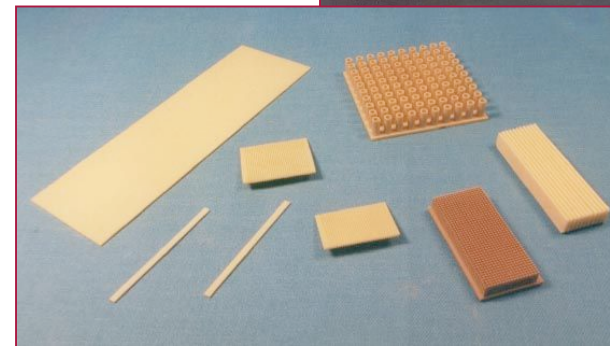
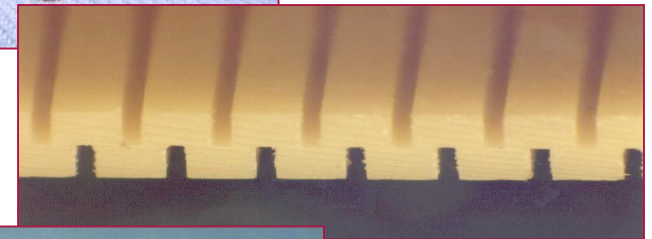
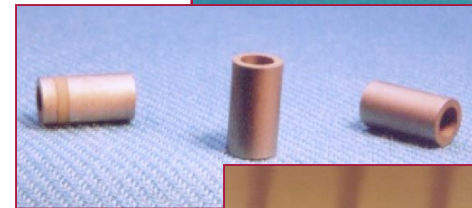
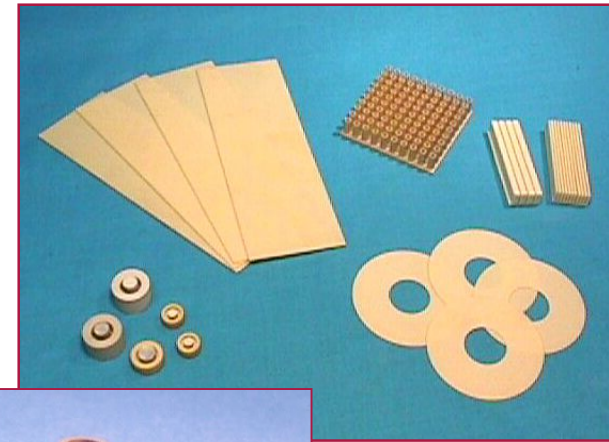


