NU - CAST, INC

A Leader In Aluminum Investment Castings

THE INVESTMENT CASTING TEAM

PROVIDING FOR "REAL SOLUTIONS"

THROUGH EXPERIENCE, UNDERSTANDING, QUALITY, FLEXIBILITY & INOVATION

NU-CAST, INC. (NCI):

Londonderry, N.H. 603-432-1600

ALUMINUM INVESTMENT CASTINGS

PROTO ENGINEERING:

Lowell, Ma. 978-446-0570

ENGINEERING, DESIGN & RAPID PROTOTYPING

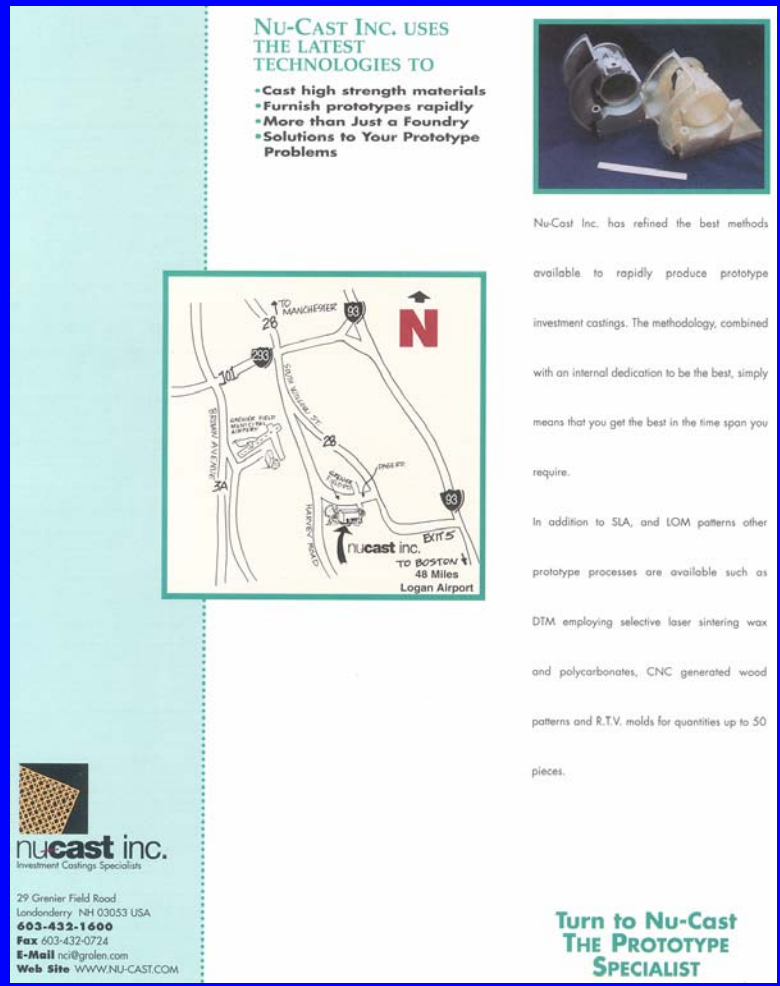
NU - CAST, INC


The Ultra-light 3D Cast Truss Beam Structure.
The STRENGTH AND weightlessness Every Satellite Needs in Orbit.
Space Structures for the next Millennium.
• Maximum Weight Efficiency
• Replaces Costly Honeycomb/Composites
• Monolithic Structures from Small to 50"
• High Strength/Stiffness to Weight Ratio
• Now Available in Most Cast Aluminum Alloys
• Soon to be Available in Almost All Cast Alloys (Steel, Titanium, Beryllium, Magnesium)
• 125 RMS Finish or Better
• Cast in Any Shape, Square, Hexagonal, Contoured
• .080-.250 Rod Diameters
• Custom Design for Each Application
• Structural Analysis/Math Model (Algor/Nastran)
• STL CAD File Development
• Pro E, CAD-Key, Autocad, Others
Patent Pending
nu-cast
Casting ultra-light 3D truss beam structures.
NASA
A valued supplier to our nation's space efforts.
Nu-Cast, Inc.
29 Grenier Field Road
Londonderry, NH 03053
Tel: (603) 432-1600
Fax: (603) 432-0724
E-Mail: nci@grolen.com
Web Site: www.nu-cast.com

