

Completion of L2 Milestone 1.2.1.4.1 (L2 CP - PXL Prototype PXL Insertion mechanism Testing Complete)

As of December 2011, insertion testing for PXL Prototype is now complete at L2 level.

Overview

The test requires that the PXL_GIZMO assembly successfully engage the kinematic mounts, located by the Grand Master fixture.

PXL_GIZMO consists of a carriage mechanism with a hinged support of a D-tube. The D-tube supports 5 sector tubes (one side of detector). The successful engagement is shown in Figure 1 and Figure 2. In Figure 3, the prototype assembly is shown prior to insertion. Here the PXL_GIZMO sits on 2 carbon fiber rails, supported by linear bearings.

A pressurized bellows maintains a stiff constraint between the carriage (resting on the rails) and the D-tube assembly (supported on the hinge mechanism). Upon engagement of the kinematic mounts, the bellows are depressurized, so that the mounts control the final position of the D-tube, unconstrained by the rail support.

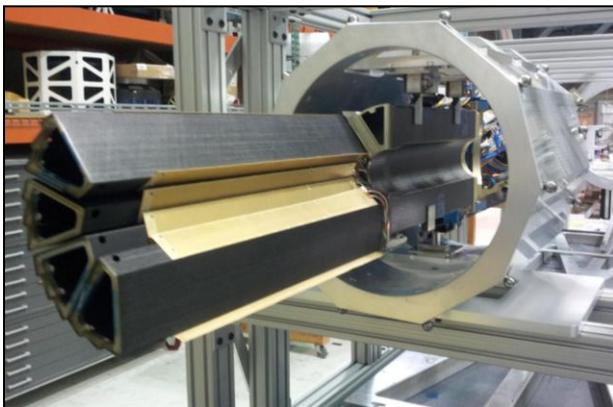


Figure 1. Prototype D-Tube + sectors after successful insertion seen from front.

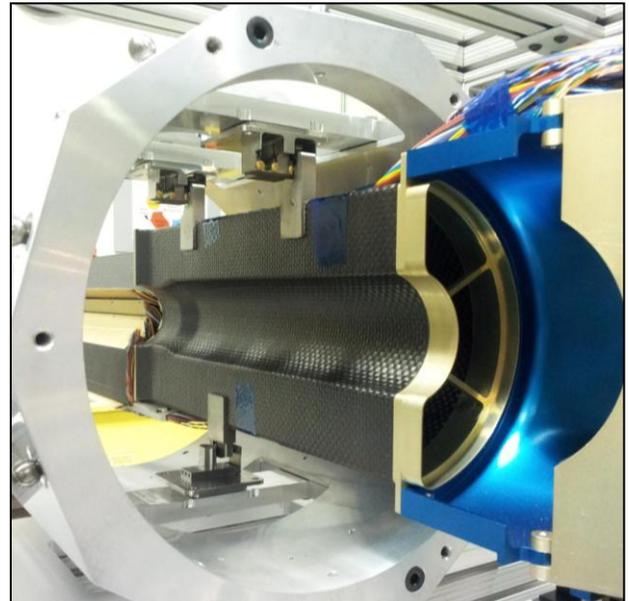


Figure 2. Successful engagement of kinematic mounts by D-tube, seen from rear.

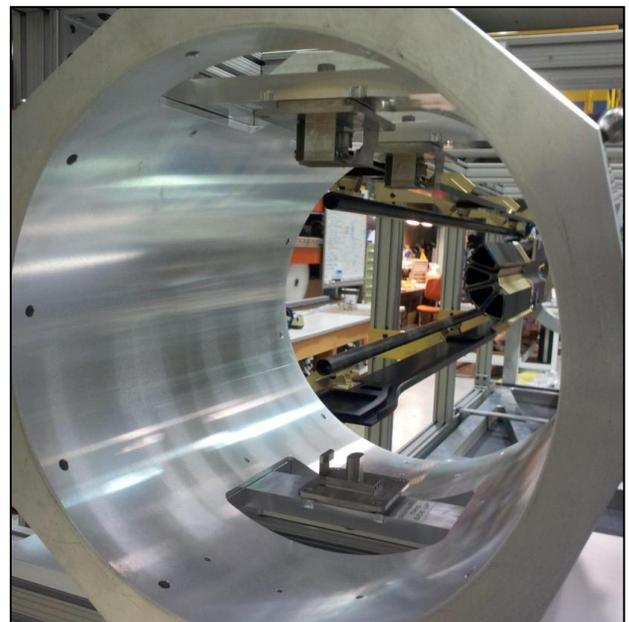


Figure 3. Prior to insertion into Grand Master alignment fixture.

