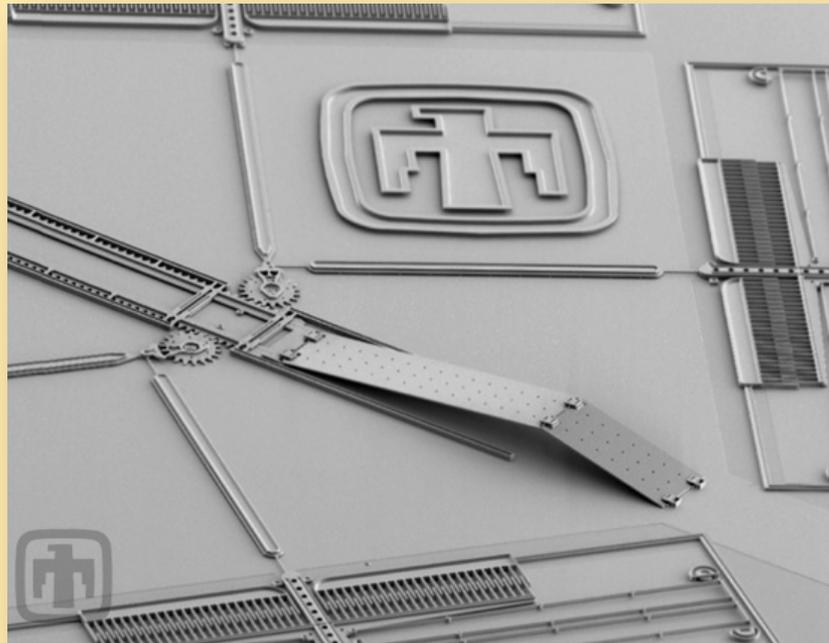


# INTRODUCTION TO ACTUATORS



*Micro-sized polysilicon mirror with drive motors consisting of combdrives and gears.*

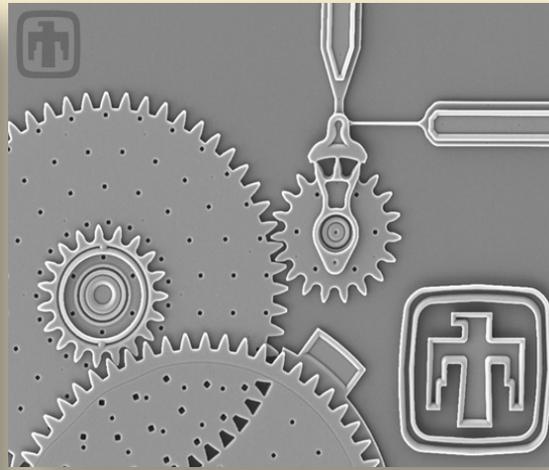
*[Courtesy of Sandia National Laboratories, SUMMiT(TM) Technologies, [www.mems.sandia.gov](http://www.mems.sandia.gov)]*

# Unit Overview

The following topics will be discussed:

- ❖ What are actuators?
- ❖ Types of actuators in both the macro and microscales.

# What are Actuators?



*Types of actuators: electric motor, gear train, screw jack*

*[Image of microgears courtesy of Sandia National Laboratories, SUMMiT(TM) Technologies, [www.mems.sandia.gov](http://www.mems.sandia.gov)]*