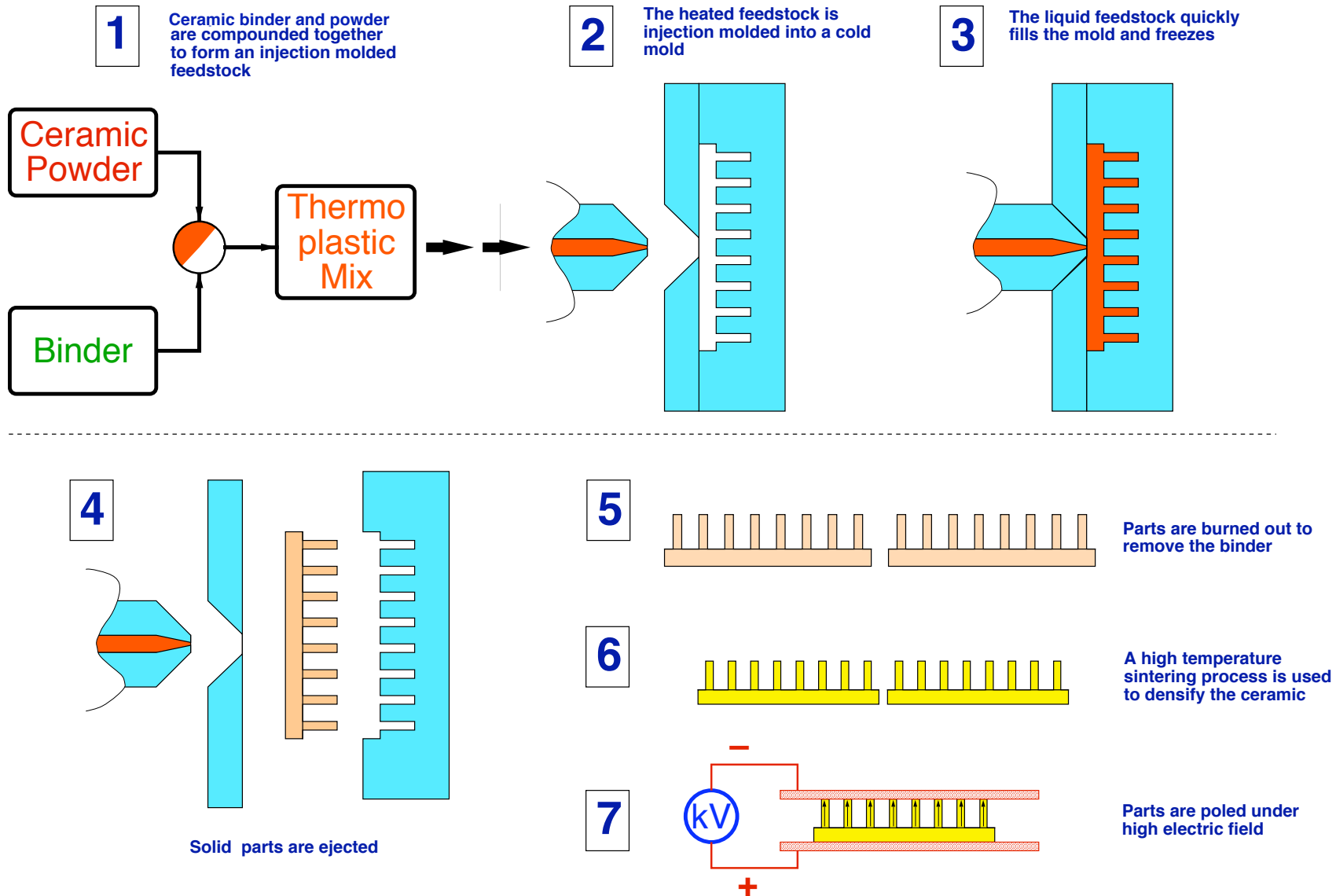
# ***MSI's Ceramic Injection Molding and Piezocomposite Fabrication Process***

## Injection Molded Piezoelectric Ceramics

- **Simple or Complex Shapes**
  - flat plates, tubes, serpentine structures, strip arrays
- **Wide Dimension Range**
  - feature sizes as small as  $150\mu\text{m}$
  - plate to  $< 50\mu\text{m}$  thickness
- **Excellent Dimensional Control and Reproducibility**
- **Net Shape Formed**
  - minimal machining requirement  
reduces subsequent assembly costs
- **Production or Prototype Quantities**