Displacement tolerance

The kinematic mounts must correctly engage despite any misalignments that may occur in PXL_GIZMO of up to 1.5mm in the X or Y directions (Z is the insertion direction, along the rails). This was demonstrated by repositioning the Grand Master fixture with respect to the rails by 2mm offsets in both X and Y (see Figure 4). Insertion tests were again successful, with the kinematic mounts guiding the D-tube into its correct final position. In all cases good contact was made between silicon nitride tooling balls (which define the kinematic contact points) and their respective contact surfaces.

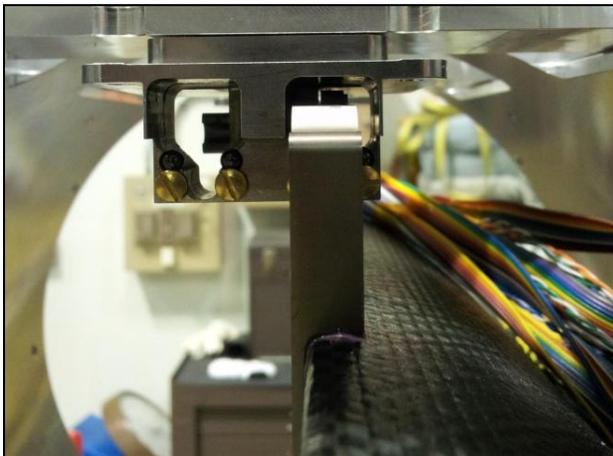


Figure 4. Upper kinematic mount with intentional 2mm horizontal misalignment, just prior to engagement.

Bellows pressure range

Input pressures to the bellows system were varied between approximately 10 and 70 psi, and the system was shown to work stiffly and robustly for all inputs over 20 psi (the designed maximum allowable pressure is 100 psi).

Guide track

The guide track was shown to successfully direct the hinged PXL_GIZMO with no interferences. See Figure 5.

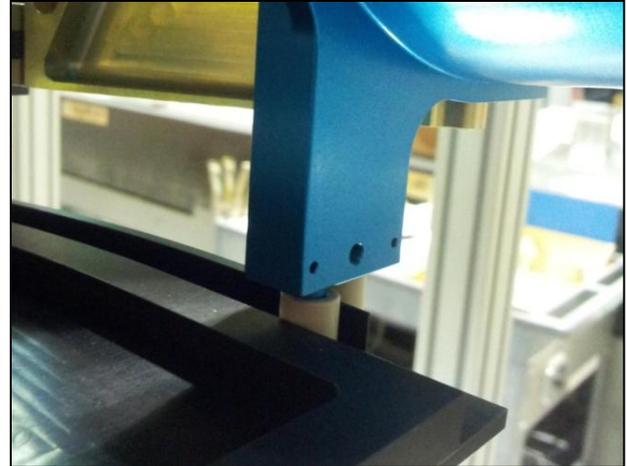


Figure 5. Guide rollers in track at end position.

Indications for design

Testing indicated two useful changes to be made for production parts:

1. Stiffer clamping springs when attaching kinematic mounts to the grand master.
2. Increase sectional inertia of arms supporting hinge mechanism.

Change (1) will improve repeatability of sector metrology, by eliminating any errors induced by D-tube strain.

Change (2) will reduce gravity droop of the disengaged D-tube, which was only marginally acceptable in the prototype (~ 1 mm).

