BioMetal® Silent Arm Demo - #3-930

Section 1 - Introduction

The BioMetal Silent Arm Demo operates on an entirely unique principle – the contraction of a BioMetal shape memory alloy (SMA) actuator.

Just 100 µm (0.1 mm or 4 thousandths of an inch) in diameter, the BioMetal wire gives the Silent Arm a like life behavior when powered by its sound activated driver circuit.

When in operation the robot's bright top mounted LED lights up, and it moves smoothly, producing no noise.

Made from a nickel-titanium alloy, and highly processed for electrical activation and long life, the thin black thread-like BioMetal acts as an artificial muscle. When powered, the BioMetal contracts, moving the arm. When power turns off, the BioMetal quickly cools and the wire extends again to its longer, starting length, helped by two helical coil springs on the forearm and upper arm.

Note: The Silent Arm demonstrates the unique properties of BioMetal alloy, and provides visual enjoyment by its unique movements. The arm cannot grip or lift anything.

Caution: This product is not children's toy but a high-precision demonstration device. *Do not touch or handle the arm while in operation. Permanent damage or breakage of the BioMetal wire may result.*

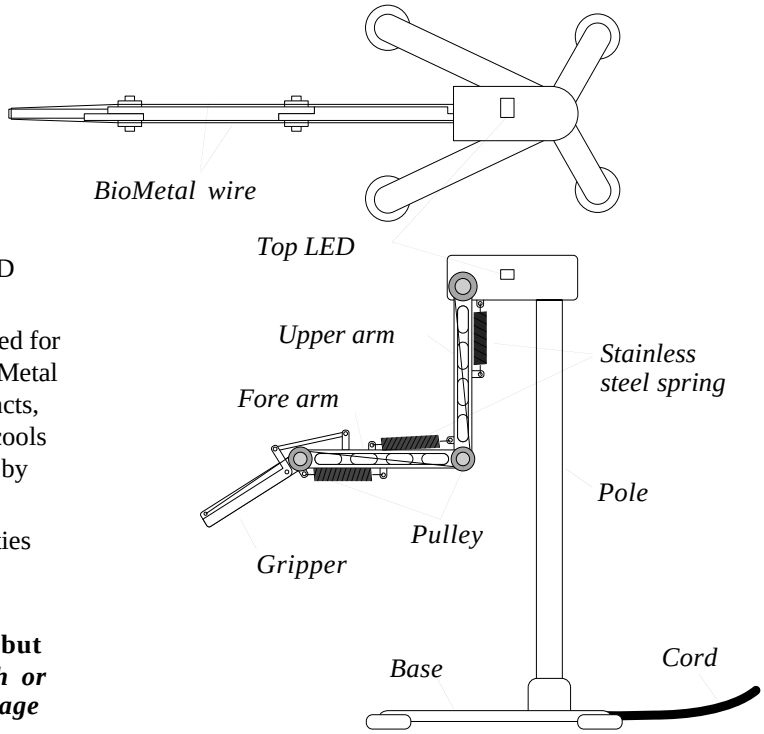


Fig. 1 – Parts of the Silent Arm Demo

Section 2 - Directions for Use

• Plug the Silent Arm and the AC adapter in the controller box, then plug the adapter into an AC wall outlet.

• The controller box has microphone that lets the Silent Arm detect and respond to changes in sound level like hand claps. One clap will cause the arm to move upward. Two claps close together will cause it to swing and the LED to blink. If the robot does not respond satisfactorily, change the position or orientation of the controller box so that the sound will reach it.

• Holding down the button on the top of the controller box manually activates the Silent Arm.

CAUTION: To prevent overheating and damage to the BioMetal, do not hold the button down for more than 10 seconds.

• When activated, current flows from the controller box to the Silent Arm and lights the bright LED on top of the Arm.

• The arm robot has been factory adjusted so as to react optimally at an ambient temperature of about 20 °C (typical room temperature), and as temperature falls the arm may react with less motion. Conversely, the Silent Arm may tend to overreact as the temperature rises. However, normal variations in environmental temperature do not pose a danger to the BioMetal wire.

Section 3 - Technical Information

Silent Arm Unit

Height: 105 mm
Arm length: 105 mm
Base size: 48 x 58 mm
Weight: 11 g (cord included)
Shoulder pulley: 3.5 mm diameter
Elbow pulley: 2.8 mm diameter
Gripper pulley: 2.3 mm diameter

BioMetal

Diameter: 100 µm (0.1 mm or 0.004 inches)
Length: 300 mm
Maximum tension: Approx. 100 grams force
Power: Input 8.2 V, 195 mA
(BioMetal: 180 mA, LED: 15 mA)
Plug: 2.5 mm diameter earphone plug, center positive
Lifetime: >100,000 cycles under no load conditions

Controller Box

Output: 9 VDC, 2.5 mm diameter earphone plug, center positive. Input: 9 VDC, 300 mA, center positive plug
Current: 240 mA maximum (with a current limiting circuit)

Precautions

• *This product is not children's toy but a high-precision hobby robot. Do not touch or handle the Silent Arm while in operation. Permanent damage or breakage of the BioMetal wire may result.*

• *The Silent Arm demonstrates the unique properties of BioMetal alloy, and provides visual enjoyment by its unique movements. It is not capable of gripping or lifting anything.*

• The arm robot consists of small parts. Keep it out of the reach of children.