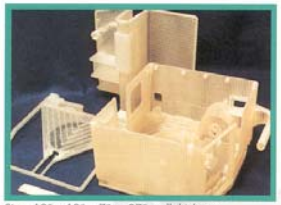

A valued supplier to our nation's space efforts.
NASA
In Space, Nu-Cast has an Excellent Reputation
REACTION WHEEL #3
POWER NODE
UTILITY MODE
BATTERY
COMPUTATION HUB
TRANSMITTER/RECEIVER
REACTION WHEEL #1
REACTION WHEEL #2
40" DIAMETER RAPID PROTYPE INVESTMENT CASTING
The Science
The SMEX•Lite space craft concept is innovative for its end-to-end consideration of all elements that contribute to mission cost. The SMEX•Lite team developed a spacecraft that not only reduces design and test engineering, development team size, flight hardware cost, and the cost of flight operations, but also maintains mission reliability and improves performance over previous SMEX missions.
SMEX•Lite is instrument friendly. Its design provides experimenters with flexibility and a growth path for future enhancements by accommodating the expansion or deletion of capabilities. Experimenters can take advantage of mission configurable spacecraft services while utilizing a common, flight proven SMEX structure.
SMEX•Lite has "plug-and-play" architecture that allows components to be added or deleted from the system with virtually no redesign and without disturbing other subsystems. Functions are segregated into "slices" that are independent at the subsystem level. The "plug and play" concept was extended to the electronics, sensors, actuators, software, solar arrays, the mechanical system, and the ground support (integration and test and operations) system.
Onboard the spacecraft, a radiation hard, 32-bit computer ties all the functions together. The flexibility inherent in the SMEX•Lite design is made possible by a heavy reliance on software. In the software "plug-and-play" is made possible by an applications layer that contains independent modules that support a variety of sensors and actuators. Several functions traditionally performed by dedicated hardware (such as the safehold and the battery charge integrator) were moved to software. Where software development is needed, software modules are coded using the C/C++ language. To maintain integrity of the mission, hardware watchdogs supervise the operation of the software and will reset the computer should software failures occur.
Communication between subsystems flows via MIL-STD-1553 interfaces. The instrument and subsystems communicate with the computer using this bus. For instruments that produce high data rates, there are four EIA RS422 Direct Memory Access (DMA) interfaces to the computer memory. In addition, the on-board computer uses the Peripheral Connection Interface (PCI) backplane commonly found in IBM-compatible PC's. The industry standard PCI backplane allows development of custom interfaces that provide DMA to instruments with unique interfacing requirements.
The flight software enjoys a significant degree of heritage from previous SMEX•Lite missions. Its architecture utilizes modular design techniques that maximize software reuse. This approach provides flexibility for tailoring the system to unique mission requirements and improves the overall reliability of the flight code.
nu-cast
Casting ultra-light 3D truss beam structures.
29 Grenier Field Road, Londonderry, NH 03053
Tel: (603) 432-1600, Fax: (603) 432-0724
E-Mail: nci@grolen.com, Web Site: www.nu-cast.com

NU - CAST, INC

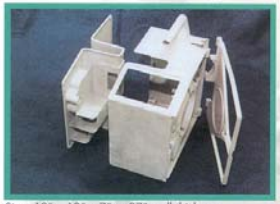

nucast inc.
SOLUTIONS FOR
SLA & Other Rapid Prototyping Techniques in
Aluminum & Other Advanced Alloys
ADVANCED INVESTMENT CASTING TECHNOLOGIES


NU-CAST INC. USES THE LATEST TECHNOLOGIES TO
•Cast high strength materials
•Furnish prototypes rapidly
•More than Just a Foundry
•Solutions to Your Prototype Problems
TO MANCHESTER
93
28
N
293
101
SOUTH MAIN ST.
MANCHESTER AIRPORT
28
3A
93
nucast inc.
EXIT 5
TO BOSTON
48 Miles
Logan Airport
Nu-Cast Inc. has refined the best methods available to rapidly produce prototype investment castings. The methodology, combined with an internal dedication to be the best, simply means that you get the best in the time span you require.
In addition to SLA, and LOM patterns other prototype processes are available such as DTM employing selective laser sintering wax and polycarbonates, CNC generated wood patterns and R.T.V. molds for quantities up to 50 pieces.
nucast inc.
Investment Castings Specialists
29 Grenier Field Road
Londonderry NH 03053 USA
603-432-1600
Fax 603-432-0724
E-Mail nci@grolen.com
Web Site WWW.NU-CAST.COM
Turn to Nu-Cast
THE PROTOTYPE
SPECIALIST

NU - CAST, INC



Size: 12" x 12" x 7" x .07" wall thickness



Size: 12" x 12" x 7" x .07" wall thickness

Size: 36" x 18" x 21" x .09 wall thickness

Aluminum 354 A356, A357, 201 C355

Beryllium Aluminum Beal 363 & Beal 191

TEAMWORK

Rapid Prototype Patterns + Nu-Cast's R-PIC

RESULTS IN

CAST METAL PROTOTYPES IN 7-10 DAYS

ENGINEERING PROTOTYPES

Rapid prototyping enhances the product design and dramatically improves your delivery cycle. Multiple technologies allows Nu-Cast Inc. to select the appropriate technology for each application. The maximum cost benefit is obtained when applied in concert with supporting technologies and with a

discipline to speed.

FULL CAD SERVICE

Nu-Cast Inc. can create solid model/STL files from 2D geometry using the following CAD-tools:

Pro E • CATIA • Auto-CAD

CADKEY & others

CYCLE TIMES FOR STEREOLITHOGRAPHY MODELS & PATTERNS

Engineering Drawings & Development	14 Days
Marketing Models	3-5 Days
Investment Casting Patterns	3-5 Days
Metal Castings	7-10 Days
Rapid Tooling Patterns (R.T.V.)	7-14 Days
Typical Quantities	1-25 Pieces

Rapid Prototyping using the following methods

TABLE OF CONTENTS

nucast inc.
Investment Castings Specialists

STEREOLITHOGRAPHY (SLA)

produces models from epoxy resin via a UV laser, directly from CAD data file. Quickcast™3D Systems.