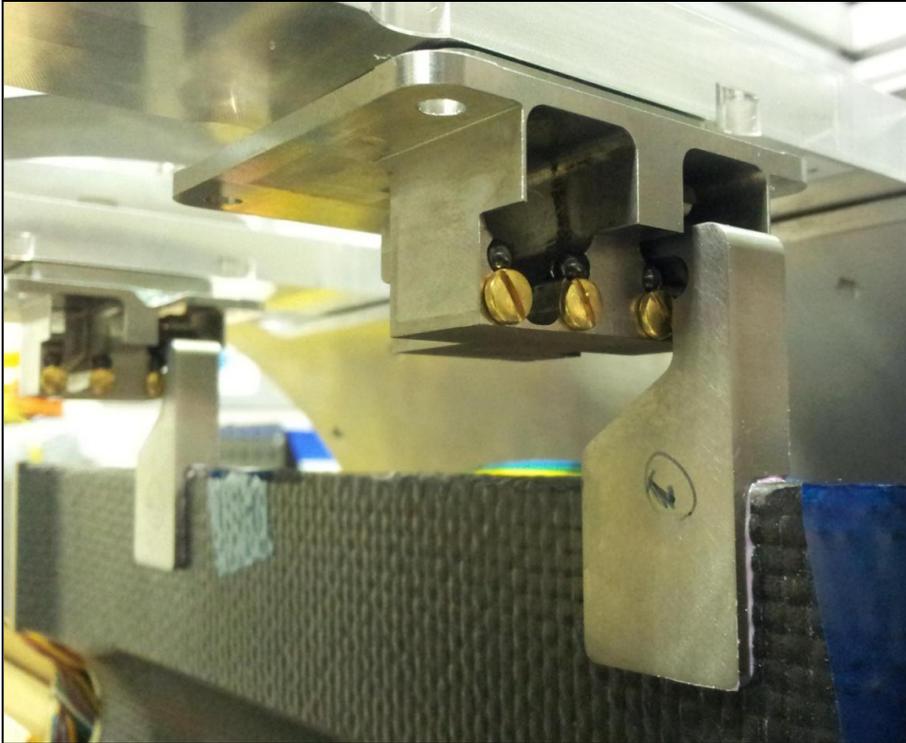


Figure 6. Engagement of upper kinematic mounts.

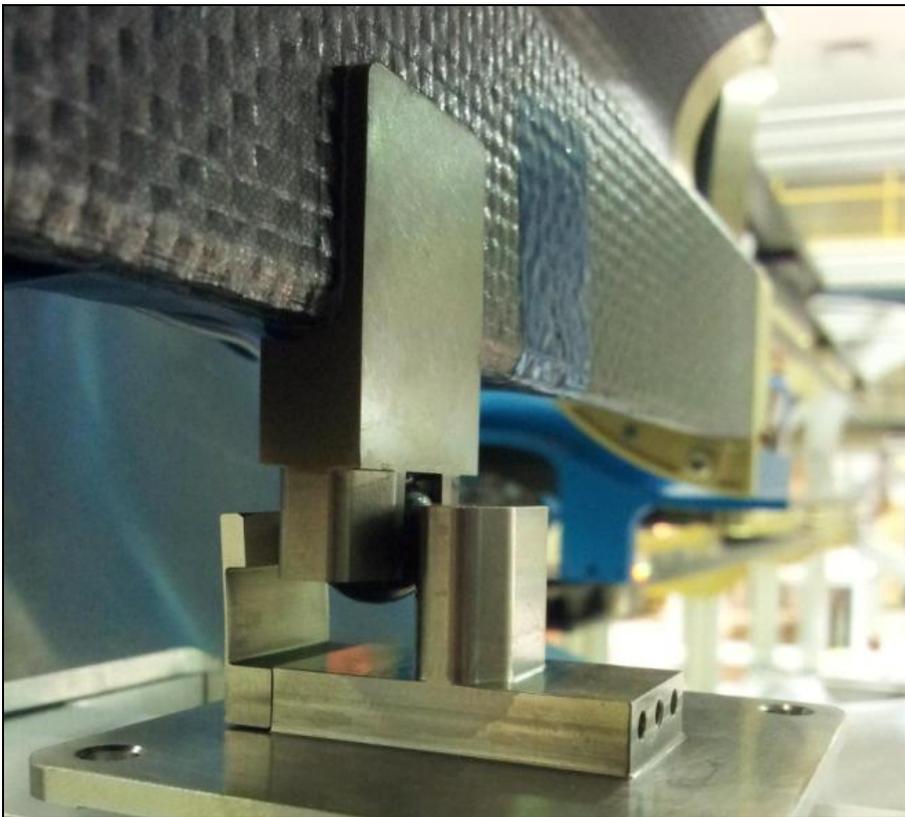


Figure 7. Engagement of bottom kinematic mount.