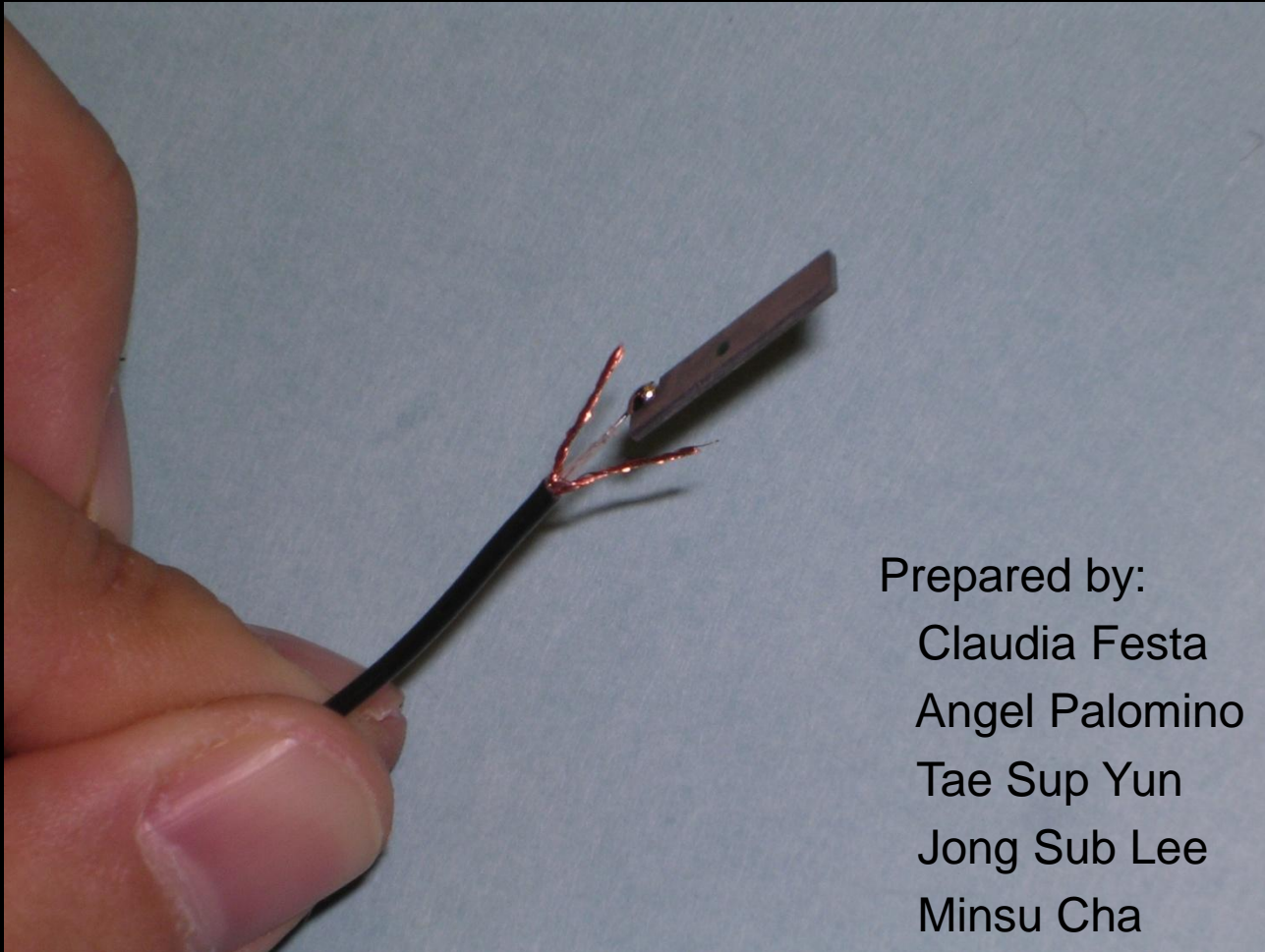


*simple procedure for the*

# ASSEMBLY OF BENDER ELEMENTS



Prepared by:

Claudia Festa

Angel Palomino

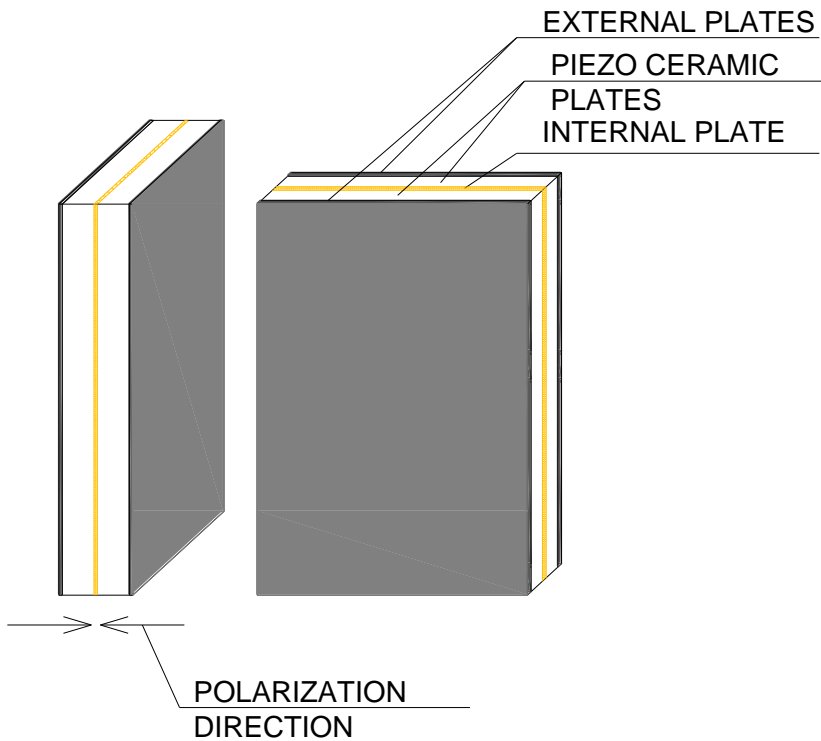
Tae Sup Yun

Jong Sub Lee

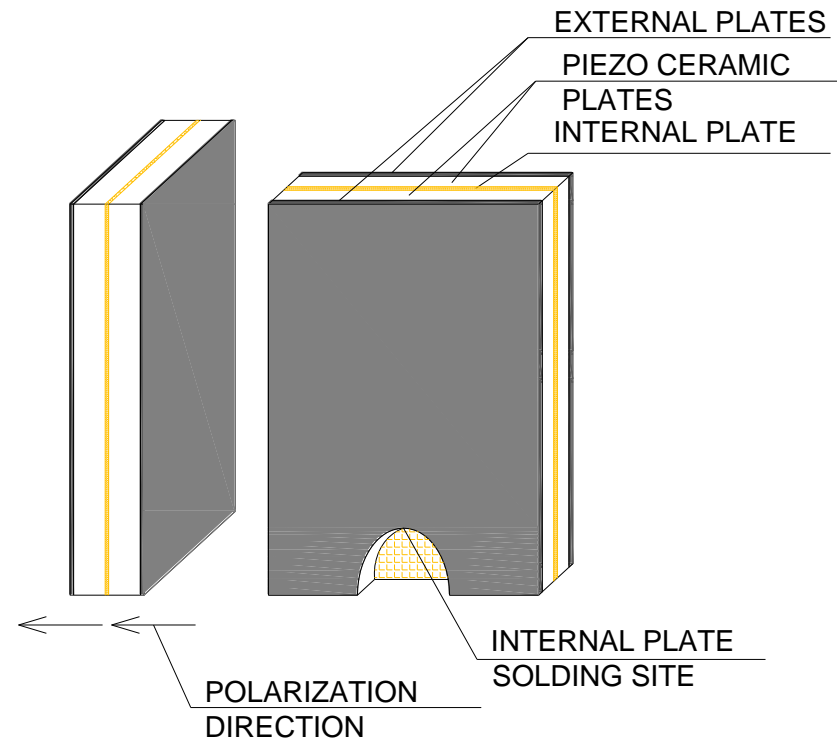
Minsu Cha

# Bender element types

## SERIES TYPE



## PARALLEL TYPE



# Devices and materials

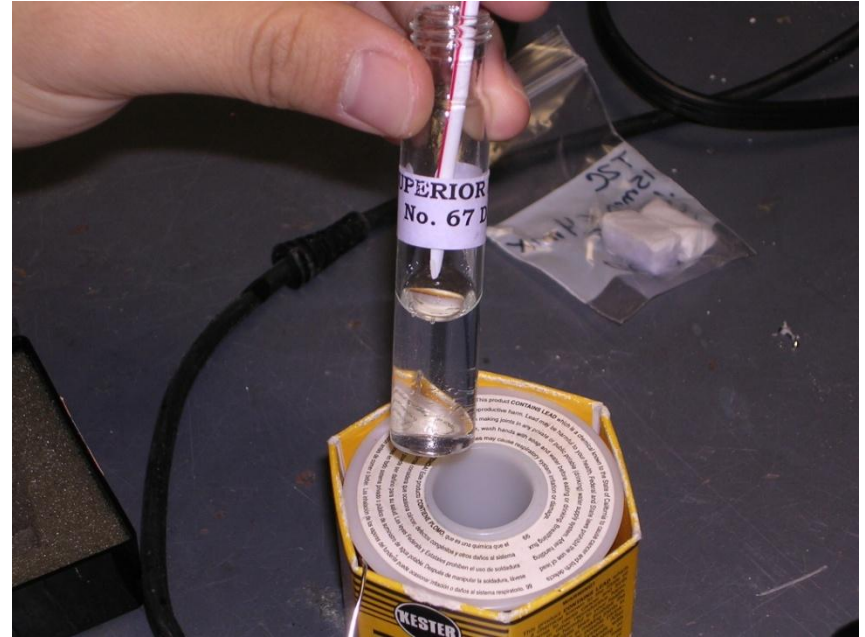
1. Soldering iron and accessories
2. Soldering flux
3. Coaxial cable
4. Epoxy
5. Multimeter
6. Silver conductive paint
7. Heat-shrink tubing
8. Nylon flat point socket screw
9. Polyurethane