SELECTIVE LASER SINTERING (SLS)

fuses powder into functional patterns and molds, directly from CAD data file.

LAMINATED OBJECT MANUFACTURING (LOM)

using the "lost paper" process, LOM objects serve as expendable patterns.

COMPUTER GENERATED WOOD

large pattern thin walls beyond other rapid prototyping capabilities.

FUSED DISPOSITION MODELING (FDM)

=

Investment Castings

RAPID PROTOTYPE INVESTMENT CASTING SPECIALISTS

An alternative source for large complex shapes produced from aluminum and new advanced beryllium alloys.

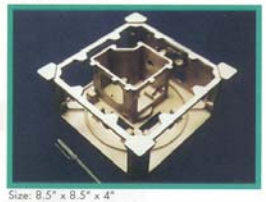
No size limitation.
Well drained SLA walls down to less than 1.5mm/0.06 in.
Yes, investment casting within 7 days to 10 days.

CHECK OUR WORLDWIDE REFERENCES:

Aselsan BAC Boeing G.E.
Honeywell Hughes
Litton Lockhead-Martin
Loral NASA
Starmet
Raytheon Texas Instruments
Thompson

Size: 8.25"dia. x 10"

Size: 12" x 6.5" x 5"



Size: 8.5" x 8.5" x 4"

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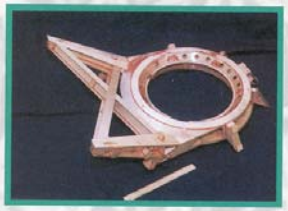

Nu-Cast Inc. now offers **Concurrent Manufacturing**, much more than concurrent engineering.

Any foundry can make castings from drawings. It takes a very special one to manufacture castings without a complete set of drawings or a CAD file.

It is not the recommended way, but many times it is the only way to meet your delivery requirements.

Nu-Cast Inc. is very experienced in working closely with your engineers and our toolmakers on a stepped (as information becomes available) manufacturing approach. With on site engineering to assist you in development, our personnel have considerable value analysis experience and can be a major asset in meeting your production needs. Our in house tooling, x-ray, penetrant, welding and heat treating facilities, enables Nu-Cast Inc. to do it all and ***do it fast.***

By the utilization of rapid prototyping you are provided with the shortest product development cycle possible.

NuCast Inc. Teams with Success in Space

Nu-Cast Inc. and NASA engineering using the latest technologies, working to produce high strength castings derived from computer generated prototype patterns.

Engineering Prototypes

Nu-Cast Inc. is particularly proud of its engineering design and drawing development capability. We have a history in providing quick turnaround, fast track prototyping that has been implemented in various space applications.

Grapple Mount for Spartan 207/IAE
18" x 15" x 48" x .125 Wall Thickness.
Successfully flown May 1996.

Pams Casting Size 14" diameter x 18" long x .060 wall thickness

Photo shown in background SMEX Casting size 40"diameter x 12" H

NU - CAST, INC

LINEAR TOLERANCES

The following tabulation lists the tolerances recommended by the Investment Casting Institute. With state-of-the-art technology, we are able to extend this list as a guide for larger configurations. Nu-Cast is equipped to handle the demand of today's industry. Your specific configuration is an important criteria in determining dimensional variations from part to part. We will be pleased to consult with you on any tolerances or dimensions you may need that are not listed.

Length	Normal	Premium
up to 1/2"	±.007"	±.003"
1/2" TO 1"	±.010"	±.005"
1" TO 2"	±.013"	±.008"
2" TO 3"	±.016"	±.010"
3" TO 4"	±.019"	±.012"
4" TO 5"	±.022"	±.014"
5" TO 6"	±.025"	±.015"
6" TO 7"	±.028"	±.016"
7" TO 8"	±.031"	±.017"
8" TO 9"	±.034"	±.018"
9" TO 10"	±.037"	±.019"
Larger castings produced at Nu-Cast		
11" TO 20"	±.040"	±.020"
21" TO 30"	±.050"	±.030"
31" TO 40"	±.060"	±.040"
41" TO 50"	±.070"	±.045"

Section Thickness	Normal - Variation	Premium
.020" to .050"	±.010"	±.007"
.051" to .100"	±.010"	±.007"
.101" to .250"	±.015"	±.010"
.251" to 1.000"	±.015"	±.010"

