MICE Actuator Functional Test

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Introduction

The MICE actuators will be used to dynamically tune the MICE RF cavities. The actuators have been re-designed to reflect recent changes in the MICE beam-line. The new actuators were designed to simplify construction and reduce cost; a prototype actuator has been completed at LBNL and tested to verify its functional operation.

Setup

Testing is done in the same manner as before, with the use of a tuning fork and stiffener ring that simulates the stiffness of the copper RF cavities. The test setup is shown in Figure 1 and Figure 2.

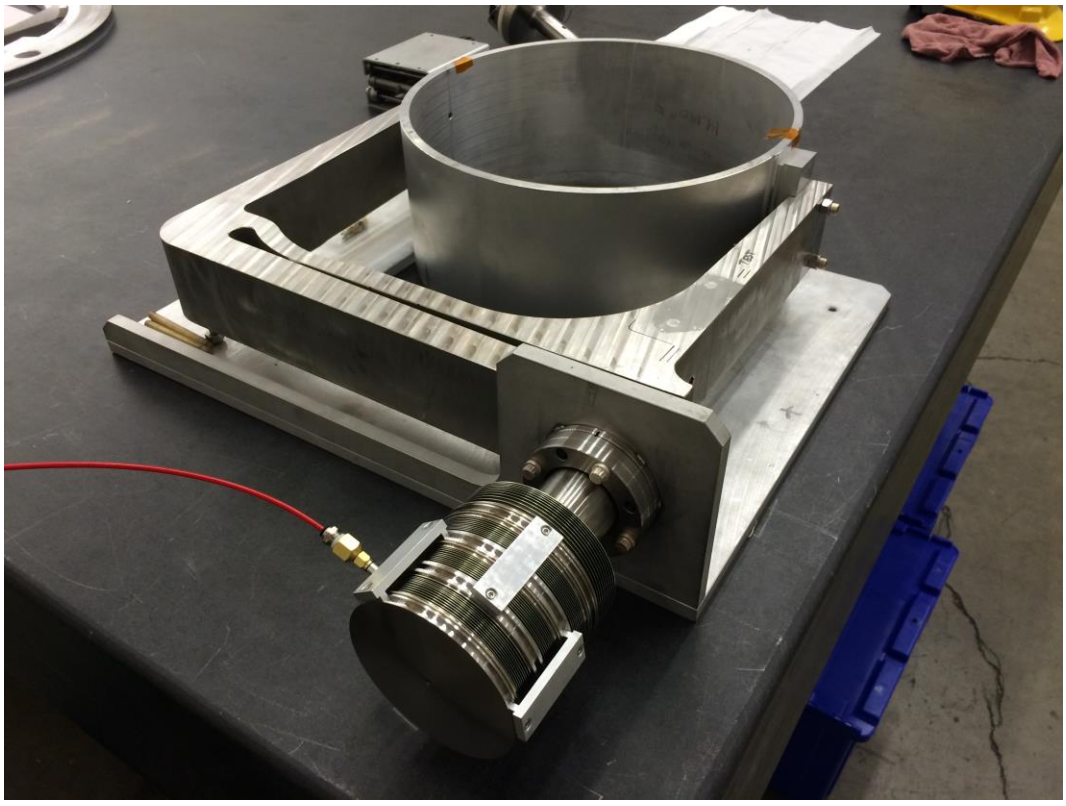

Figure 1: Actuator installed into tuning fork