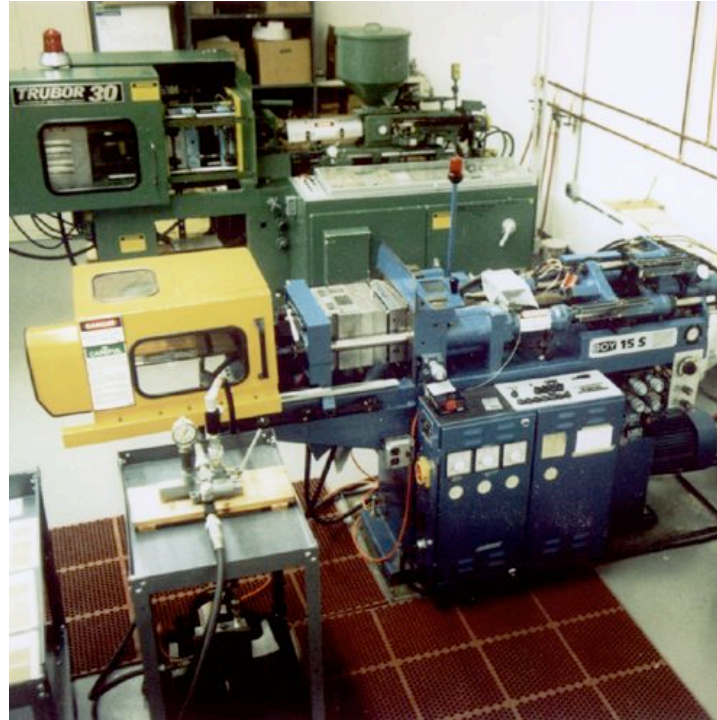


## MSI's Injection Molding Process Was Adapted From the Plastics Industry (U.S. Patent #5,340,510)



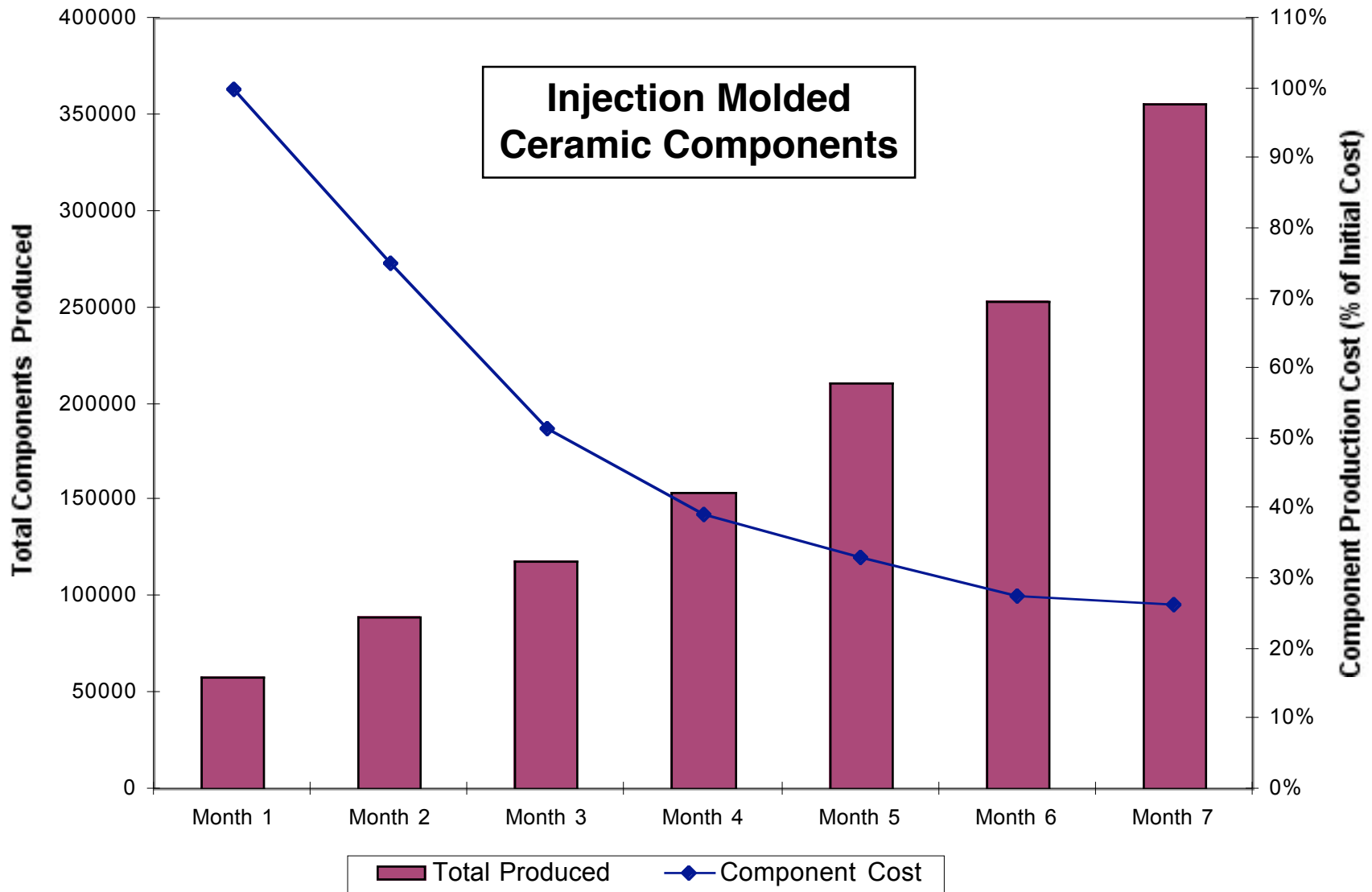
**High Volume Manufacturing  
Provides You with the Highest Performance  
Transducer at a Competitive Cost**

