# Next Generation Molding Technologies

CENTER FOR ENERGETIC CONCEPTS DEVELOPMENT

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## Injection Molding Using Multi-Piece Permanent Molds: Space Puzzle Molds

- Enable Manufacturing of Geometrically Complex Objects
  - » Objects that are impossible to make using traditional two-piece molds
  - » Applications: automobile parts, consumer appliance housings
- Current Research Thrust
  - » Development of design for manufacturing guidelines for parts being produced using space puzzle molds
    - – draft angles, section dimensions, tolerances
  - » Development of geometric reasoning algorithms for automated design of multi-piece permanent molds
    - – disassembly-based spatial partitioning

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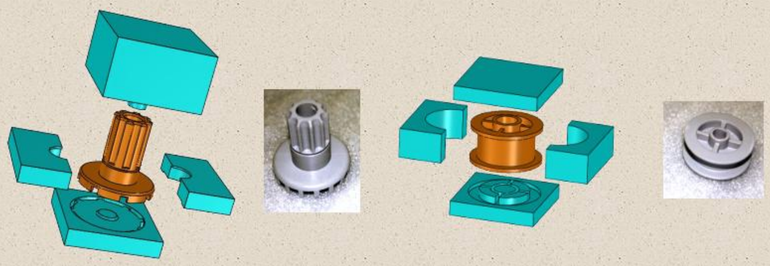
## Examples of Multi-Piece Permanent Mold



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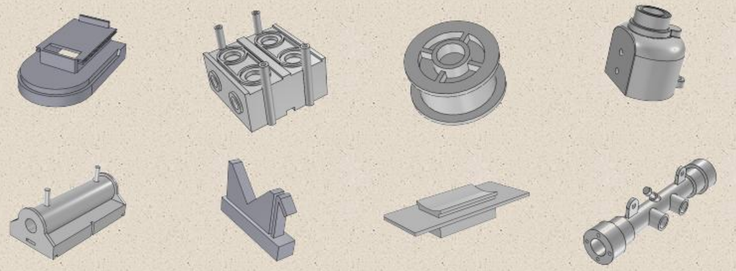
## Examples of Objects Produced Using Permanent Multi-Piece Molds



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## Low Temperature Molding Using Multi-Piece Sacrificial Molds

- Enable Manufacturing of Geometrically Complex Objects
  - » Objects that are impossible to make using permanent molding processes due to demolding problems
    - – gelcasting of complex ceramic parts
  - » Applications: ceramic housing, heat exchangers, turbine parts
- Current Research Thrust
  - » Development of a molding process that combines CNC machining and layered fabrication for mold fabrication
    - – large objects with very small features
    - – low cost molds
  - » Development of geometric reasoning algorithms for automated design of multi-piece sacrificial molds
    - – accessibility and process driven spatial partitioning

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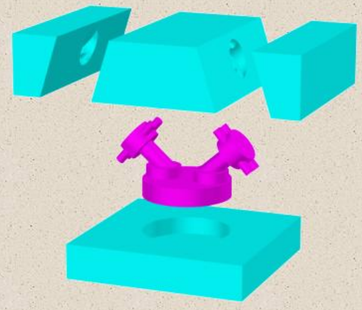
## An Example of Sacrificial Multi-Piece Mold



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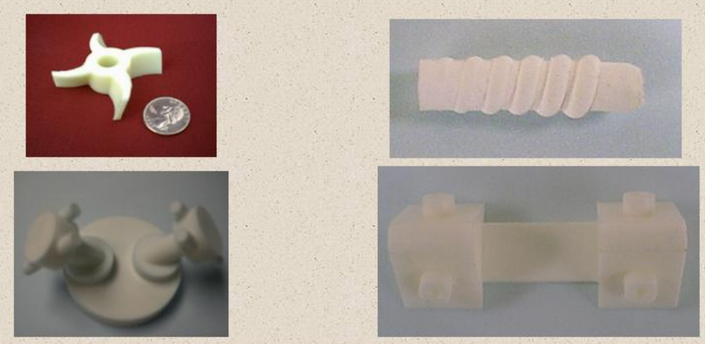
## Examples of Objects Produced Using Sacrificial Multi-Piece Molds



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## Multi-Stage Molds for Producing Multi-Material Objects

- Enable Manufacturing of Multi-Material Objects
  - » Difference in compliance, color, and hardness can be utilized to create products with superior performance
    - – in-mold assembly: no assembly operations are needed afterwards
  - » Applications: automobile parts, toys, consumer products, articulated mechanisms
- Current Research Thrust
  - » Development of a new multi-stage molding process for providing geometrically complex interfaces
    - – combination of chemical, macroscopic, and mesoscopic interfaces
    - – articulated assemblies
  - » Development of geometric reasoning algorithms for automated design of multi-stage molds
    - – disassembly and assembly driven spatial partitioning

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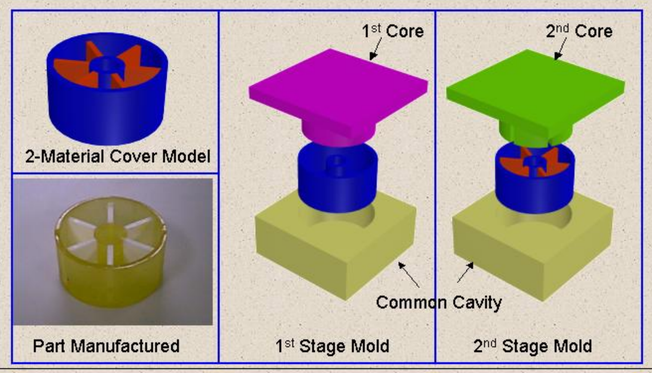
## An Example of Multi-Stage Mold

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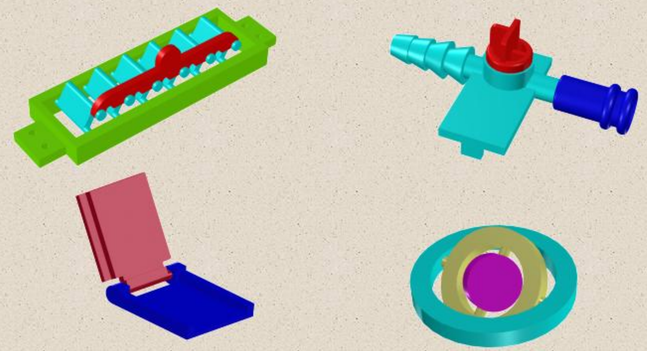
## Example of Objects Produced Using Multi-Stage Molding



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