ALUMINUM-BASE ALLOYS

Alloy Designation	Preferred Temper	Common Specifications	Tensile (KSI)	Yield (KSI)	Elongation (%)	COMMENTS
A201	T7	MIL-A-21180 AMS-4229	55/65	45/55	2/4	HOT SHORT ALLOY, VERY LOW CASTINABILITY, CONFIGURATION SENSITIVE. APPLICATIONS: HIGH-STRENGTH CASTINGS (DESIGN ONLY IN CONSULTATION WITH FOUNDRY).
A355	T6	MIL-A-21180 AMS-4215	35/44	30/33	1/3	SOMEWHAT LOWER CASTABILITY THAN A356 OR A357 ALLOYS. APPLICATIONS: COMPONENTS EXPOSED TO MODERATE SUCH TEMPERATURES, AS TURBINE ENGINE PARTS, PUMPS, ETC.
A356	T6	MIL-A-21180 AMS-4218	33/42	27/32	2/5	MODERATE STRENGTH, EXCELLENT CASTABILITY, WELDABILITY AND PRESSURE TIGHTNESS. APPLICATIONS: HOUSINGS, CHASSIS, CASTING REQUIRING FINE DETAIL.
A357	T6	MIL-A-21180 AMS-4219	36/41	28/31	3/5	EXCELLENT CASTABILITY, MODERATE HIGH STRENGTH, EXCELLENT WELDABILITY AND PRESSURE TIGHTNESS. APPLICATIONS: STRUCTURAL COMPONENTS.
C712	T1	QQ-A-601 QQ-A-596	24/32 26/32	16/22 20/27	1/5 2/3	LOWER CASTABILITY, USED ONLY FOR ITS BRAZING CHARACTERISTICS.

To avoid additional costs we recommend that configurations maintain a minimum wall thickness as specified:

Casting Size:	Nominal Walls:
1" to 10"	.06" ± .02
11" to 20"	.09" ± .02
21" to 50"	.12" ± .02

RADII As a general rule, a 0.03 maximum corner and a 0.06 minimum fillet are recommended. Smaller radii are possible depending on the complexity of the design.

ANGLES Angular tolerances of ±1/2° are normal.

FLATNESS AND STRAIGHTNESS When a high degree of flatness and straightness is required, castings must be mechanically straightened; however, proper design can control distortion and minimize straightening functions. Flatness and straightness tolerances are .003 to .005 TIR per linear inch and depend on alloy properties and configuration of part.

HOLE TOLERANCES The hole tolerances for round, square and D-holes are:

up to .250" I.D.	±.003
.250" to .500" I.D.	±.004
over .500" I.D.	±.005 inch/inch

SURFACE FINISH
NAS 823 visual comparison.
Normal - 125 Premium - 63

DRAFT Generally draft allowance can be disregarded.

ROUNDNESS The general linear tolerances can be held for diameter.

CONCENTRICITY The general section thickness tolerances will prevail.

Our goal is solving your problems whether it be cost, delivery, size or quality.

For Requirements of Beryllium Material Contact Starmet at

1-978-369-5410

Fax 1-978-369-4045

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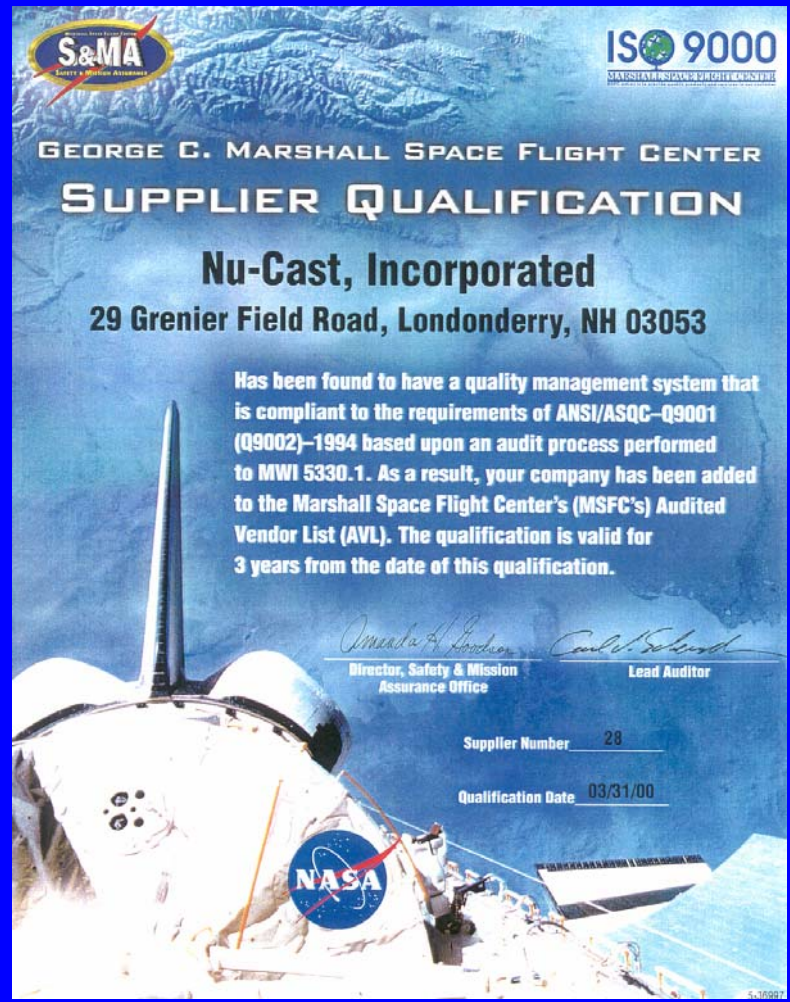

PROTO ENGINEERING

EXPERIENCE/BACKGROUND:

- 36 years in the design, development and management of ground based, airborne and spaceborne optical reconnaissance systems @ ITEK/LITTON.
- 15 years full time and 18 years part time (consulting, design and rapid prototyping) in the investment casting field @ UNI-CAST/NU-CAST.