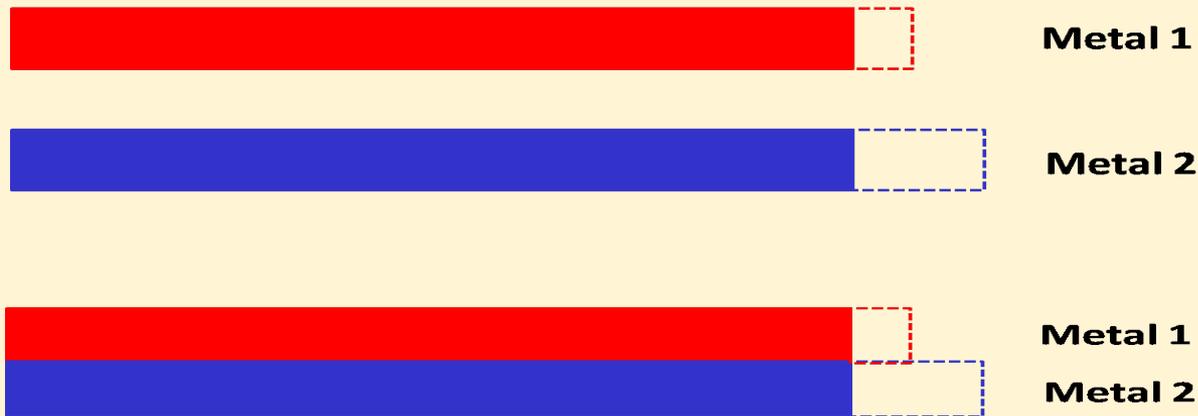
- ❖ An actuator actuates or moves something.
- ❖ An actuator uses some type of energy to provide motion or to apply a force.

# Types of Actuators

- ❖ Manual or mechanical
- ❖ Hydraulic/Pneumatic
- ❖ Thermal
- ❖ Electric

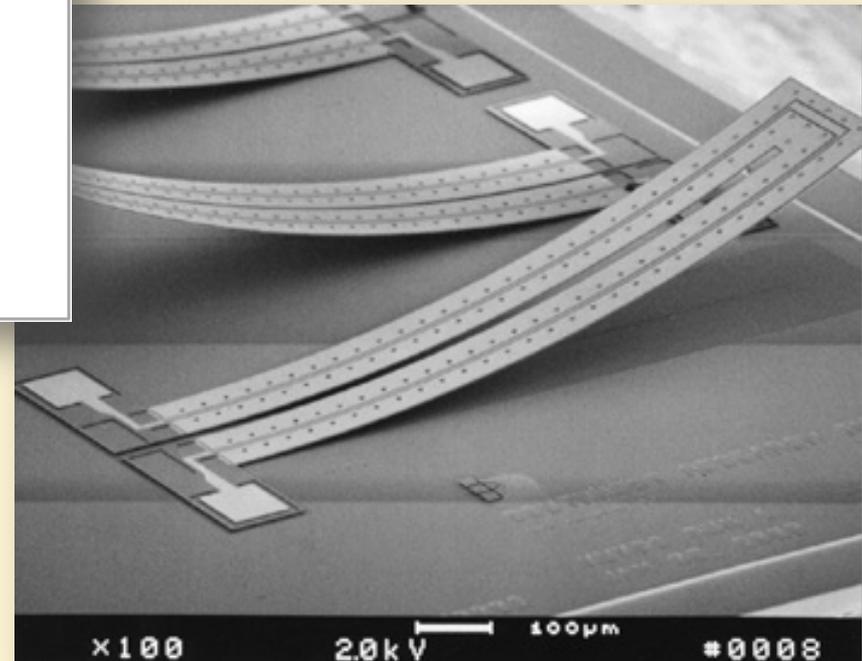
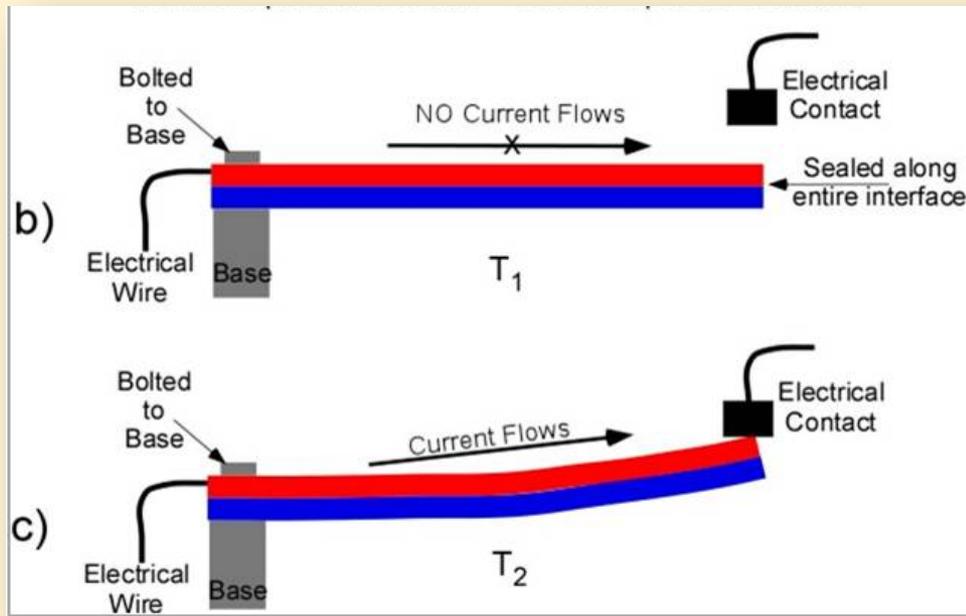
# Thermal Actuators