# Preparation



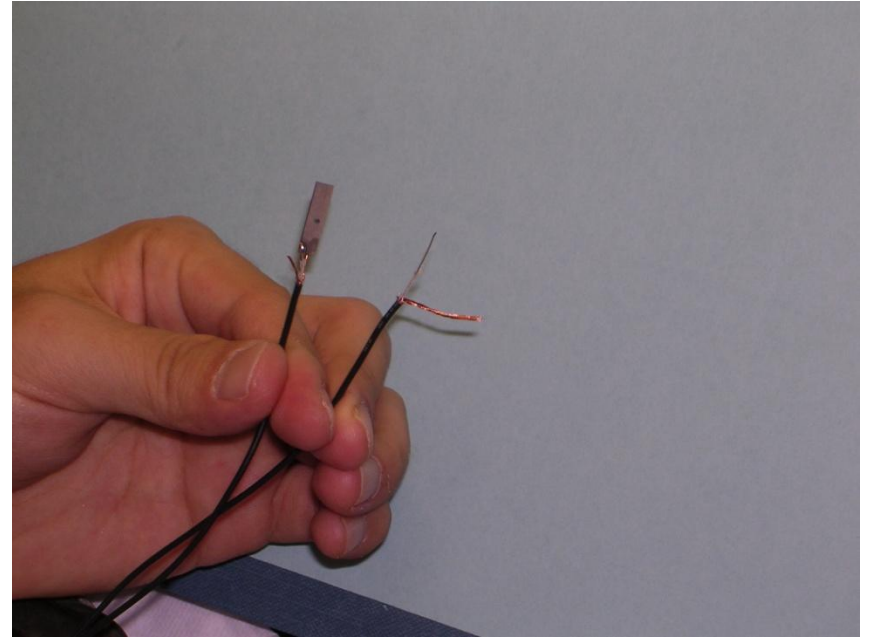
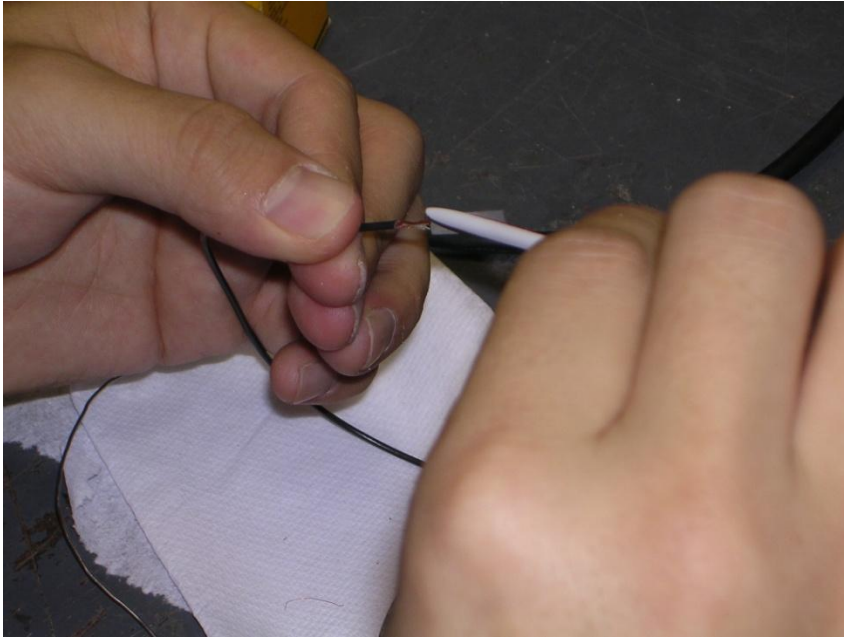
Remove outer shield from one end of coaxial cable. Separate the inner core from the copper mesh. Remove the end of inner core shield. If making a parallel BE, divide the copper mesh into two branches.



Coat the ends of the cable and the BE with soldering flux.