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**MSI developed ceramic injection molding of Piezoelectric Ceramic in the mid 1990's to address the U.S. Navy's need for low cost, large area hydrophones**

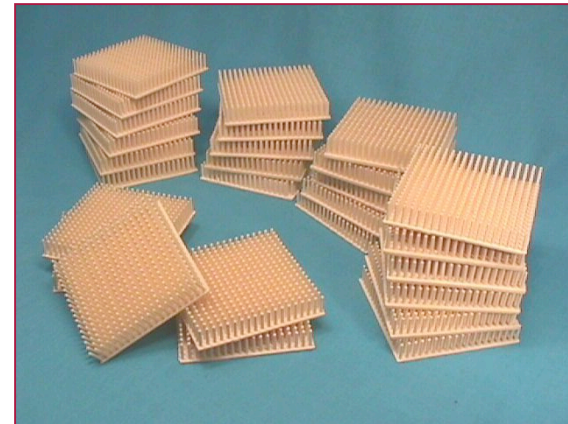
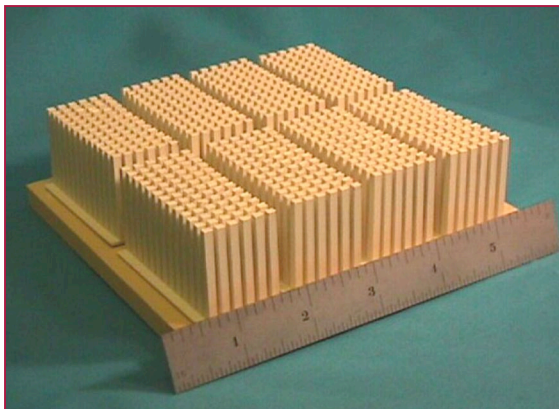
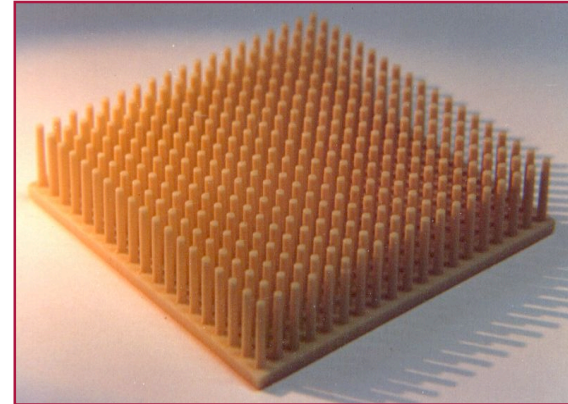
## MSI Has Demonstrated Manufacturing Experience



