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ID 87’

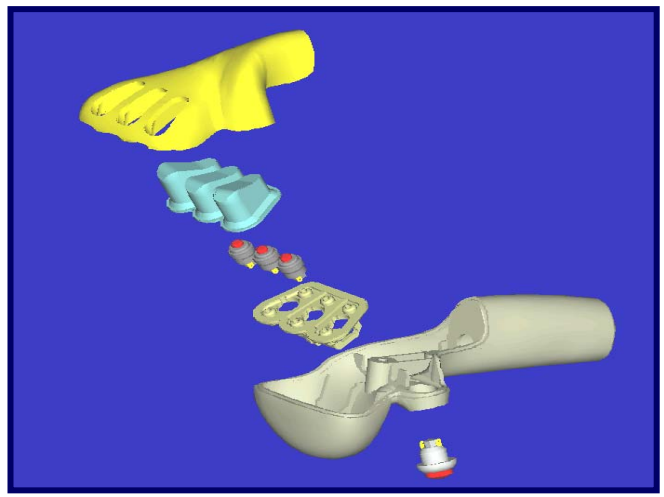
Prototyping Overview

Prototyping
for Mechanical Parts

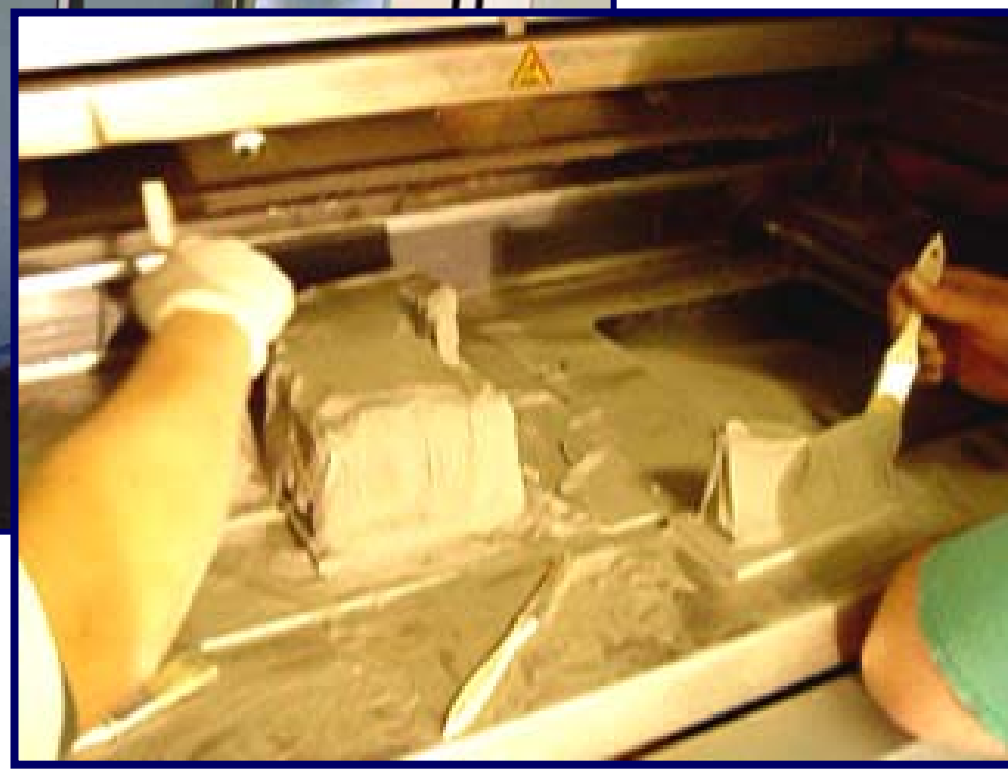
Paramount Industries

Started as prototyping vendor, then added:

- Industrial Design
- Product Engineering
- Product verification
- Breadboard models
- Computer Animations
- Graphic Design



Rapid Prototyping Chart- 3D data required	Common uses	Material Description	Cost for Ball Tray	Delivery for Ball Tray	Tolerance	Layer height	Surface scale 1-4 fine to coarse
SLA							
Stereo Lithography Apparatus		liquid photopolymer				0.002- 0.005	
standard	appearance models, casting masters	rigid	$300	2 days	+/-.002 +/-.005	0.005	1
flex resin	more durable appearance models	flexible	$300	2 days	+/-.002 +/-.005	0.005	1
SLS							
Selective Laser Sintering		thermoplastic powder					
Nylon	living hinges, snap fits, functional models	nylon, polyamide	$250	2 days	+/-.007	0.004	2
Glass Filled Nylon	extremely durable	33% glass filled	$250	2 days	+/-.007	0.004	2
Somos, elastomeric	soft touch parts	like Santoprene	$200	2 days	+/-.007	0.004	2
Castform	investment cast masters	styrene/wax	$300	4 days	+/-.007	0.004	2
FDM,							
Fuse Deposition Modeling		modeling filament					
ABS	replicate ABS	thermoplastic	$250	2days	+/-.005 +/-.010	0.005 - 0.016	4
Polycarbonate	replicate PolyCarb	thermoplastic	$250	2 days	+/-.005 +/-.010	0.01	4
ZCorp	form study models, colors available	starch	$150	2 days	+/-.005 +/-.010	0.003 - 0.010	3

