

Mechanical Preliminary Test Plan and Feasibility Analysis

P1003 Dynamic Keyboard: Phase 2

Joshua Locke and Robert Piccirillo

Test Plan

We plan to use our designed test rig to apply a repeatable load to a single key with force output. We will also use the set up to press the key and make comments on the overall feel and response of the keystroke. Based on the results of this testing we will make a final decision of what material will be used, if any, to fabricate our keyboard for the best response.

We will collect baseline data using our test plan with no modification to the keyboard to compare with all other tests.

- Considerations:**
- Linearity of the force output
 - Ability to differentiate as many force levels as possible with relative ease
 - Ability to fabricate design time and cost effectively
 - Saturation force

- Assumptions:**
- Repeatability in testing conditions accounts for a calibrated system
 - Force is applied at the same location between tests
 - Force is constant between tests
 - Force is not distributed to other sensors (tested to be safe)

- Materials to Test:**
- Existing Keyboard Rubber Extrusions (Baseline)
 - Foam cylinder
 - ¼" Closed Cell Silicone Sponge (Red)
 - ¼" Cast Silicone Foam (Black)
 - Compression Spring

¼" Closed Cell Silicone Sponge (Red):

Compression Force-Deflection: 2-7 PSI (Compressed 25% at 73 °F) per ASTM 1056
Soft Grade

¼" Cast Silicone Foam (Black):

Compression Force-Deflection: 0.5-1.5 PSI (Compressed 25% at 73 °F) per ASTM 1056
Ultra Soft Grade

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Test Type	Pre-load	Josh		Robert		Test Rig
		Hard	Finger Type	Hard	Finger Type	
Existing Keyboard Rubber Extrusions:	0	144	15	135	17	34
Existing Keyboard Rubber Extrusions w/ foam cylinder (medium):	0	593	126	592	291	238
Foam Cylinder (medium):	0	594	55	594	115	334
Just Cylinder (long):	33	594	181	594	195	315
1/4" Red Cell Silicone Sponge (Red):	0	152	25	275	35	37
1/4" Red Cell Silicone Sponge (Red) w/ Foam Cylinder:	10	594	85	594	65	58
1/4" Red Cell Silicone Sponge (Red) button flush w/ Foam Cylinder:	0	594		594		46
1/4" Cast Silicone Foam (Black):	0	120	25	101	34	26
1/4" Cast Silicone Foam (Black) button flush w/ Foam Cylinder:	0	455	50	525	94	75
1/4" Cast Silicone Foam (Black) w/ Foam Cylinder:	0	593	61	593	75	103
Compression Spring:	0	172	45	172	50	95

Sensor Saturated

Test Type	Comments
Existing Keyboard Rubber Extrusions:	Poor force sensor readings, Softer than regular keystroke
Existing Keyboard Rubber Extrusions w/ foam cylinder (medium):	Nice but can do better
Foam Cylinder (medium):	Picks up all forces, rests on sensor matrix, nice linearity but short range of motion
Just Cylinder (long):	Preloaded with a longer range of motion
1/4" Red Cell Silicone Sponge (Red):	Absorbs almost all key force but depresses nicely
1/4" Red Cell Silicone Sponge (Red) w/ Foam Cylinder:	Picks up light presses, filters medium presses and enhances the hard presses
1/4" Red Cell Silicone Sponge (Red) button flush w/ Foam Cylinder:	Very bad keystroke response
1/4" Cast Silicone Foam (Black):	Nice soft feeling but doesn't max out the sensor
1/4" Cast Silicone Foam (Black) button flush w/ Foam Cylinder:	Best linear feel, does not max out . Greatest range
1/4" Cast Silicone Foam (Black) w/ Foam Cylinder:	Very nice keystroke response, soft, maxes out the sensor reading
Compression Spring:	Nice keystroke response, similar to keyboard without assist, very linear

