Kappa Diffractometer Damage Report

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Introduction and Summary

On September 30, 2003, MHATT-CAT's Newport/Microcontrole kappa diffractometer (herein called "kappa") located in the 7ID-C hutch experienced a catastrophic failure, severely damaging the equipment. The kappa rests on three vertical jacks which are labeled Y1, Y2, and Y3 (located at the upstream inboard corner, upstream outboard corner, and downstream center of the diffractometer base respectively). While all three motorized jacks were being raised, mechanical failure(s) of the Y1 jack caused the upstream inboard corner of the kappa to fall to the floor, destroying much of the Y1 equipment. The Y1 leadscrew, for instance, is snapped in two. The only sound was a brief crash, lasting less than one second. The Y2 jack has fallen off its seat, and a large portion of the kappa's weight is resting on a corner of the assembly, with enough stress to discolor the anodized aluminum; no further mechanical damage on this side is obvious, but it is not in a stable position. The Y3 jack is still on its seat, although tilted of course. Digital photos of the damage are posted at
http://www.mhatt.aps.anl.gov/~walko/kappa_damage/

Immediate Background

The Y2 jack has recently been giving intermittent trouble when raising the kappa; it would occasionally fail to begin moving and the motor would make a loud whining noise. The Y2 jack did not have a problem once motion had begun. A suggestion to solve this problem was to grease the V-grooves and their rollers. Lubriplate Aero grease was used. First, all three jacks were driven down to their lower (software) limit of nearly –115 mm, with all jacks moving at the same time to avoid tilting the kappa too much; grease was applied to the exposed grooves of all three jacks. The jacks were then being driven towards their upper (software) limits of +60 mm when there was a sudden crash and the diffractometer had fallen.

Further History

When the kappa was originally installed at MHATT-CAT, the tilt limit switch (to prevent excessive tilting of the kappa) was inverted. This did not prevent excessive tilting, rather, it prevented reversing direction to try to level the diffractometer. This was noticed when

the cross-rollers of the Y1 and Y2 jacks were being repaired in May 2001 (the plastic was cracking). More information can be found in Eric Dufresne's report at
http://www.mhatt.aps.anl.gov/~dufresne/kappa/Y1Y2problem/
In May 2003, the lead screw of the Y1 jack was replaced because the Y1 jack was getting stuck; gouges were found in the lead screw and although the motor was turning (and the encoder recorded that the motor was moving), the jack was not in fact being raised. More information can be found in Eric Dufresne's report at
http://www.mhatt.aps.anl.gov/~dufresne/kappa/Y1_0503/
Peter Eng of GSE-CARS, University of Chicago, greatly assisted with both of these repairs.