## Piezocomposite Injection Molding has Many Advantages over Conventional Ceramics Processing

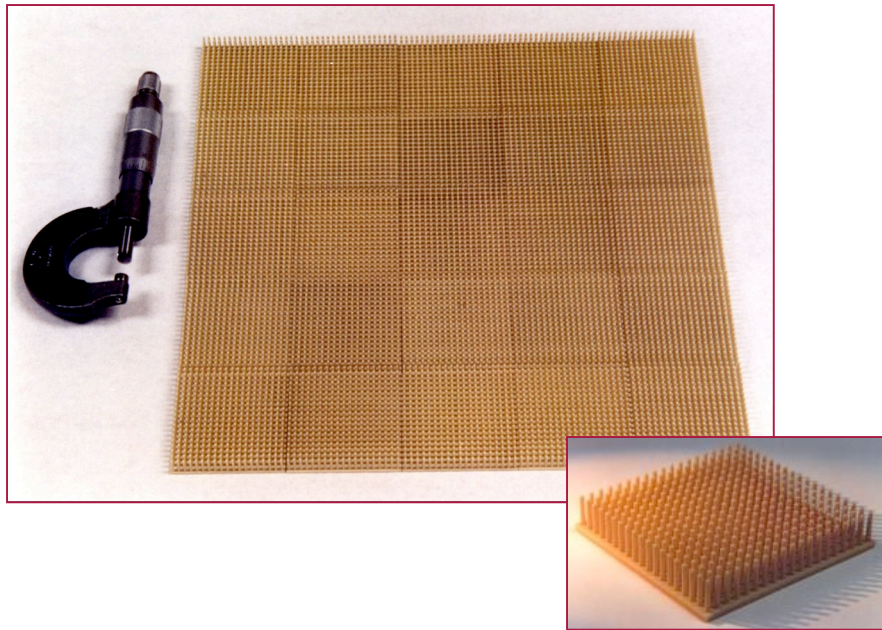
### Piezoelectric Ceramic Injection Molding

- **Complex Ceramic Shapes**
- **High Manufacturing Rate (>1 per minute)**
- **No Post-processing Machining**
- **Excellent Dimensional Uniformity**
- **Excellent Piezoelectric Uniformity**

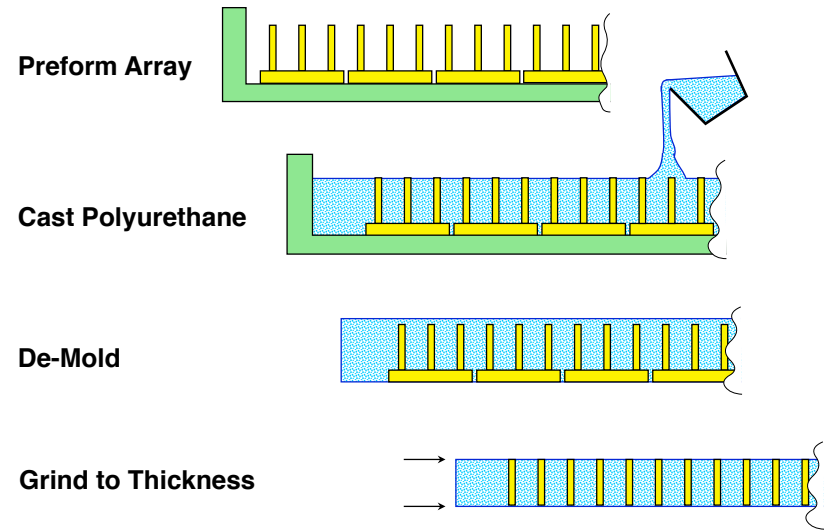


# Modular Manufacturing Process Allows Many Sizes and Complex Shapes of Piezocomposite to be Made from a Single Material

## 1-3 Ceramic Preform Lay-up



## 1-3 Fabrication Steps



*One common commercial off-the-shelf part ... many applications*