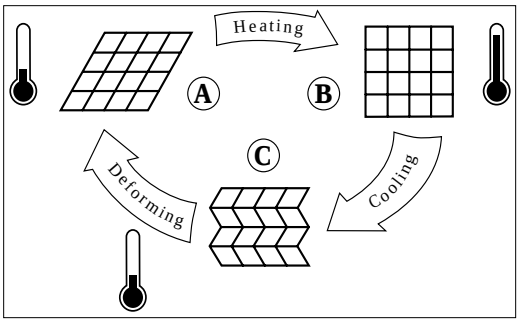
• Applying a voltage higher than the rated value to the arm robot or controller may cause it to fail or sustain damage. In particular, the BioMetal may become damaged by overheating.

• BioMetal heats to 70 °C or higher during operation under normal conditions, but the heat is not generally felt even by touch because it is thin and low in thermal conductivity. However, use care to not touch it while the robot is in operation. To prevent accidents, do not bring a heat-sensitive or flammable material into direct contact with the BioMetal.

• This product should not be modified, or have component parts replaced. Doing so voids the warranty.

• BioMetal Silent Arm Demo designed by Toki Corporation, Tokyo, Japan, and produced in limited production runs. Specifications are subject to change without prior notice.

Section 4 - About Muscle Wires®



Muscle Wires like BioMetal belong to the class of metals known as Shape Memory Alloys (SMAs) having crystal structures that can assume different shapes at distinct temperatures. At low temperatures (part C at right), Muscle Wires can be easily stretched (to A), then when heated they return to their original shape with a usable force and speed (part B).

In 1932 Swedish researcher Arne Ölander first observed the shape recovery abilities of a gold-cadmium alloy, and noted its potential for creating motion. In 1950, L.C. Chang and T.A. Read, at Columbia University in New York, used X-rays to study the alloy and to understand the phase changes of its crystal structure.

In 1961, while searching for non-corrosive marine alloys, a team led by William Beuhler at the U.S. Naval Ordnance Laboratory (NOL) found the shape memory effect in an alloy of nickel and titanium. They named the alloy *nitinol* (pronounced “night in all”), an acronym of Nickel, Titanium and NOL. On disclosure of their observations their discovery generated much interest.

During the 1960’s and 70’s researchers worldwide observed the shape memory effect in various titanium, copper, iron and gold alloys. NASA studied SMAs for applications such as satellite antennas that would expand from the heat of the sun, and other experimenters developed a variety of engines that operated on hot and cold water. Universities and companies researched SMAs, and some commercial applications resulted. Among the most successful applications, Raychem Corporation introduced a line of SMA pipe connectors that would shrink to fit and provide highly reliable seals for jet engines and hydraulic systems.

In 1986 China hosted the International Symposium on SMAs which saw the presentation of seventy eight papers from fourteen countries. Topics included basic alloy research and development, crystal structures, medical applications, product designs, and manufacturing studies. SMAs have since found uses in a wide range of fields including medical, industrial, consumer and aerospace.

Nitinol alloys contains nearly equal amounts of nickel and titanium. Differences of less than one percent can change the transition temperatures by as much as 150°C. Therefore the materials require very careful formulation and processing. The manufacturer measures the component metals, then melts them together. The cast material is cooled, then rolled and formed into the desired shape. Nitinol’s hardness (greater than some steels), and its shape change abilities makes processing difficult and more expensive than similar non-memory metals.

When drawn into wires, Nitinol can be easily heated by an electric current, and with additional processing, as with Muscle Wire, the wires can contract and relax for millions of cycles. SMA wires function like electric muscles, and could contribute to robotic and prosthetic devices that would be difficult to make using other methods.

Around the world, interest in Shape Memory Alloys continues to grow, and many frontiers await exploration. We hope this product brings you hours of educational fun, and leads you to new and interesting discoveries of your own. For more information, see our “Muscle Wires Project Book”. Explore amazing new devices from simple levers to complete motorless miniature walking robots. It includes fifteen fascinating hand-on projects, circuits, devices, history, references, software listings and essential secrets for maximum performance. You can find current product and technical information at MuscleWires.com.

Contact Us:

Mondo-tronics. Inc.
124 Paul Drive #12
San Rafael, CA 94903

Phone 415-491-4600
Fax 415-491-4696

Web http://www.MuscleWires.com
Email support@MuscleWires.com

Comments? Errors? Improvements? Compliments?
Help us make this product better with your feedback. We want to hear from you!
Email us: support@MuscleWires.com