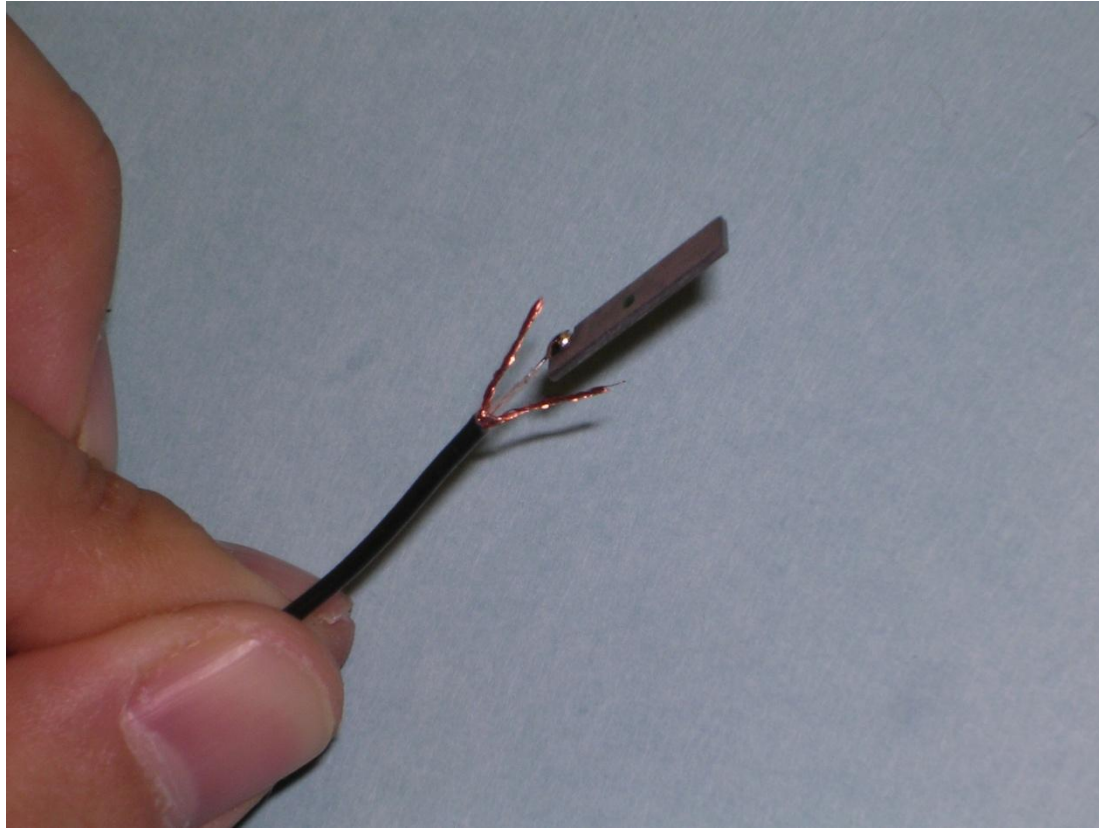


# Preparation



If making a series type BE, solder the core to one external plate and the copper mesh to the other one.