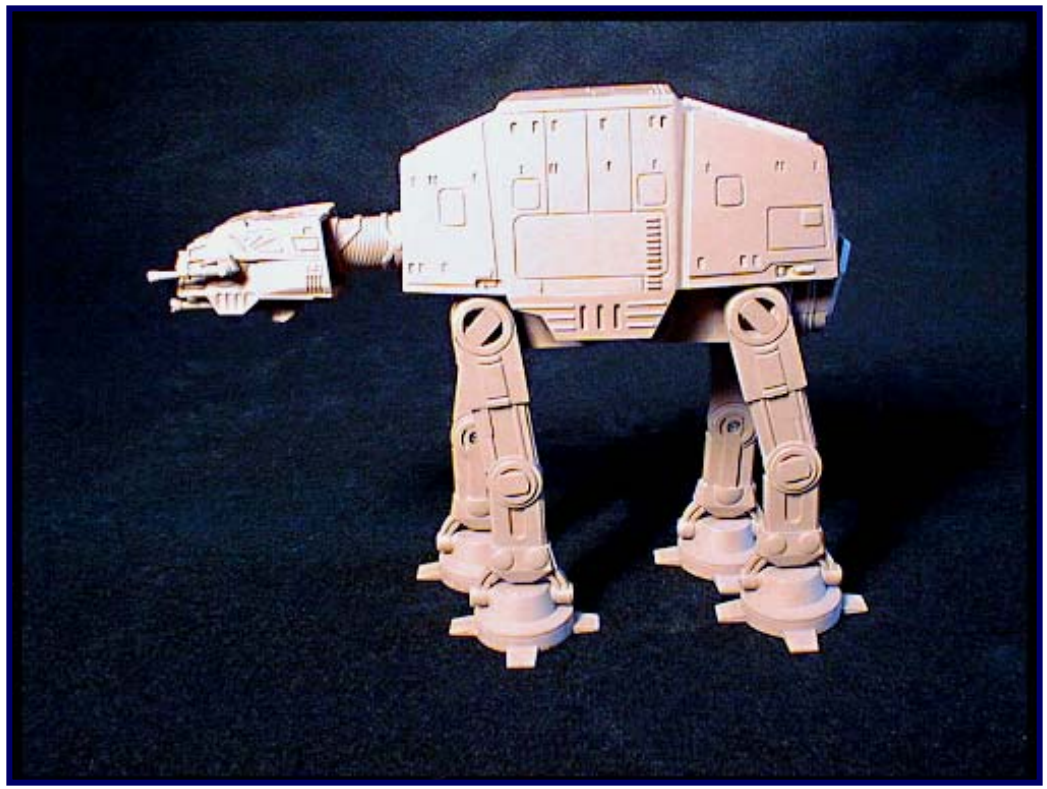


Rapid Prototyping- SLS

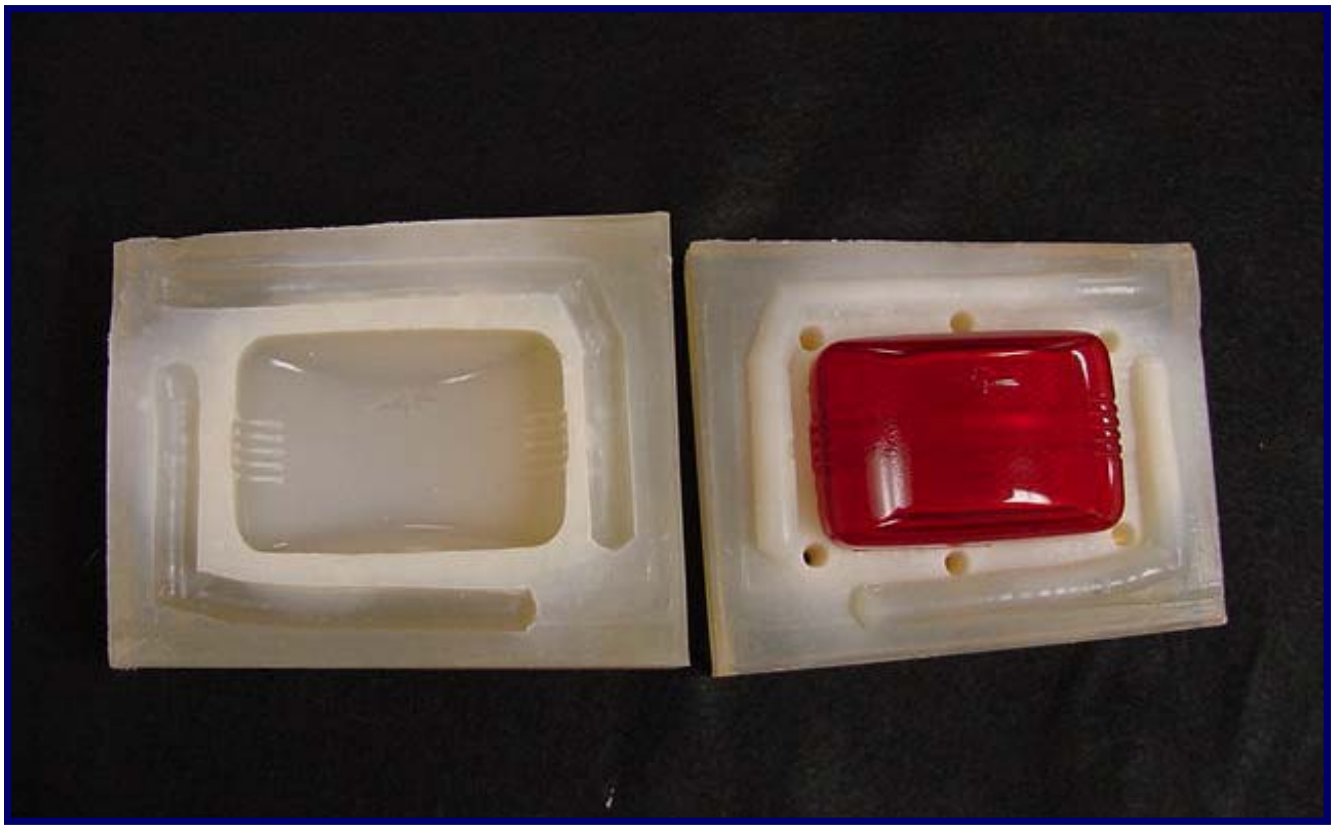
Other Prototyping Methods	Common uses	Benefits	Input/ Process	Delivery	Tolerance	Material characteristics	Quantities
Fabrication							
hand made models	form study models, wax models, breadboard models, LooksLike/WorksLike models	achieve geometry too complex for 3D CAD, multiple materials	napkin sketch to part drawings	complexity dependant	as needed	limitless	1-5
Urethane Castings							
Silicone RTV Molds, cast urethane resins	sales samples, LL/WL models,	replicates production, fast, inexpensive, color	pattern/ cast silicone	1-2 weeks	+/- .001-.100 in/in	rigid, flexible, clear, hollow, insert and co-molding, production *like* materials	10 - <50
Thermoforming							
Sheet thermoplastics	wall thickness housings, blister packaging	quick, molds and produce many parts	pattern or mold	.5-2 weeks	+/-.010- .060	simple geometry, opaque and clear	prototype & production
Investment Casting							
metal cast process	engineering check models	production materials	pattern	2-4 weeks	material dependant	metals, zinc to titanium	prototype & production
CNC Machining							
Computer numeric controlled machining	engineering check models, strong parts	production materials	part drawings, 3D data	geometry dependant	limitless	all plastic and metals	prototype & production

