**2. Experimental details**

**2.1 Materials and sample preparation**

Bare AA2024-T3 was used as the basic substrate. In a first step the bare AA2024-T3 aluminum alloy from Alcoa is anodized in a tartaric-sulfuric acid (TSA) according to aerospace requirement AIPI 02-01-003. In a second step the anodized AA2024-T3 samples were coated with a polyurethane chemistry model coating (Table 1) with a dry film thickness of 20-25 µm. Coatings without corrosion inhibitors (negative reference) and lithium carbonate containing coatings were applied. To study the performance of these coated panels, an artificial damage is made with a mechanical milling device yielding a U-shaped scribe of 1mm wide and approximately 100-150 µm deep.[20][21][22][23][24][25]

**2.2 Odd-Random-Phase Electrochemical Impedance Spectroscopy (ORP-EIS)**

A typical three electrode set-up was used for the electrochemical experiments with a Ag∕AgCl 3M KCl reference electrode (RE), a platinum grid as a counter electrode (CE) and the mechanically scribed coated AA2024-T3 sample as the working electrode (WE) with an exposed area of 3,14cm² and a scribed area: 0,48cm², placed in a Faraday cage. Measurements were recorded right from the start up until 2 weeks of immersion in 0.05 M NaCl. The first 12 hours of the experiments are monitored continuously, i.e. a measurement is taken every 10 minutes, the later stages are monitored every hour.

The Odd-Random-Phase Electrochemical Impedance Measurements are performed with a Matlab controlled Biologic SP-200 potentiostat and National Instruments PCI-6110 DAQ-card covering a frequency range from 10-2 Hz to 2.103 Hz. The excitation signal applied was 10 mV (7.07mV RMS) versus the free corrosion potential. The Matlab software to build the odd-random-phase multisine excitation signal, to record the measurements and do the modelling was developed at the Vrije Universiteit Brussel.

To point out the advantages of ORP-EIS compared to classical EIS ,the ORP-EIS measurement data is treated also as if it was classical EIS data by ignoring the extra information obtained by the statistical data evaluation in the ORP-EIS technique.