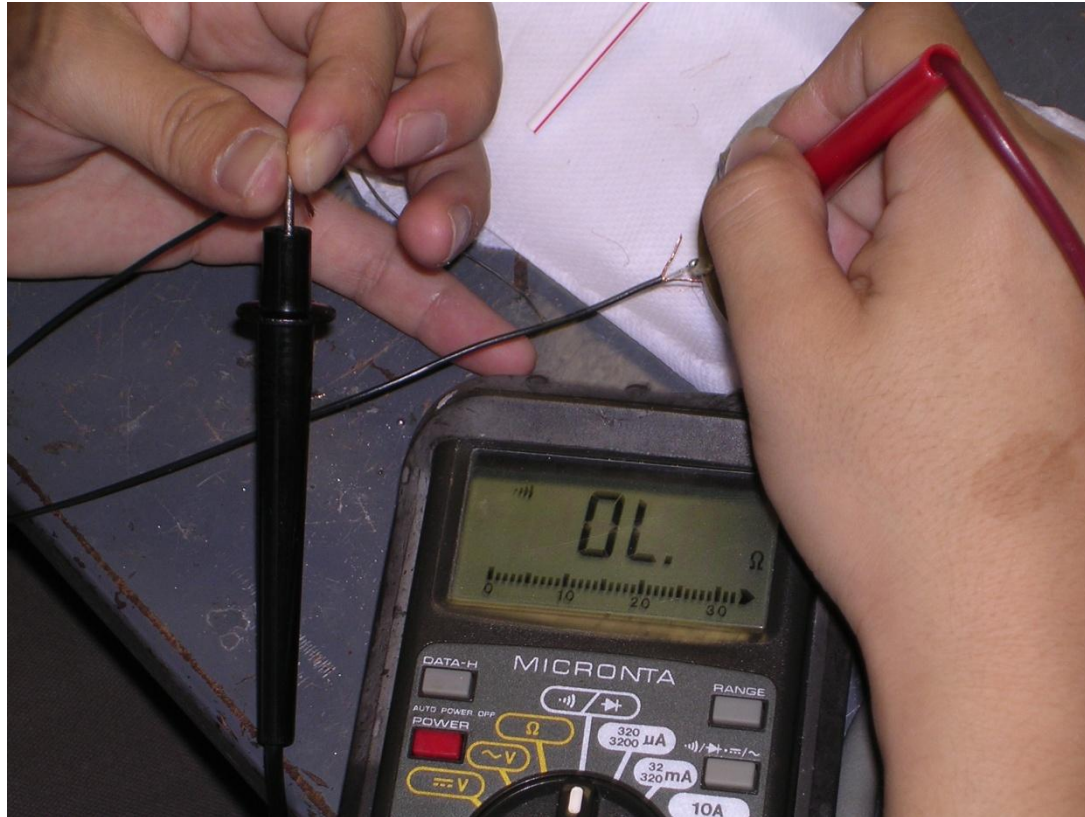
# Preparation



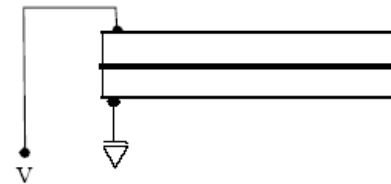
If making a parallel BE, solder the core of the cable to the BE internal plate.

**Caution:** The core/soldering metal should not touch the external plates. Solder the two copper branches to the external plates.