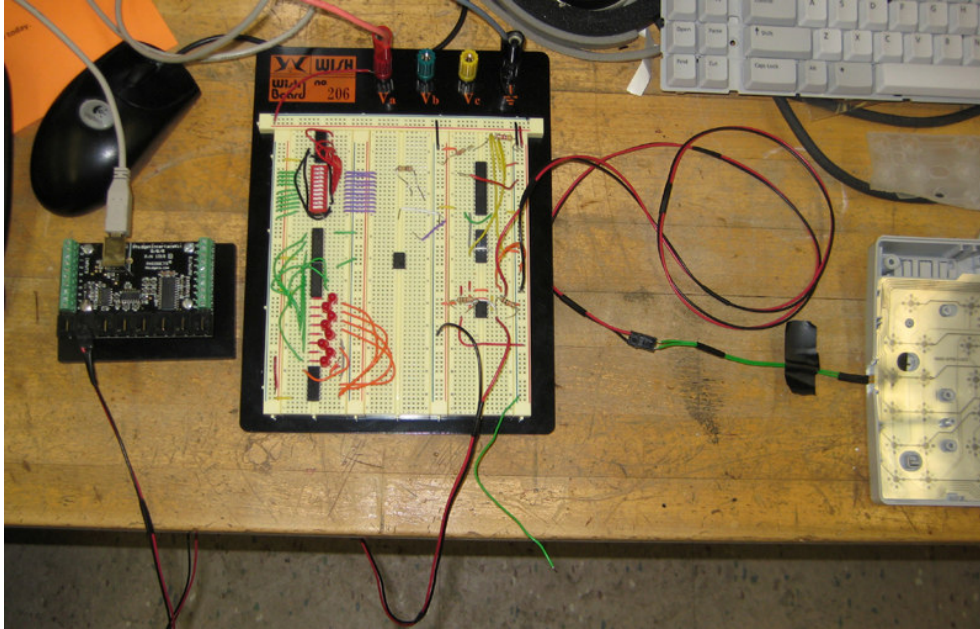
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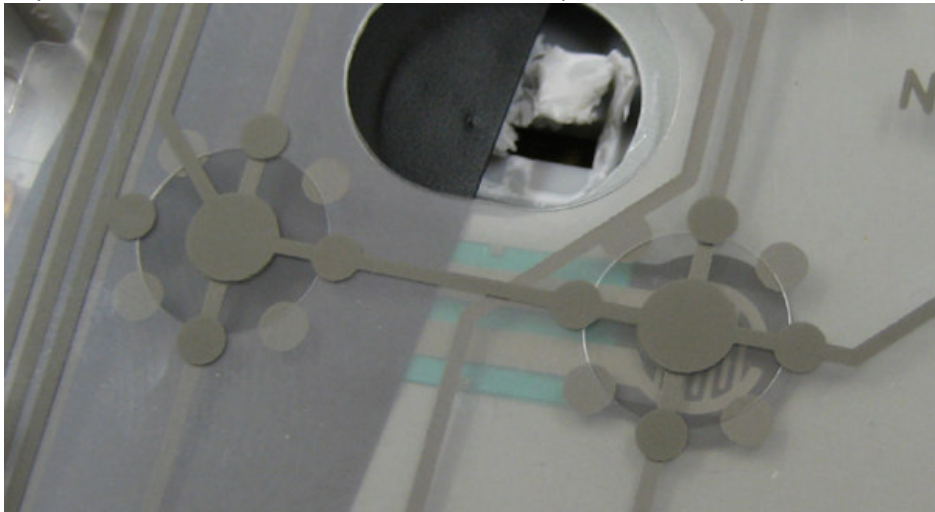
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Pictures from testing:

Electrical test setup for force sensor readings.



Keyboard electrical matrix with force sensor taped to hold its position under the key.

