Notes on meeting with Adrian Leyland (Engineering Materials), 8th September 2008

The technical requirements and previous problems with the actuator were discussed. He agreed that having different material surfaces in contact was the better approach. The steel bearings and titanium shaft present different problems.

Bearings

These should be made of as hard a material as possible. A hardened tool steel (M2) might be preferable, but this is ferritic so could cause magnetic problems for the actuator. Wire erosion marks are visible on the present bearings. This implies a poorer surface with reduced adhesion for the vapour-deposited coating. Two possible approaches were outlined.

1) Use the present austenitic steel. Electropolish to achieve a very smooth surface, and remove wire-erosion damage. (Possible local company: Firma-Chrome Ltd) Coat with Chromium Nitride by plasma deposition (TecVac).
2) Use a harder steel. Apply electroless Nickel (Nickel–Phosphorus?) coating, heat-treated to increase hardness. (Poeton Industries Ltd of Gloucester, or Firma-Chrome Ltd) 25µm very hard coating; probably don't need to electropolish surface first. Mirror finish. May need to specify changed dimensions to allow for coating thickness. Chemical coating process (rather than plasma) means could go back to simpler 2-piece lower bearing instead of quadrants. (Electroless Nickel coating may also be an option for the austenitic steel, but without the heat-treatment hardening.)

Shaft

Titanium is neither hard nor stiff, nor does it have a good surface for coating! Are the following options available, or are they ruled out by other constraints?

1) Use a titanium alloy, e.g. Ti_6Al_4Va. This is harder, with a hardness better matching DLC. Polish surface as well as possible. Coat with DLC (TecVac) as at present. *Questions: is Ti_6Al_4Va acceptable from activation point of view? Is it ok instead of pure Ti for particle production? Are there any machining problems?*
2) Use present titanium material. Again polish as well as possible. Pre-treat with a nitride coating before DLC coating. This significantly hardens the surface, and should improve stiffness. *Question: nitride coating involves exposure of Ti to temperatures of 700°C. Will this give stress-relief problems?*

CNB

9th September 2008