MAJOR SYSTEMS/PROGRAMS:

- Corona (secret satellite) declassified 1995.
- Classified reconnaissance systems (airborne/spaceborne).
- MOL (Manned Orbiting Lab).
- CIS (Compensating Imaging System) Maui
- Manager of major A/C modification (G111) and systems integration for recce platform including large optical windows and requiring FAA certification/STC's.

NASA RELATED PROGRAMS:

- Large Space Telescope (Hubble) proposal/study.
- Apollo Program (pan camera for moon).
- Viking Program (Mars Lander camera).
- 30 meter space based laser transmitter (proposal/study).
- Principal Investigator, SBIR Phase 1 & 11 (High Efficiency Monolithic Lightweight Cast Structure).

PROTO ENGINEERING

SERVICES:

ON SITE (CUSTOMER) OR @ PROTO ENGINEERING:

PROVIDE SEMINARS ON THE INVESTMENT CASTING PROCESS AND INVESTMENT CASTING DESIGN (ALUMINUM):

INVESTMENT CASTING DESIGN & ENGINEERING:

- Review systems/components on the basis of function, design, producibility and cost. Discuss casting issues with proposed designs. Provide specific recommendations, alternate design approaches and supporting rationale.
- Systems/component design specializing in airborne & spaceborne applications.
  - Optical systems, components and their mounting.
  - Structural systems and mechanical components.
  - Electronic enclosures.
- Investment casting design.
  - Provide knowledge (basic principles) of the investment casting process and how to realize the maximum benefits of this versatile process based on current technology.
  - Design to cost. Recommend options and provide direction for an efficient cost effective approach.

PROTO ENGINEERING

INVESTMENT CASTING DESIGN & ENGINEERING (CONT'D):

- View problems/issues through the eyes of the customer as well as the foundry, concentrating on part functional requirements for practical solutions. Note; the many years of airborne and aerospace design experience along with the association and actual foundry experience by Proto Engineering, provides for this unique opportunity.
- Provide for realistic tolerancing, dimensional set-up (datum's/tooling points) and proper transitioning to machining (kinematic type restraints, tooling lugs, etc.).
- Determine those areas/features that should be cast and those that should be machined due to tolerancing or configuration limitations.
- Recommend design techniques that minimize distortion when machined and those processes recommended for long term casting stabilization (critical optical configurations).
- Provide casting design, supporting analysis (FEA/NASTRAN), detail drawings (casting & machining) and solid model (CAD) or variations as required. See the following for typical approach:
  - Discuss/establish design requirements, goals and gather the necessary interface/environmental data via "SCD" or appropriate agreed upon format.
  - Provide preliminary design/layout of proposed approach for customer evaluation and subsequent update and approval. Note; FEA/NASTRAN analysis would be provided at this time if required by customer.
  - Provide detail casting and machining drawings (2D) on customer format per customer specifications and solid model (3D) as required of approved design

PROTO ENGINEERING

INVESTMENT CASTING DESIGN & ENGINEERING (CONT'D):

- Provide design/detail drawing (2D) and solid model (3D) conversion as required for the following:
  - Dip brazing to casting.
  - Sheet metal to casting.
  - Weldment to casting.
  - Machined part "hog out" to casting.
  - Multi-piece assemblies (sheet metal or machined) to casting.
- Provide engineering drawings per Y14.5M - 1982 or Y14.5M - 1994.
- Assist in material and specification selection:
  - Recommend material specification, classification and method for determining mechanical properties, x-ray of designated areas (when required) and general processing notes based on system/component requirements.
  - Discuss/define advantages/disadvantages.
- Provide the following:
  - Design/detail (2D & 3D) via CADKEY and or PRO E.
  - Systems/part analysis (FEA) via NASTRAN).

PROTO ENGINEERING

RAPID PROTOTYPING (WOOD PROCESS):

- Rapid prototyping process for investment castings unique to Proto Engineering and Nu-Cast Inc Pattern fabrication is via A/C plywood (computer generated or machined assembled parts) as compared with the use of computer generated resins (SLA). This process has been used for over 35 years and currently provides additional flexibility in the use of investment castings for limited production or development runs.
- Advantages over the SLA type process:
  - Design changes can be implemented at any time during pattern generation and even into the shell process in extreme situations. This process in general allows for changes after pattern review.
  - Pattern/part size limited to foundry facility only (currently 80 inches in length @ Nu-Cast Inc).
  - Solid model (CAD) not required (2D acceptable).
  - Fillet radii and outside radii not required in CAD file.
  - Minimal wall thickness .02/.03 available (requires engineering or foundry review).
  - No pattern shrinkage to contend with allowing for greater pattern tolerance control,

