



# **TMT P2 Prototype Actuator Draft Test Plan**

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## 1. Background

A limited set of simple functional tests will be completed by the supplier prior to shipment of the prototype actuators. These are intended to address basic functionality prior to beginning the performance testing that will be carried out by TMT.

This is a draft of the “M1CS Prototype Actuator Test Procedure”. We expect that these tests should take less than 2 hours per actuator assuming all test equipment is available and no major problems are found.

A compliance matrix is given at the end.

## 2. Test equipment

- Encoder interface adapter (MicroE Systems ATMII5000-S-US SmartPrecision Alignment Tool)
- Stepper motor driver/indexer (Applied Motion Products Model Si2035 or similar)
- Audio signal generator
- Laptop computer with network adapter (for encoder) and serial port adapter (for motor driver)
- Spring gauge (+/- 200 N range)

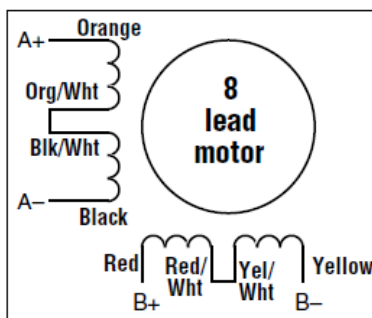
## 3. Functional tests

Mount the actuator securely to a flat surface using bolts through its two mounting holes.

### 3a. Test for range of travel and force

The stepper motor offloader specified for the prototype actuator is a direct drive device. As long as it's not driven at high speeds, it will stall safely at both ends of travel.

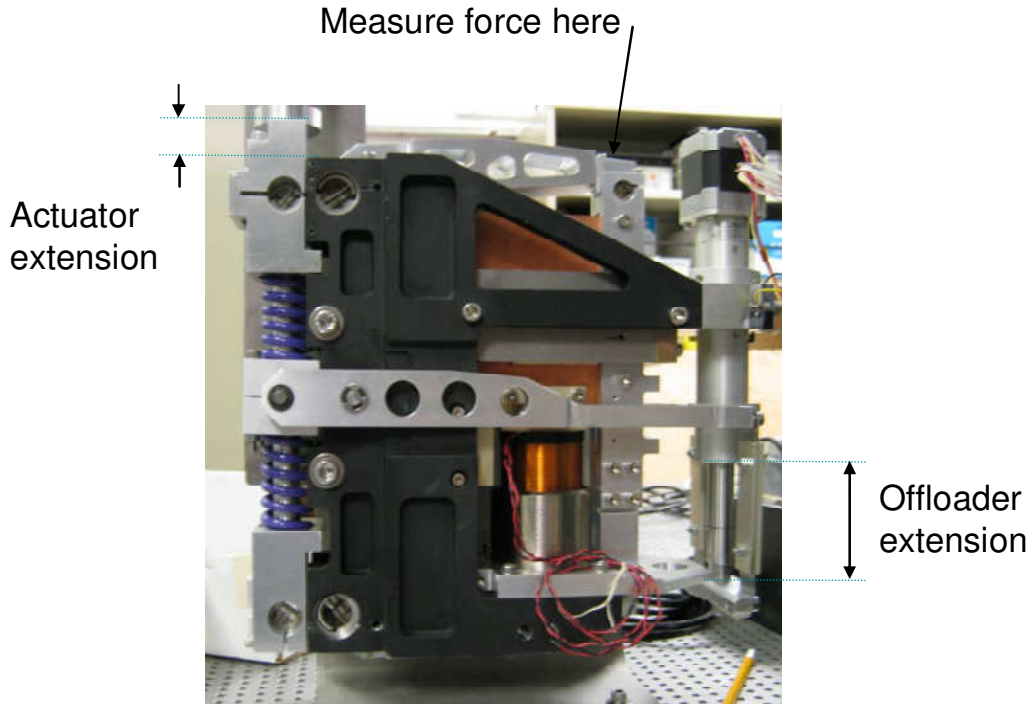
Connect the stepper motor to the stepper motor driver using series wiring.



Configure the driver for 0.5 A/phase, 10,000 steps/rev. For the Si2035 driver specified above, configuration is done through a serial port to the laptop using software provided with the driver.)

Drive the motor at 1 rps to retract the offloader (minimum extension) until the motor stalls. Stop the motor. Measure:

- a) Extension of the actuator output shaft.
- b) Extension of the offloader.
- c) Using a spring gauge, measure the push force at the end to the top arm (there is tapped hole for attaching a gauge directly above the 1/2" flex pivot) before the four-bar linkage moves.



Drive the motor at 1 rps to extend the offloader (maximum extension) until the motor stalls. Stop the motor. Measure:

- d) Extension of the actuator output shaft.
- e) Extension of the offloader.
- f) Using a spring gauge, measure the pull force at the end to the top arm (there is tapped hole for attaching a gauge directly above the 1/2" flex pivot) before the four-bar linkage moves.

### 3b Test for encoder operation

(This test can be done in parallel with preceding test).

Connect the encoder to the encoder interface adapter, connect the adapter to a laptop computer, and run the encoder diagnostic software (free from MicroE). Move the offloader over its range of travel as above. Measure:

- g) Encoder measurement with offloader retracted.
- h) Encoder measurement with offloader extended.

- i) Confirm a “green” signal strength over the full range of travel.

**3c Test for voice coil operation.**

Drive the motor at 1 rps to put the offloader approximately mid-range, so that the four-bar linkage is free to move and the voice coil is in the center of its range. Connect the voice coil to an audio signal generator configured for a 0.05 Hz square wave (the voice coil has two sets of windings; connect them in parallel). Set the peak-to-peak amplitude at the voice coil leads to 0.4 V. Measure:

- j) Encoder peak-to-peak value.

Move the offloader so that the voice coil is 3 mm from minimum extension. Measure:

- k) Encoder peak-to-peak value.

Move the offloader so that the voice coil is 3 mm from maximum extension. Measure:

- l) Encoder peak-to-peak value.

**Compliance Matrix**

| Test                       | Measurement                      | Data | units  | Acceptance     |
|----------------------------|----------------------------------|------|--------|----------------|
| <u>Offloader retracted</u> |                                  |      |        |                |
| a                          | Actuator shaft extension         |      | um     | n/a            |
| b                          | Offloader shaft extension        |      | mm     | n/a            |
| c                          | Push force                       |      | N      | > 50 N         |
| <u>Offloader extended</u>  |                                  |      |        |                |
| d                          | Actuator shaft extension         |      | um     | d-a > 4000 um  |
| e                          | Offloader shaft extension        |      | mm     | e-b > 75 mm    |
| f                          | Pull force                       |      | N      | > 130 N        |
| <u>Encoder test</u>        |                                  |      |        |                |
| g                          | Encoder with offloader retracted |      | um     | n/a            |
| h                          | Encoder with offloader extended  |      | um     | g-h  > 4000 um |
| i                          | Green light over full range      |      | yes/no | yes            |
| <u>Voice coil test</u>     |                                  |      |        |                |
| j                          | Encoder peak-to-peak (mid range) |      | um     | >20 um         |
| k                          | Encoder peak-to-peak (Min range) |      | um     | >20 um         |
| l                          | Encoder peak-to-peak (max range) |      | um     | >20 um         |