- ❖ Converts thermal energy into motion
- ❖ Utilizes an effect called thermal expansion.



If the joined metals are heated, in what direction will they bend – up or down?

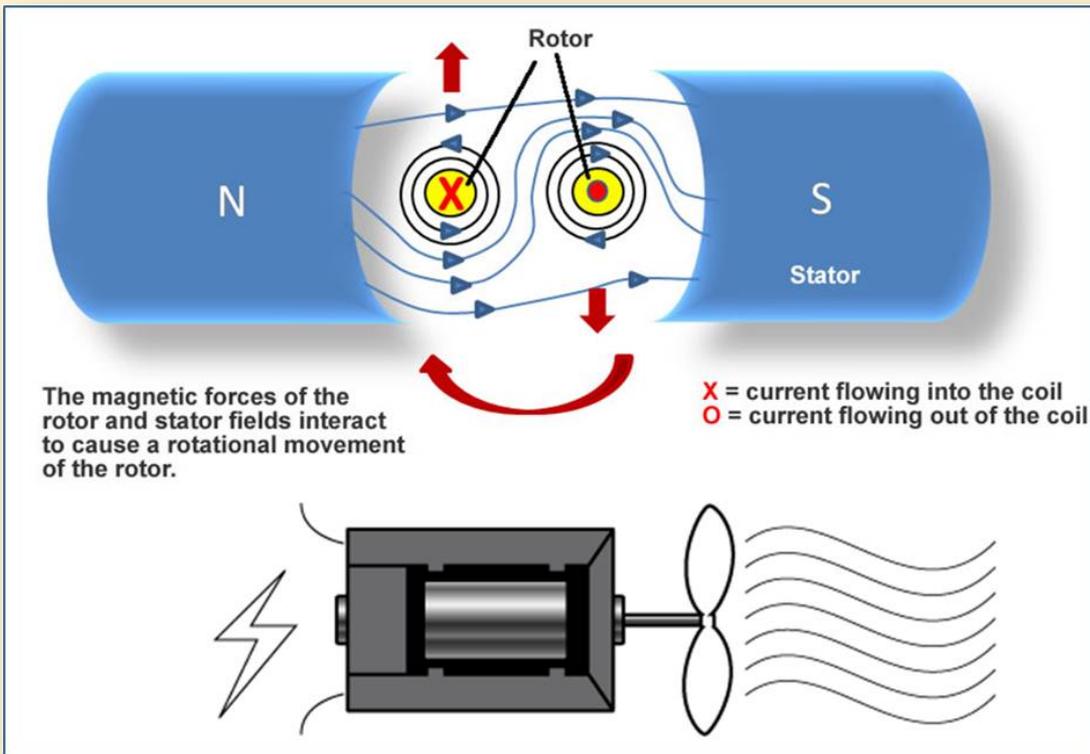
# Bimetallic Switch



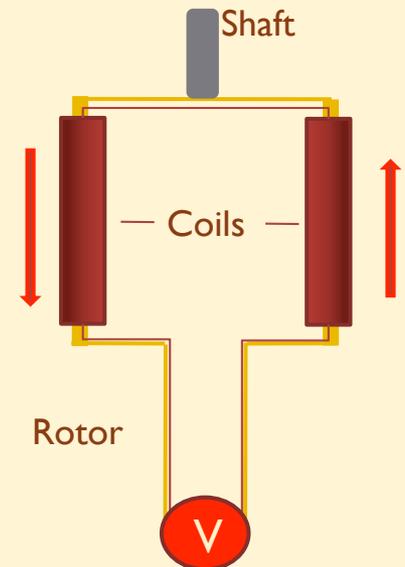
**Vertical Thermal Actuators**  
[Images courtesy of Southwest Research Institute.  
Copyright SwRI.]

# Electric Actuators

An electric motor is a transducer AND an actuator because it converts an electric current into a large magnetic field which then turns a shaft (mechanical energy).



*Schematics of an Electric Motor*



# Mechanical Actuators

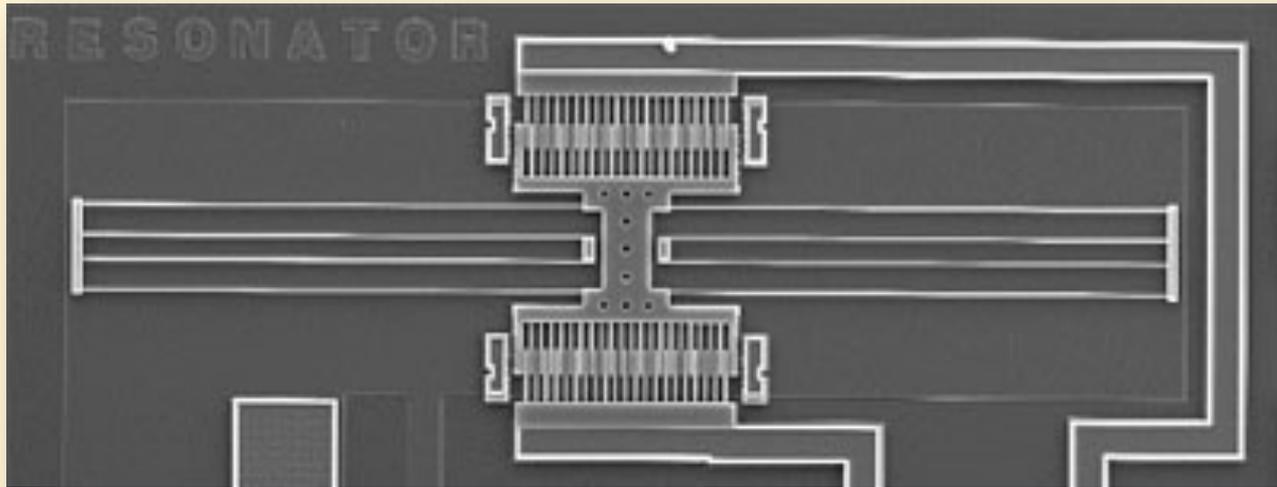
- ❖ Anything that requires a mechanical input and causes motion
- ❖ A Screw Jack is one example

*A screw jack converts rotational energy into linear motion*



# MEMS Actuators

- ❖ Electrostatic Comb drive
- ❖ Uses in resonators, microengines, gyroscopes



***SEM of a typical comb-drive resonator***

*[Courtesy of Sandia National Laboratories]*

# Questions

- ❖ *When was the last time that you “actuated” something?*
- ❖ *What did you do?*
- ❖ *What was the actuator?*
- ❖ *What was moved?*

# Summary

- ❖ An actuator is a device that converts energy into motion.
- ❖ Actuators can be thermal, electric, manual, or hydraulic/pneumatic.
- ❖ Actuators are found in both the macro and micro-scales.

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