Proto Engineering

Aerospace/Investment Casting Design and Rapid Prototyping

Gordon H. Goodwin

225 Stedman St. STE # 28

Lowell, Ma. 01851

TEL: 978-446-0570

FAX: 978-446-0571

EMAIL: gordon.h.goodwin@verizon.net

PROTO ENGINEERING

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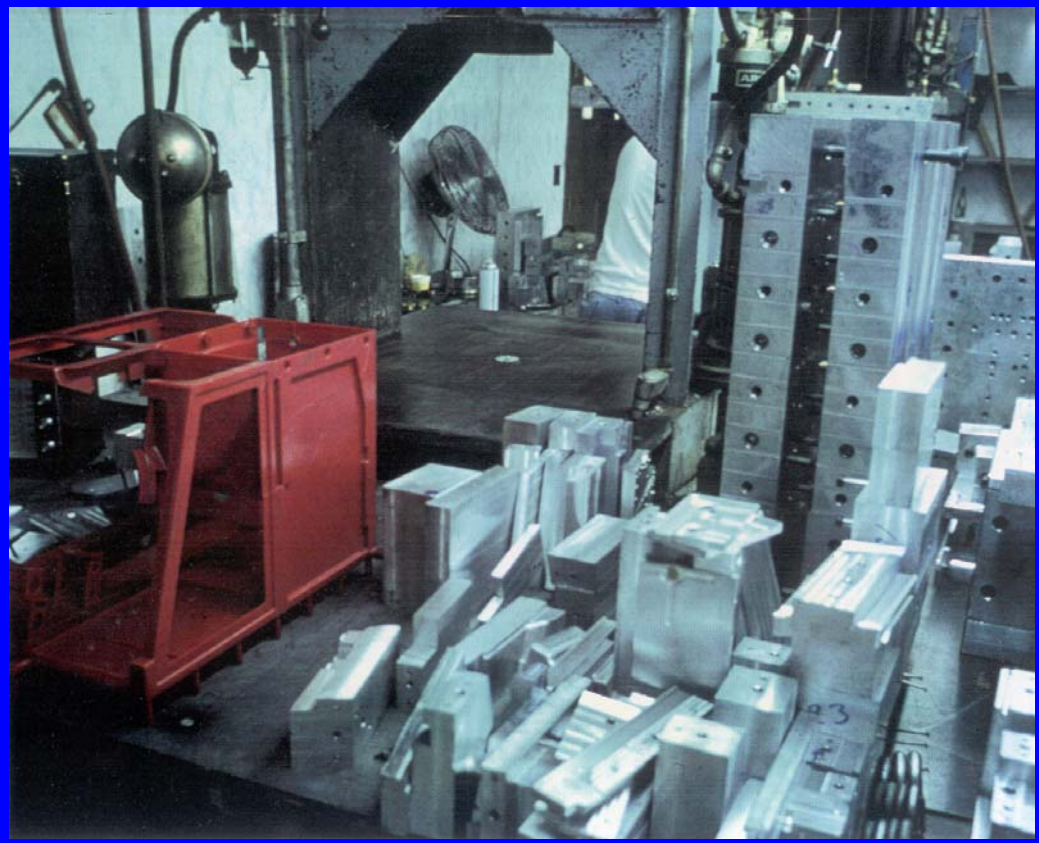
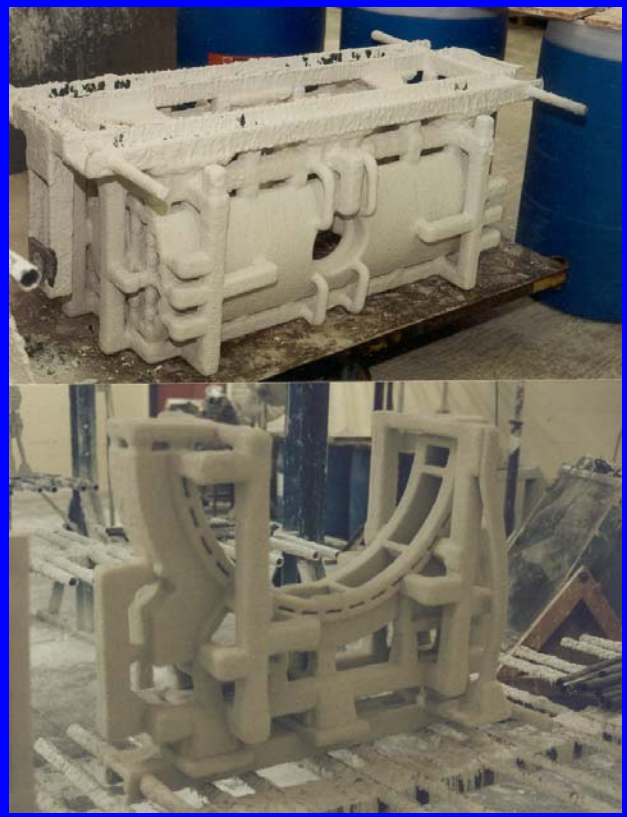


Wax Injection

(Large Injection Tool Depicting Cores With Red Wax Pattern On Left)