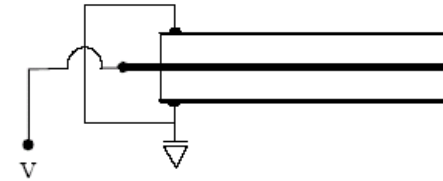
# Check connections



SERIES  
TYPE

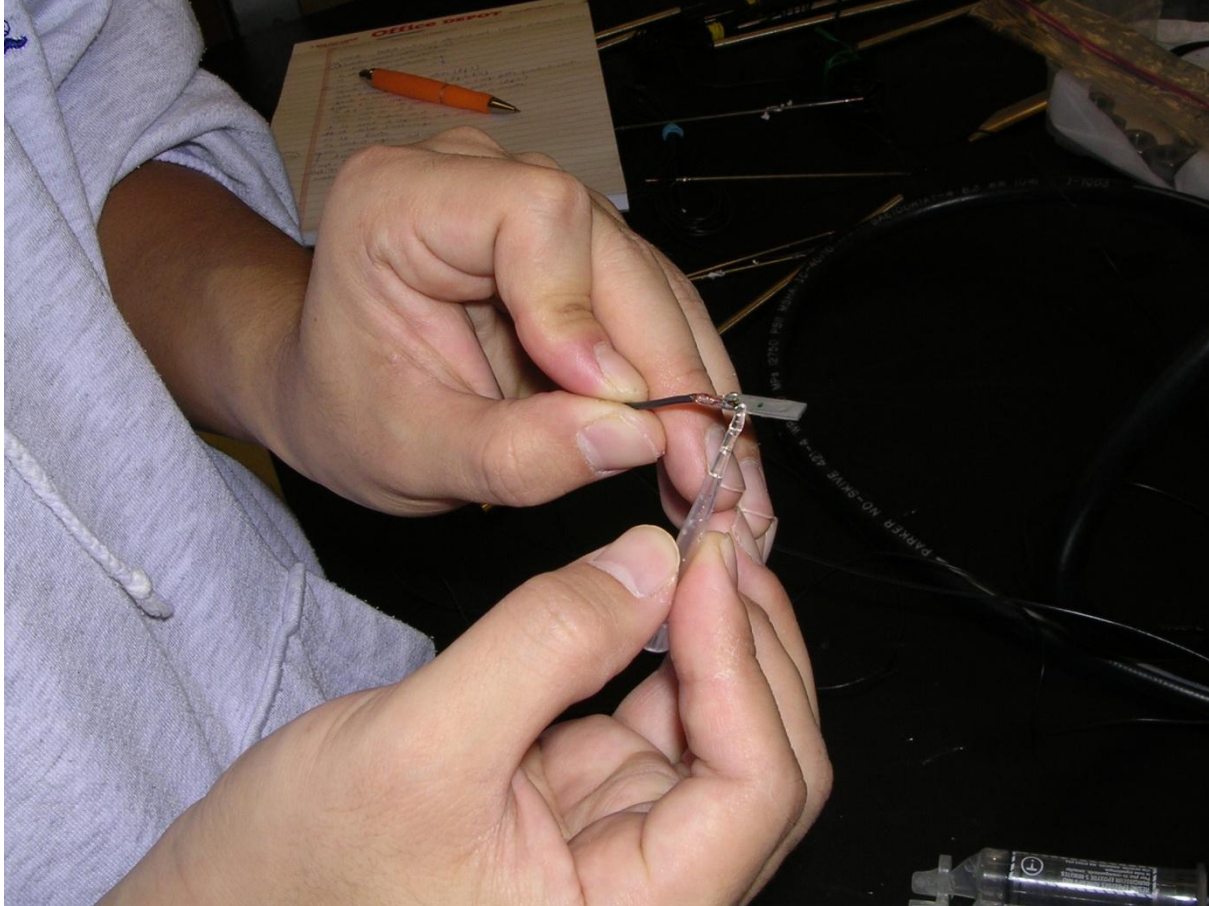


PARALLEL  
TYPE



Check the circuits with a multimeter.  
The core-to-shield resistance must be infinite (open circuit).

# Coating



Water-proof the BE by coating the BE and the exposed portion of the cables with low viscosity polyurethane. Be sure to coat all BE faces, including the edges. Allow the polyurethane to dry with the BE in the upright position. A second coat may be applied if needed.

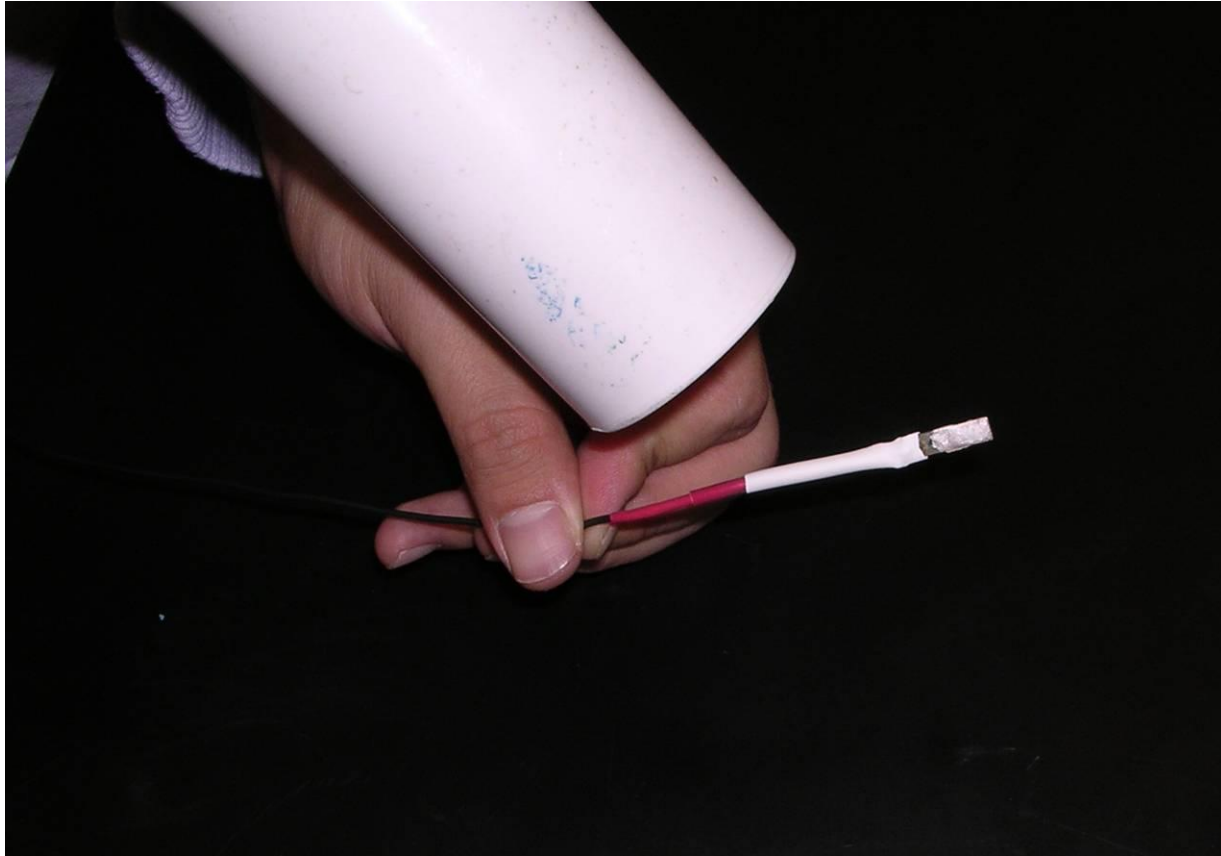


# Electric shield



An electric shield is needed to prevent cross talk phenomena (critical in wet soils – Parallel bender elements are “self-grounded”). Spread a layer of silver conductive paint over the surfaces of the coated bender element. The conductive paint must contact the shield in the coaxial cable, i.e., ground.