Wax Sculpting

Fabricated Model



Cast Urethane Samples



Vacuum Forming

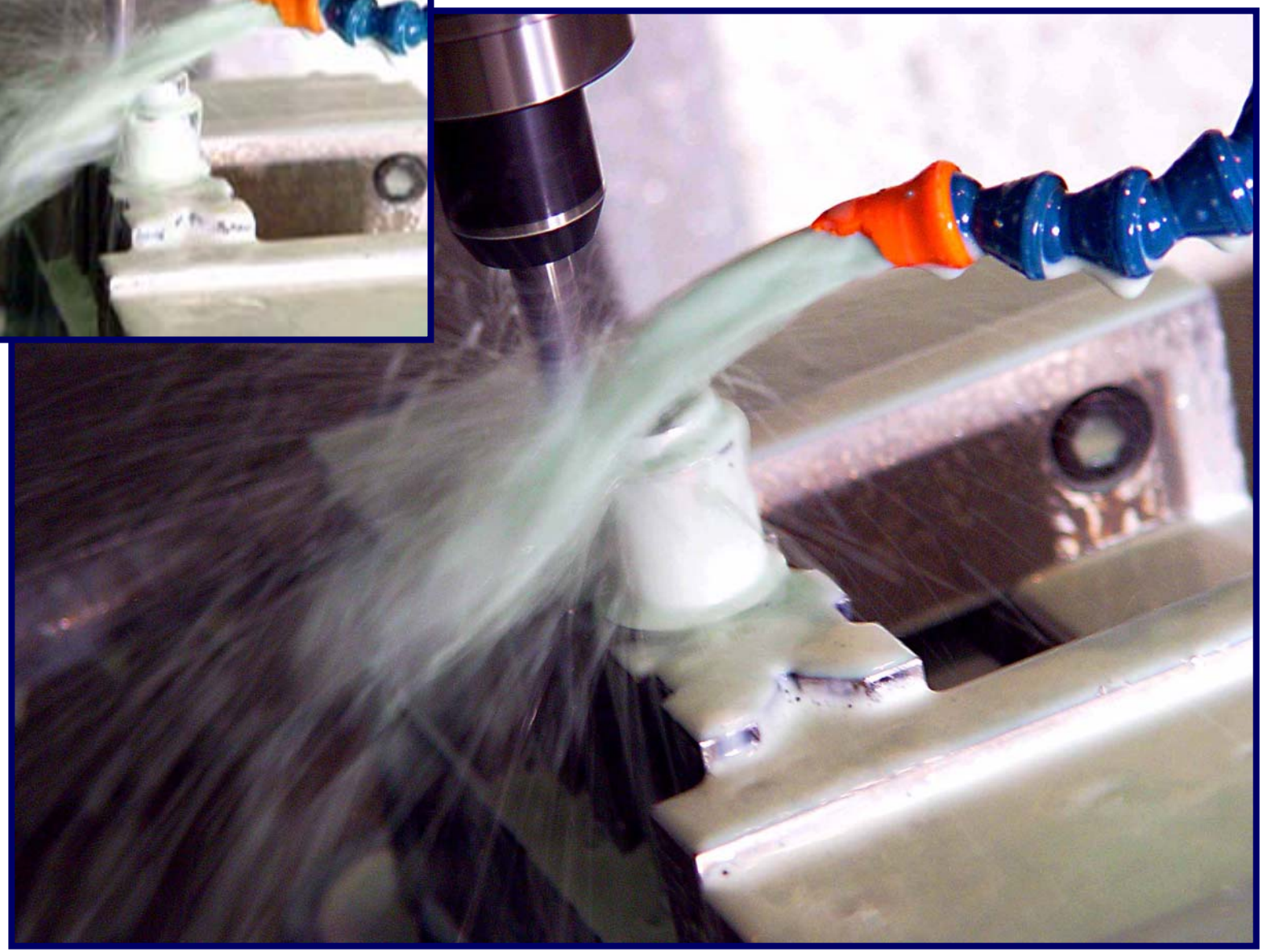
Pattern Part

Investment Casting

1. Wax Pattern is created (positive)
2. Pattern is dipped in ceramic slurry and then fine sand
3. Assembly is de-waxed by applying heat
4. Molten metal is poured into shell

- Creates metal parts that are difficult or impossible to machine

CNC Machining



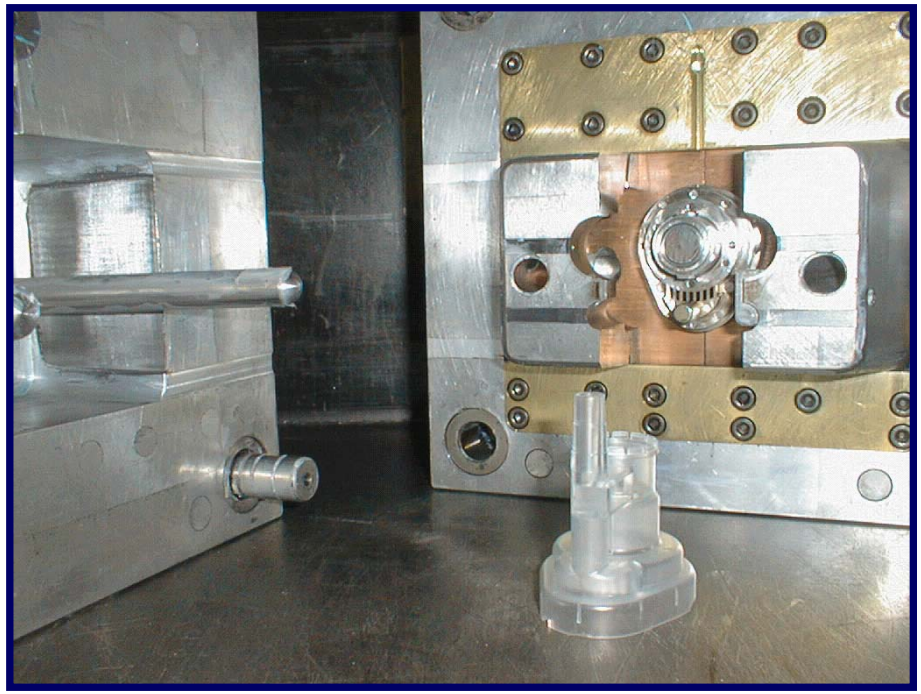
Prototype Tooling	Uses	Benefits	Input/ Process	Delivery	Tolerance	Material characteristics	Quantities
Aluminum	test production materials and part geometry	faster and less expensive than production tooling	2D, 3D data, Pattern/ CNC EDM, pantograph	1-10 weeks	+/- .002 in/in	medium temp thermoplastics	25K- <50k
Pre-Hard Steel (P-20)	same as aluminum, longer tool life, more complex tools, wider range of materials	same as aluminum	2D, 3D data, Pattern/ CNC EDM, pantograph	1-10 weeks	production	all thermoplastics w/ glass	100K - <250K
Production Tooling	Uses	Benefits	Input/ Process	Delivery	Tolerance	Material characteristics	Quantities
Hardened Steel, Multi Cavity	all materials	large quantities, lower part cost	2D, 3D data, Pattern/ CNC, EDM, pantograph	complexity dependant	production	all thermoplastics w/ glass	1M +