NU - CAST, INC

Wax Assembly



Shell

Shell

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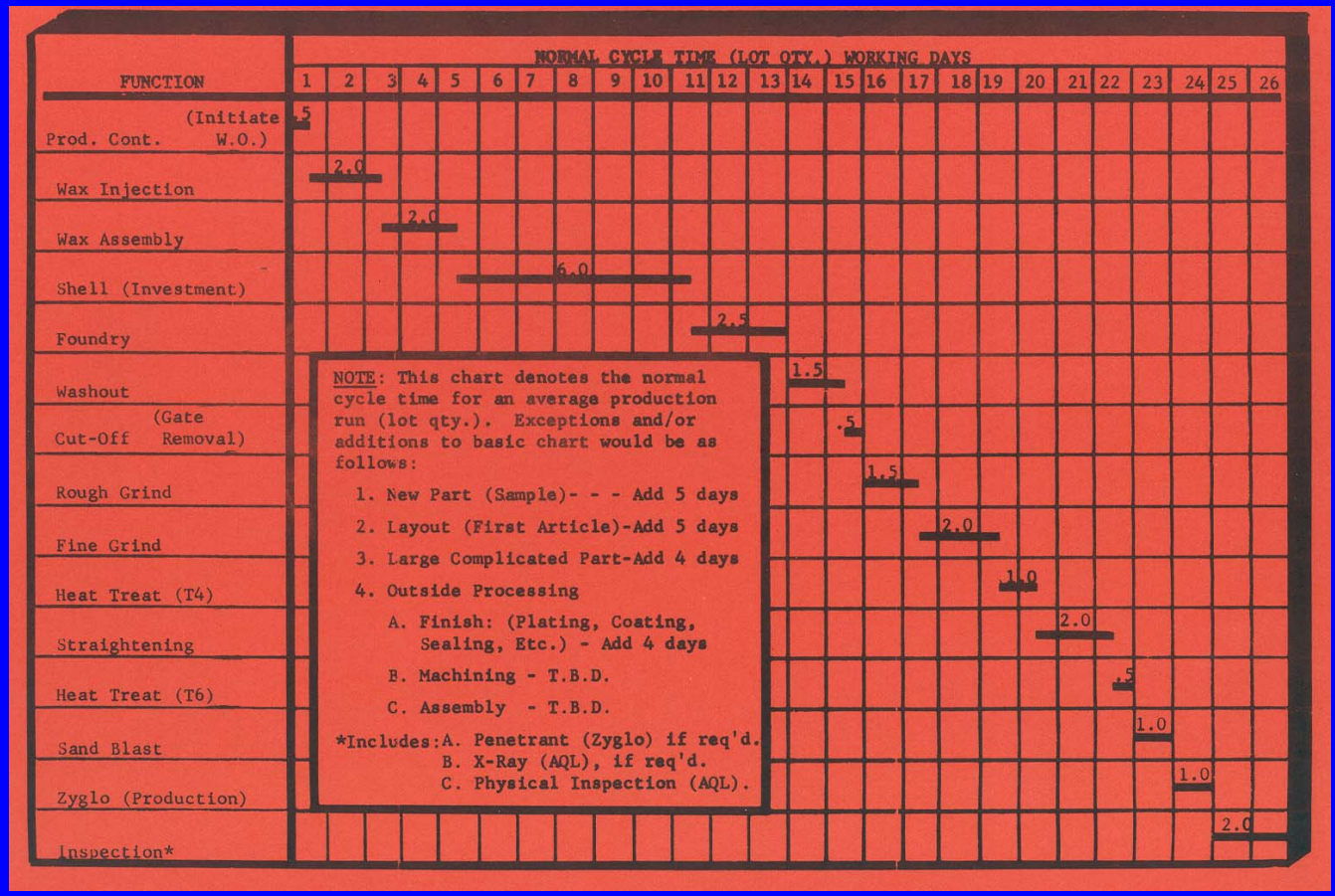

