Due to the hydrocarbon emission during baking, the motor should not be baked in situ. We are going to investigate other motors of the same factory to check the repeatability of performances. The most relevant gases outgassed during motor operation are H_2, H_2O, N_2/CO, CO_2, which we think are coming from the friction on the bearings. In the typical working conditions of VIRGO, outgassing should not be a concern.