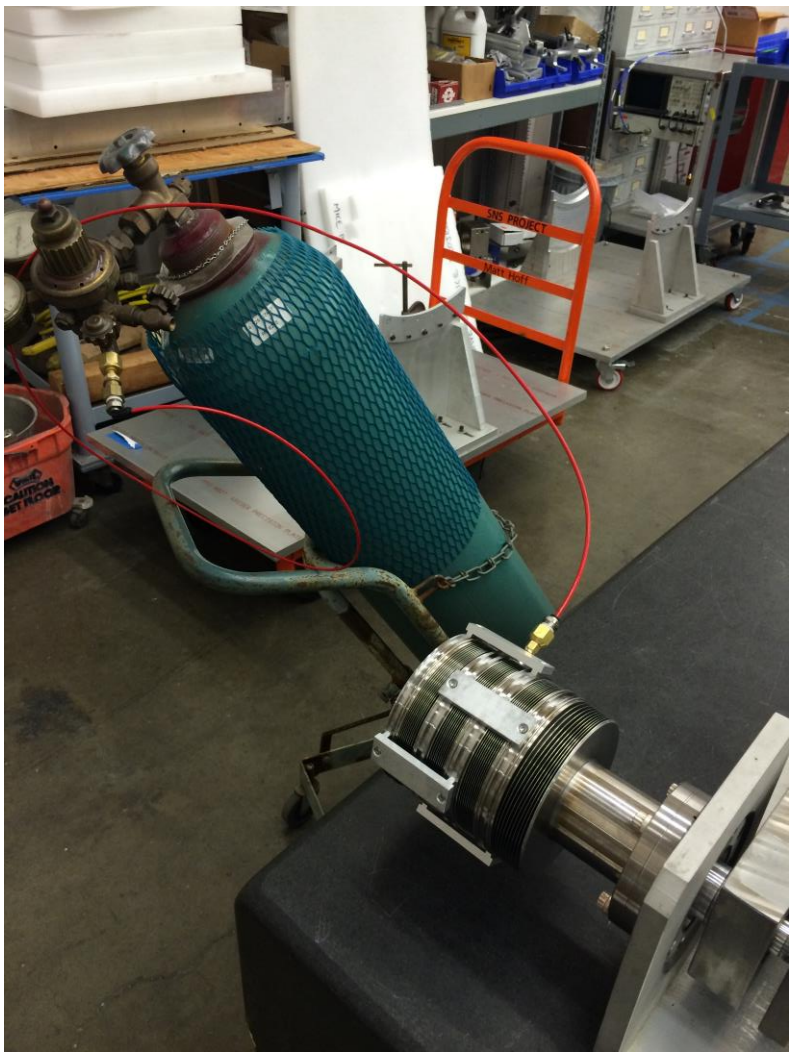

Figure 2: MICE actuator hooked up to argon tank for functional test

Argon gas is used to pressurize the actuator chambers; pressure is controlled on the argon tank itself. Digital calipers are used to measure the "stretch" and "squeeze" of the tuning fork when the actuator is pressurized. Each chamber is pressurized to 20, 40, 60, and 80 psi; the deflection is read directly from the calipers. The results are shown in Table 1 and Table 2.

Table 1: Stretch vs. Pressure

Pressure (psi)	Stretch(mm)
0	0
20	0.38
40	0.87
60	1.38
80	1.91

Table 2: Squeeze vs. Pressure

Pressure (psi)	Squeeze
0	0
20	-0.38
40	-0.83
60	-1.24
80	-1.82

These results are also plotted in Figure 3.