# Cable reinforcement



Reinforce the connections using heat-shrink tubing. Shrink the tube using a hair dryer. May use more than one shrink-tube layers.

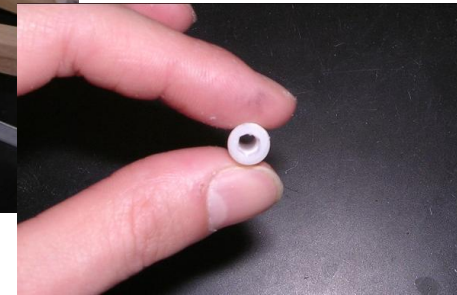
# Housing in nylon socket screw: 1-drill



Nylon screw

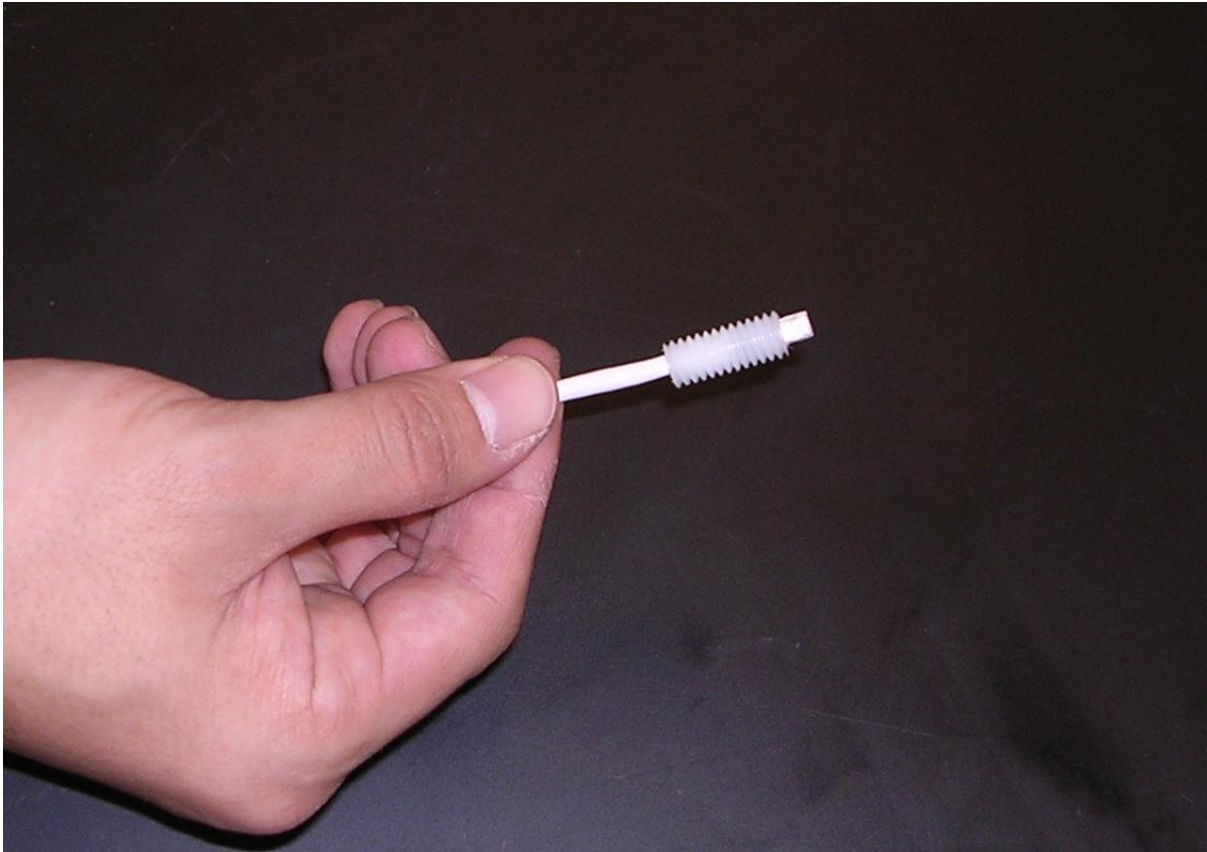


Drilled Nylon screw



Take a nylon socket screw and make a hole through its center with a drill

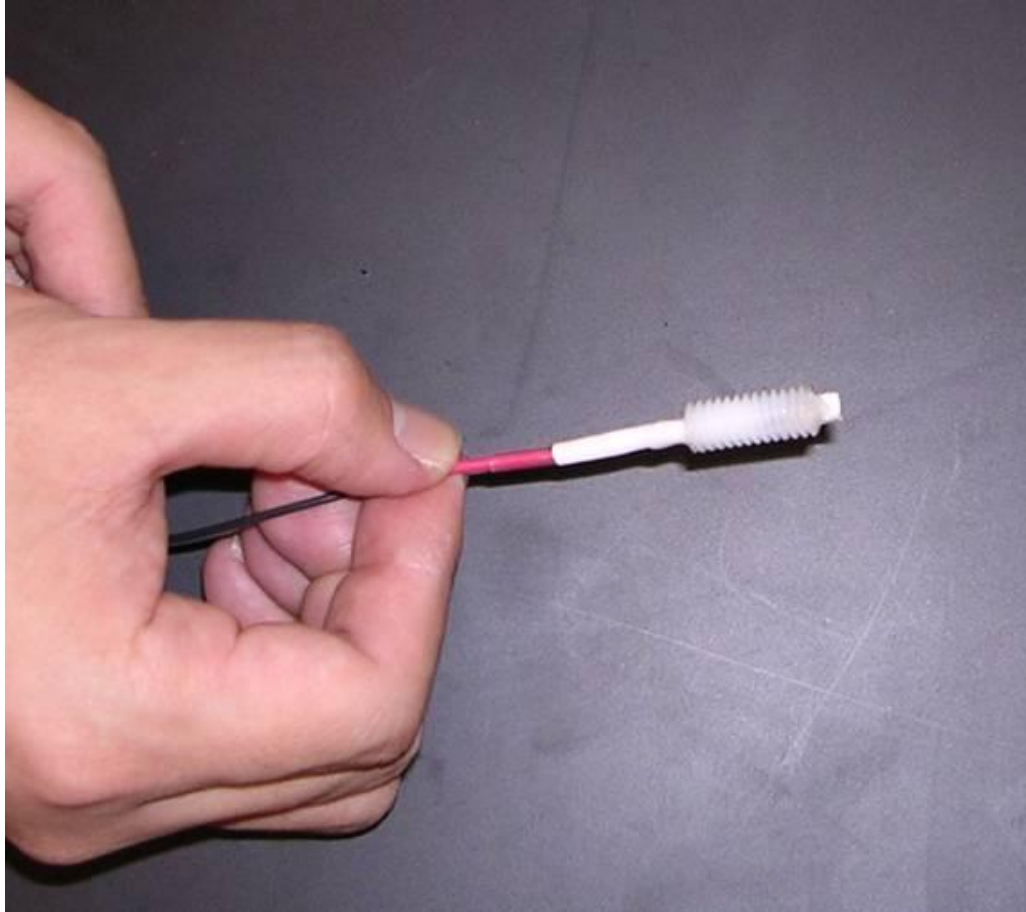
# Housing in nylon socket screw: 2-fix



Slide the BE into the hole inside the nylon screw.  
Fill in the air gap between the BE assembly and the screw with epoxy.



# Done !



The BE assembly is ready for use once the epoxy has cured.  
The threaded nylon screw housing can be conveniently installed in any geotechnical cell, and easily replaced in case of malfunction.

# Components and Possible Vendors

Specifications may vary and there are many possible vendors  
This list reflects our most recent purchases

## Piezoelectric transducer

APC [www.americanpiezo.com](http://www.americanpiezo.com)

PIEZO SYSTEMS, INC. [www.piezo.com](http://www.piezo.com)