Prototype Tooling

Prototype Tooling

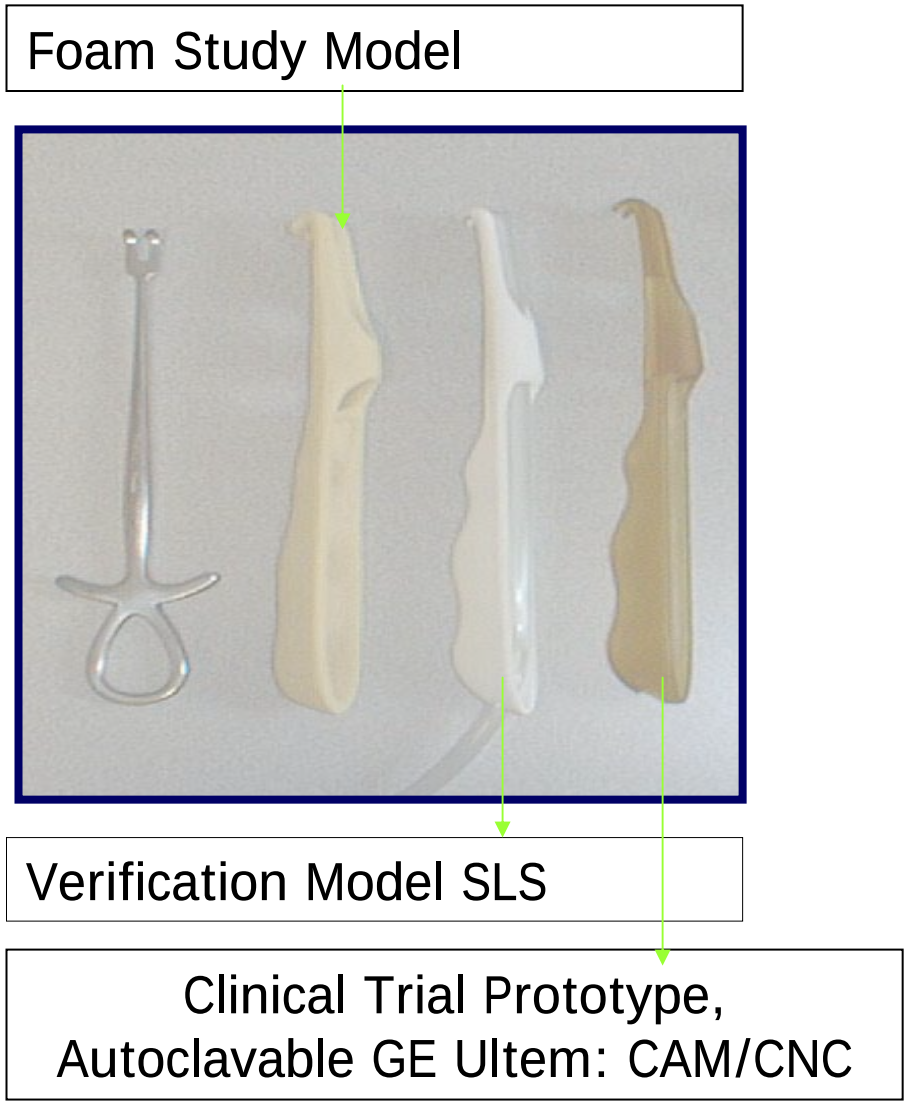
Aluminum or Pre-hardened Steel

- Process, machined, EDM
- Tool Life: 12 - 250,000
- Benefits:
  - Low volume production
  - High accuracy
  - Most Thermoplastics
- Delivery: 4-6 weeks