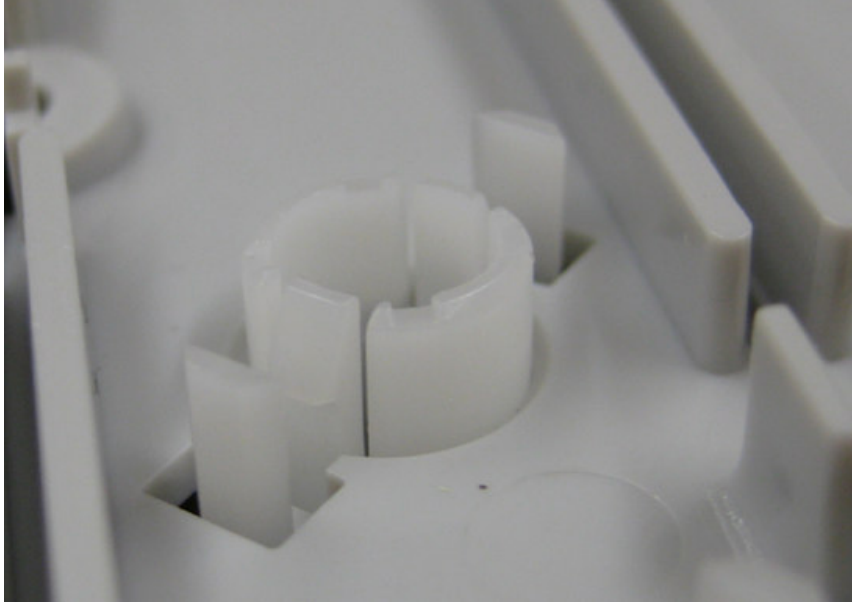


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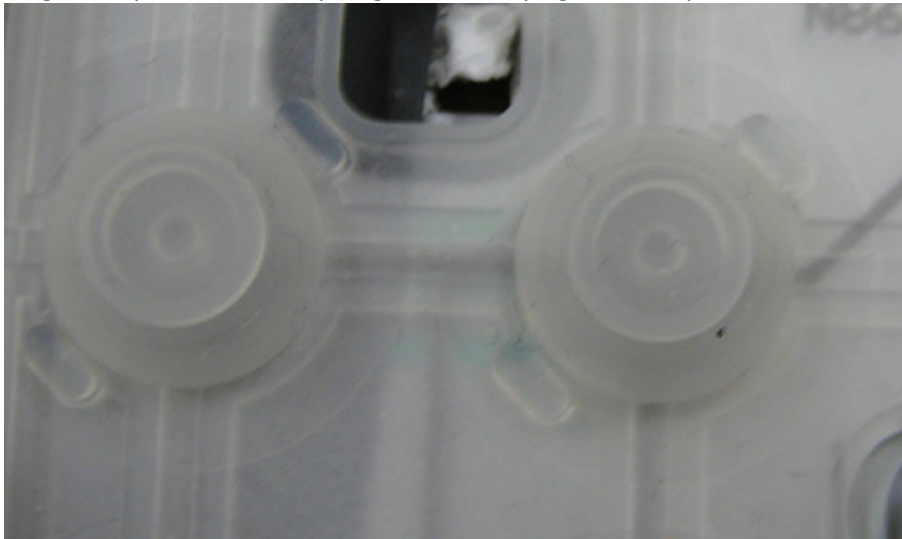
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Existing keyboard plunger



Original keyboard silicone plunger matrix laying above key matrix.



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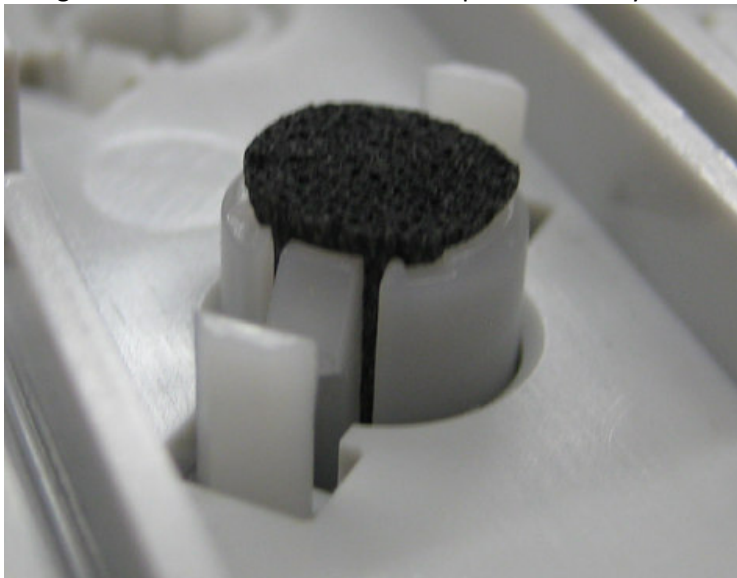
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Finger tester to test the key material while removing the variability of a finger keystroke.



Plunger filled with foam to eliminate open area in key and allow for a different keystroke feel.

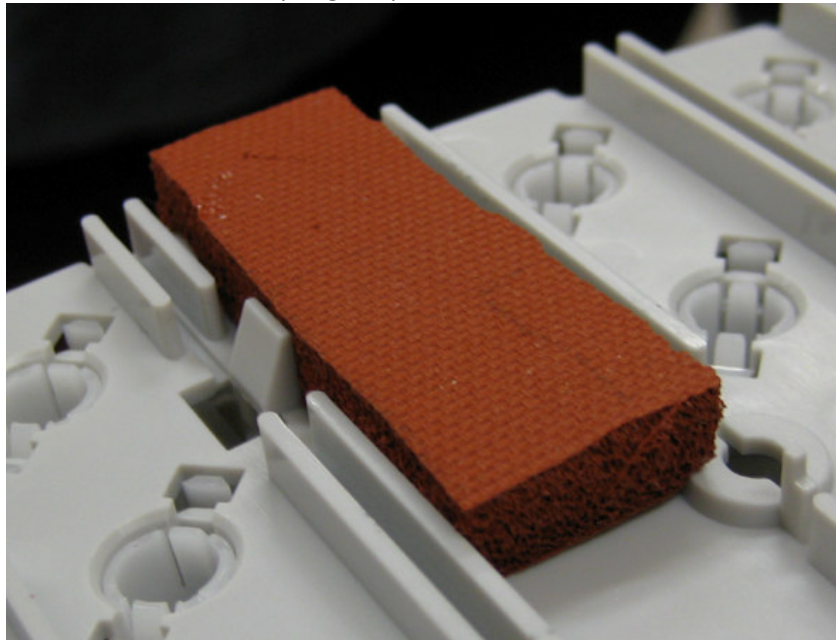


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1/4" Red Cell Silicone Sponge in place to be tested.



Labview .vi showing the force histogram and Analog Input reading