PIEZOTECHNOLOGY [www.piceramic.com](http://www.piceramic.com)

Parallel type recommended (lower cross-talk, self-shielding)

## Coaxial cable

We use the small diameter BELDEN - 8700 010250

Many possible vendors (e.g., [www.newark.com](http://www.newark.com))

## Solder & Flux Kit

PIEZO SYSTEMS, INC. [www.piezo.com](http://www.piezo.com)

Solder & Flux Kit (For Nickel Electrodes)

Part Numbers: MSF-003-NI

## Polyurethane (moisture protection)

Vishay Micro-Measurements

M-COAT A POLYURETHANE

## Silver paint (electrical shielding and grounding)

SPI Supplies [www.2spi.com](http://www.2spi.com)

Description: SPI #: 05001-AB Ag-Colloidal Suspension

Thinner: SPI #: 05004-AB

## Nylon screw (to mount bender elements)

McMaster.com

Nylon Flat Point Socket Set Screw 5/8"-11 Thread, 1" Length

Part Number: 94564A615

## Epoxy (to anchor bender element)

LOCTITE Professional Heavy Duty Epoxy 5 Min.

Devcon High Strength 5 Minute Epoxy

## Shrink tube (to reinforce cables near connections)

Flexible Polyolefin Heat-Shrink Tubing 3/32" ID Before, 3/64" ID After, 4' L, Black

McMaster.com Part Number: 7856K121