Types of Models

- Concept
  Functional, bread boards, form
- Looks like model
  Photography, presentations
- Looks like/ works like
  Sales samples, market testing
- Tooling patterns
- Engineering check models
  Confirm geometry,
  test production materials,
  prove function



Concept Models

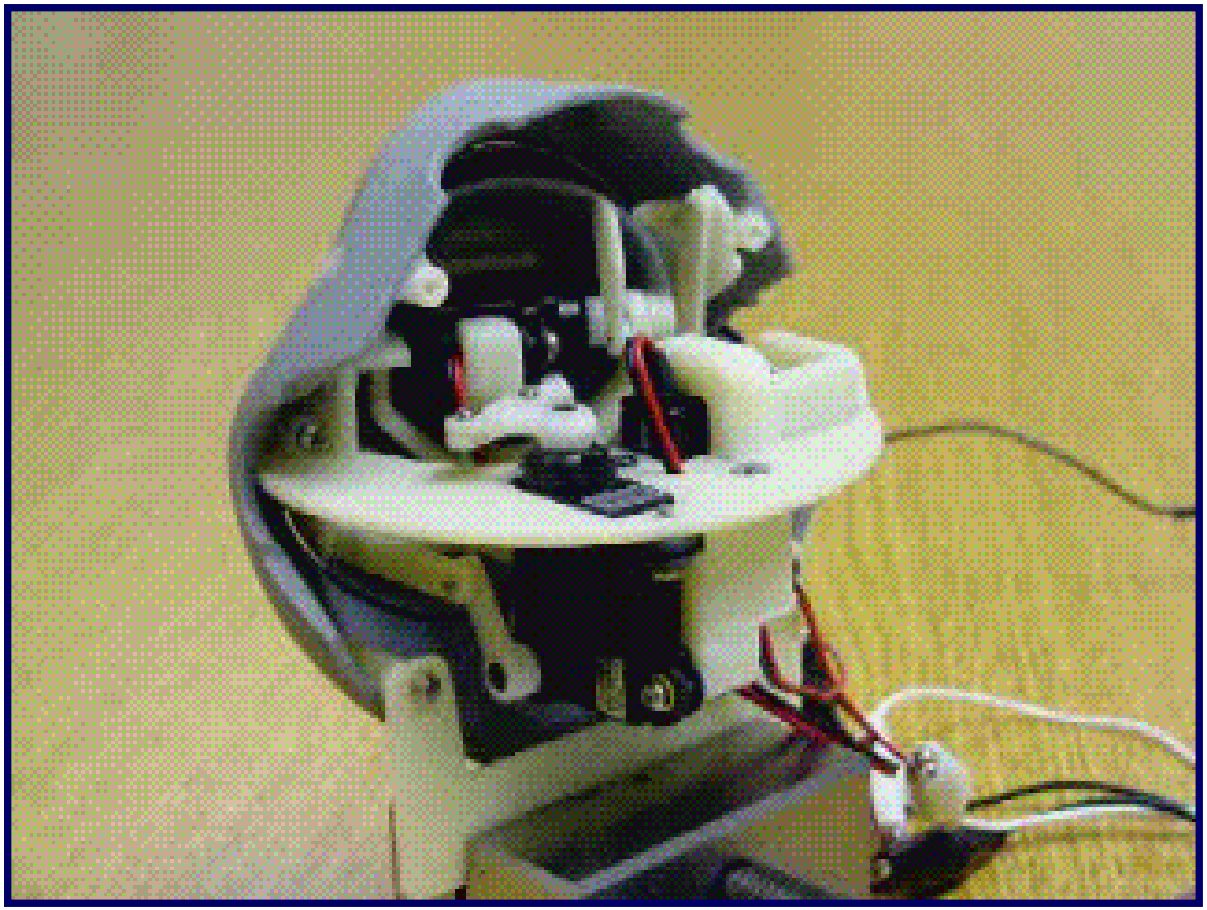
- Purpose; Study scale, develop form, explore ergonomics
- Input; Sketches, verbal description, 3D data
- Process and materials;
  - Hand build, foam, insulation or urethane, foam core, clay, cannibalize existing products
  - Rapid prototyping, Z Corp, SLS, SLA
  - Machining, block, tube and sheet stock
- Tolerances; Not important
- Quantity; Usually ONE

Concept Model

Handmade foam model to explore form

Chosen for speed, 3D data not available

Concept Breadboard Model



Fabricated by hand

Chosen to accommodated many materials

Looks Like Model (LL Model)

- **Purpose**, aesthetic
  - Shows surface finish; color, clear parts, labels, tactile materials

Looks Like/ Work Like Model (LL/WL)

- **Purpose**, same as above including functional requirements.
  - Draft included only as it effects the performance.
  - Cored for function only.
  - Materials used to replicate production material performance.
  - Includes batteries, electronics, springs, LEDs .
- **Process and materials.**
  - Rapid prototypes, SLS, SLA.
  - Castings/ urethane, silicone.
  - Machining/ stock plastic.
- **Tolerances,** tight as needed.
- **Quantity,** 1-12.