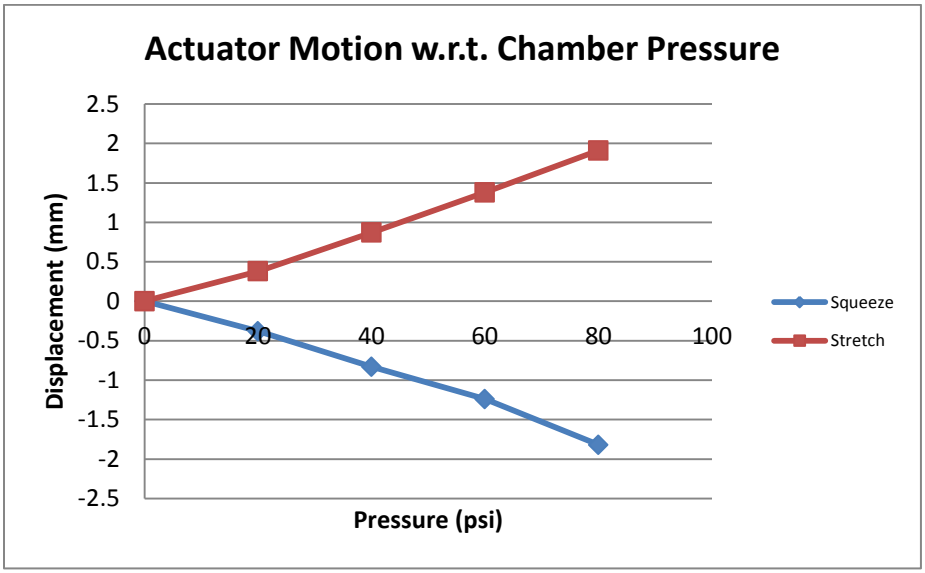

Figure 3: Actuator motion during functional test

The actuator motion is similar to that seen during testing at the FNAL MTA facility [1], which is shown in Figure 4. Overall, performance is much the same, with small discrepancies that are most likely due to the altered design. Based on the slope of the lines plotted in Figure 3, the requirement of +/- 2.0 mm of deflection is attainable with pressures of 84 psi and 88 psi for the "stretch" and "squeeze" modes, respectively. The bellows used in the assembly are rated to 120 psi, so the desired performance is attainable without pushing the bellows to their limit.

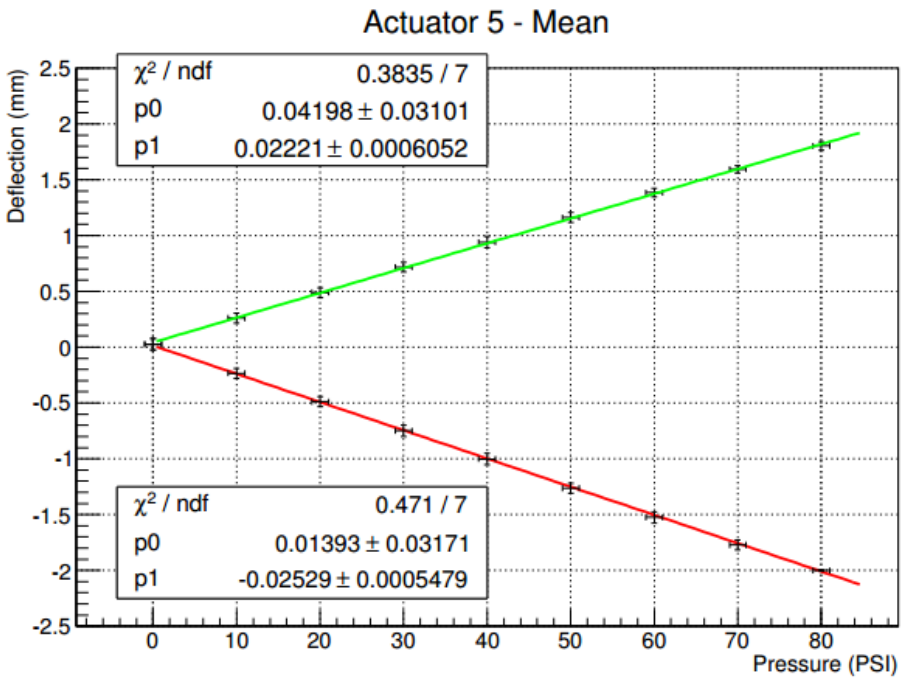

Figure 4: Actuator deflection as reported by [1]

Summary:

The functional actuator test shows that the new actuator design successfully moves as intended and may be used to tune the MICE RF cavities. The new design greatly reduces the complexity of machining and assembly, as well as reducing overall cost. The next step in testing the new actuator is a lifetime/survival test to verify the actuators operation through cyclic loading.

References:

[1] Somaschini, Luca, *Test of the Fermilab Radio Frequency Accelerating Unit for the MICE Experiment at Rutherford Laboratory*, Universita Degli Studi Di Milano, Facolta Di Scienze e Technologie