Looks Like / Works Like

SLA master RTV Mold, Cast Urethane

Chosen for production *like* resins

LooksLike / WorksLike

Urethane Casting from SLA master and RTV molds

Chosen to replication production parts in accuracy, color and texture

Tooling Pattern

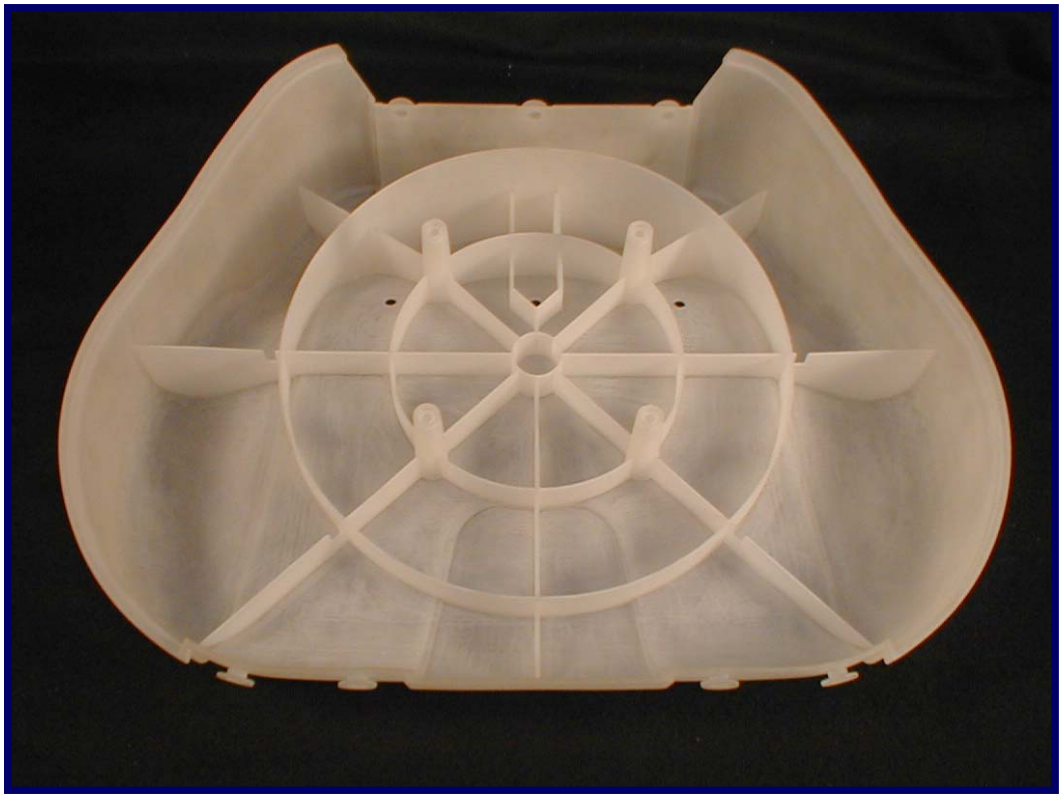
Fabricated by hand

Chosen to accommodate highly complex geometry

Engineering Models

- Purpose, confirm geometry, test production materials, review function
- Input, 3D data, detailed part drawings
- Process and materials
  - Rapid prototyping/ SLS, FDM, SLA
  - CNC or machined/ production materials
  - Prototype molds/ production materials
- Tolerances, critical
- Quantity, usually ONE

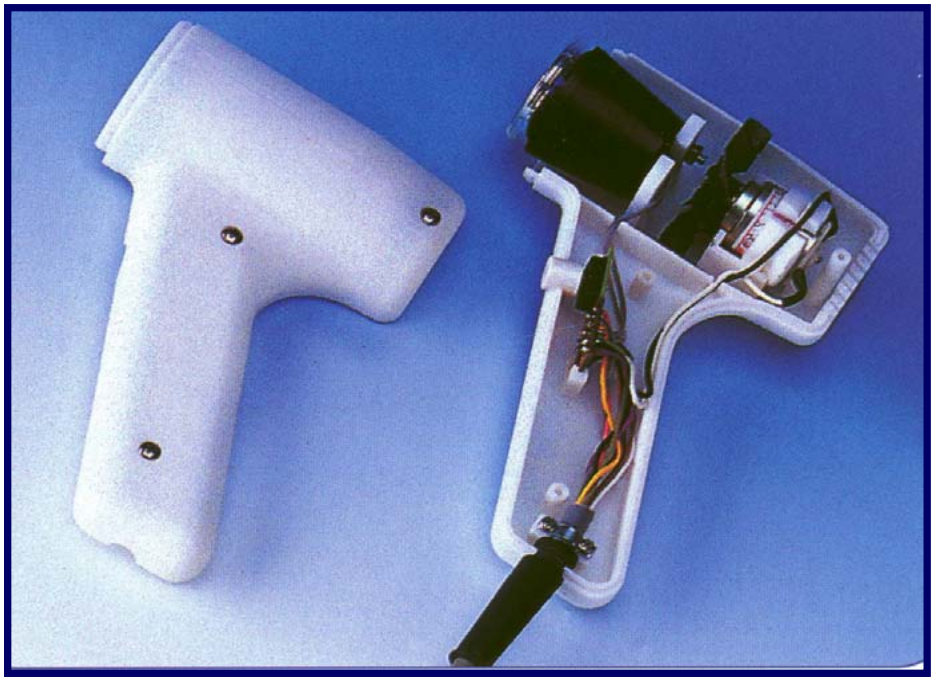
Engineering Model



Rapid Prototype, SLA

Chosen for accuracy and speed

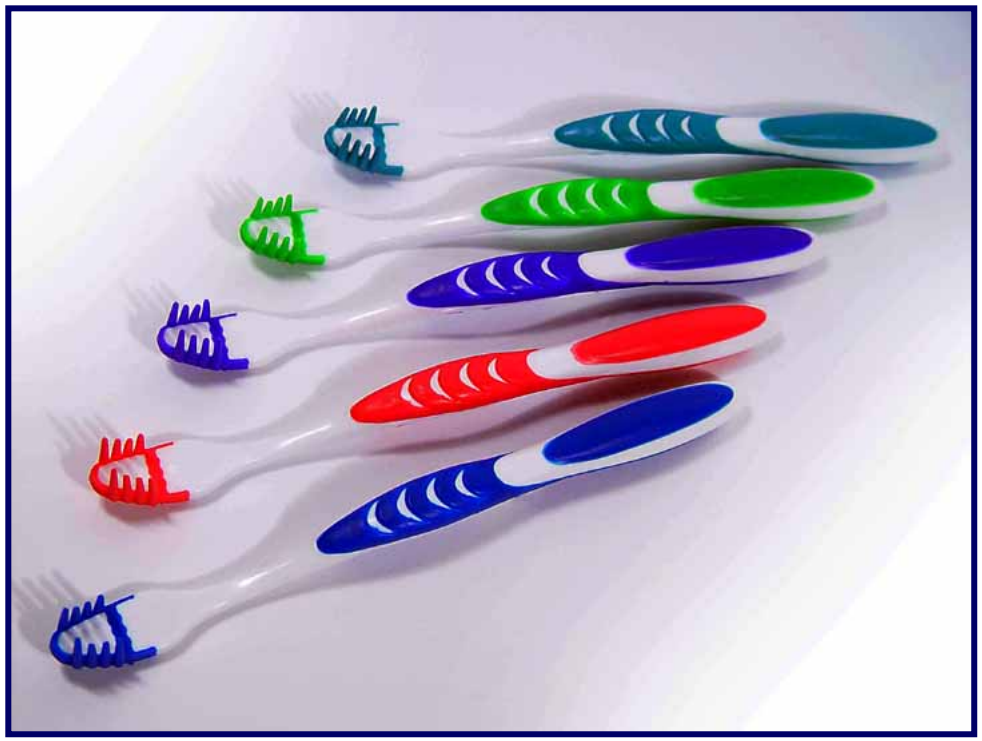
Engineering Model



Rapid Prototype, SLS Glass Filled Nylon

Chosen for durability to withstand testing

Prototype Molded Parts



Aluminum Prototype Injection Mold

Chosen to prove material adhesion and for market testing

Qualifying your prototyping needs

- What type of model do you need?
- What type of input do you have?
  - sketches, control drawings, 3D data
- Is the production material required?
- What are the tolerances?
- How many do you need?
- When do you need it?
- Are you working within a budget?

PD Efficiency

The right questions will improve PD efficiency

- Identify risk in your project
- Formulate questions, that if answered, will reduce/eliminate risk
- Use models/prototypes to get the answers
- Target individual questions at first.

Repeat as necessary.

Can use other tools to answer questions.