Part Production Cycle - Investment Castings

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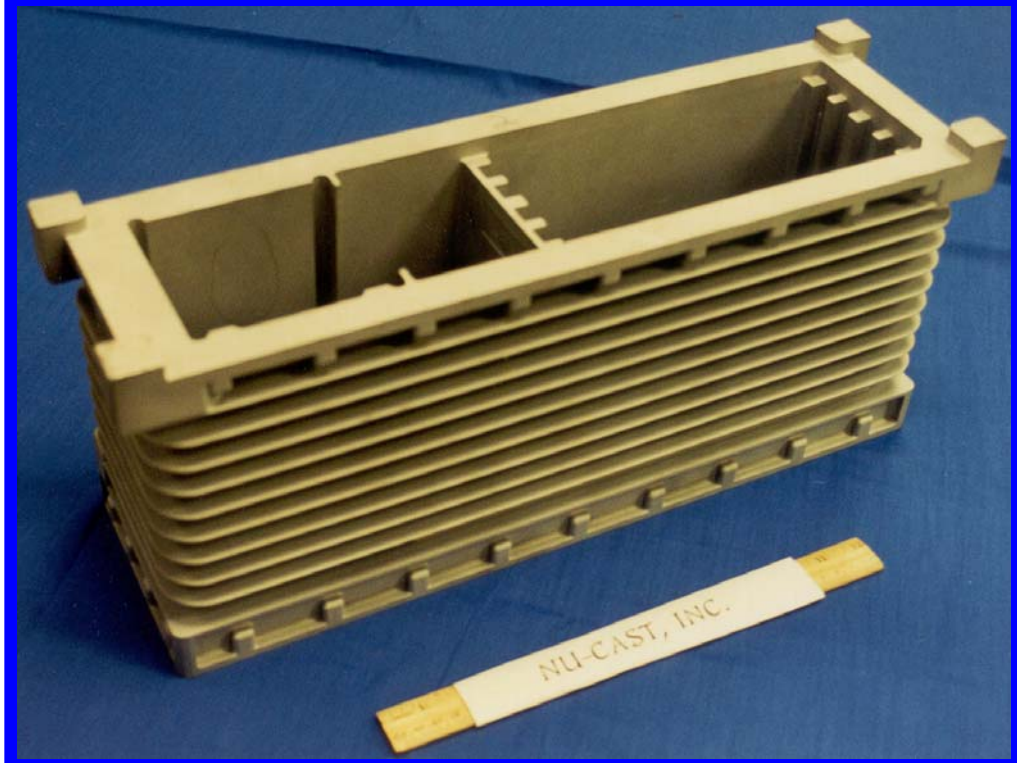
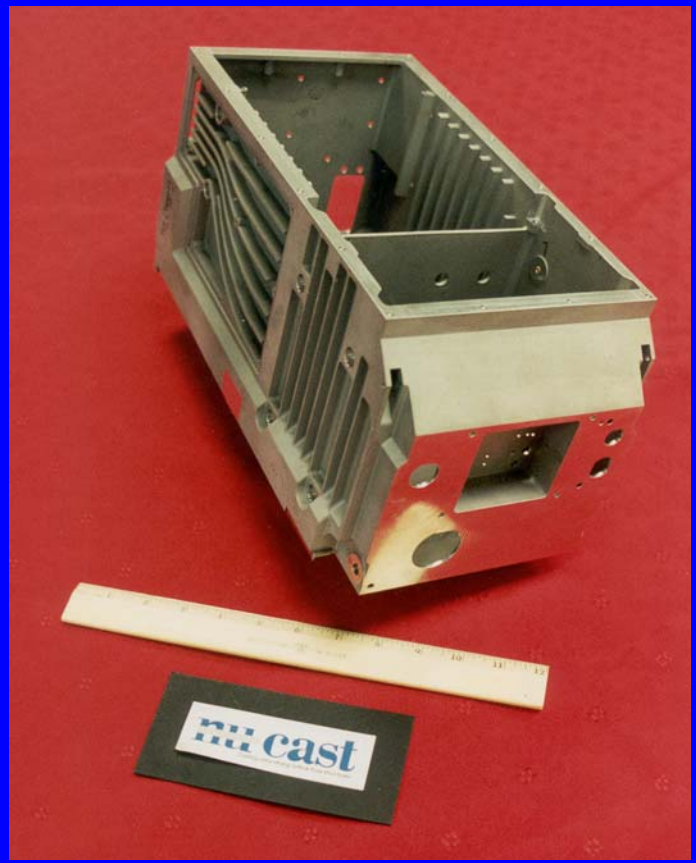
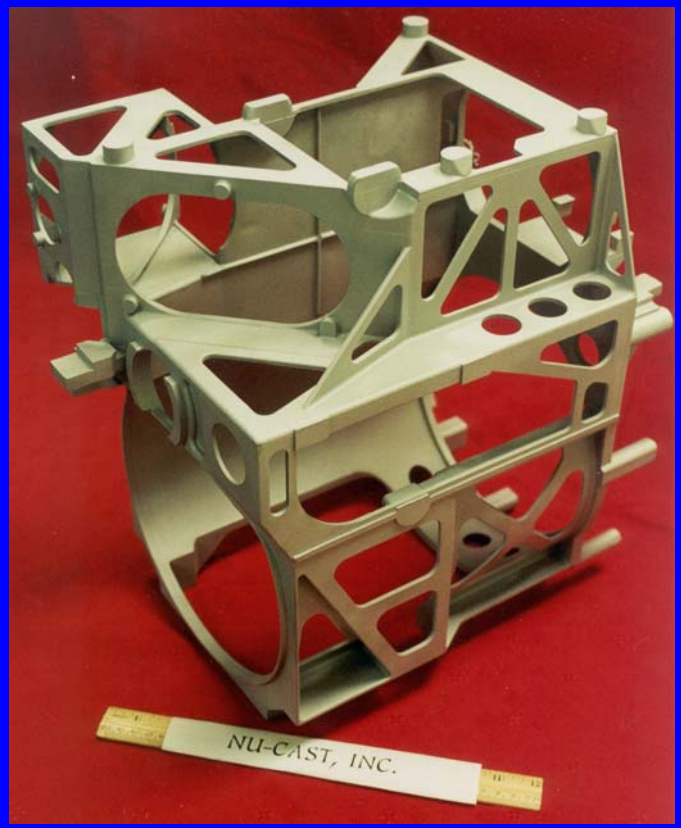


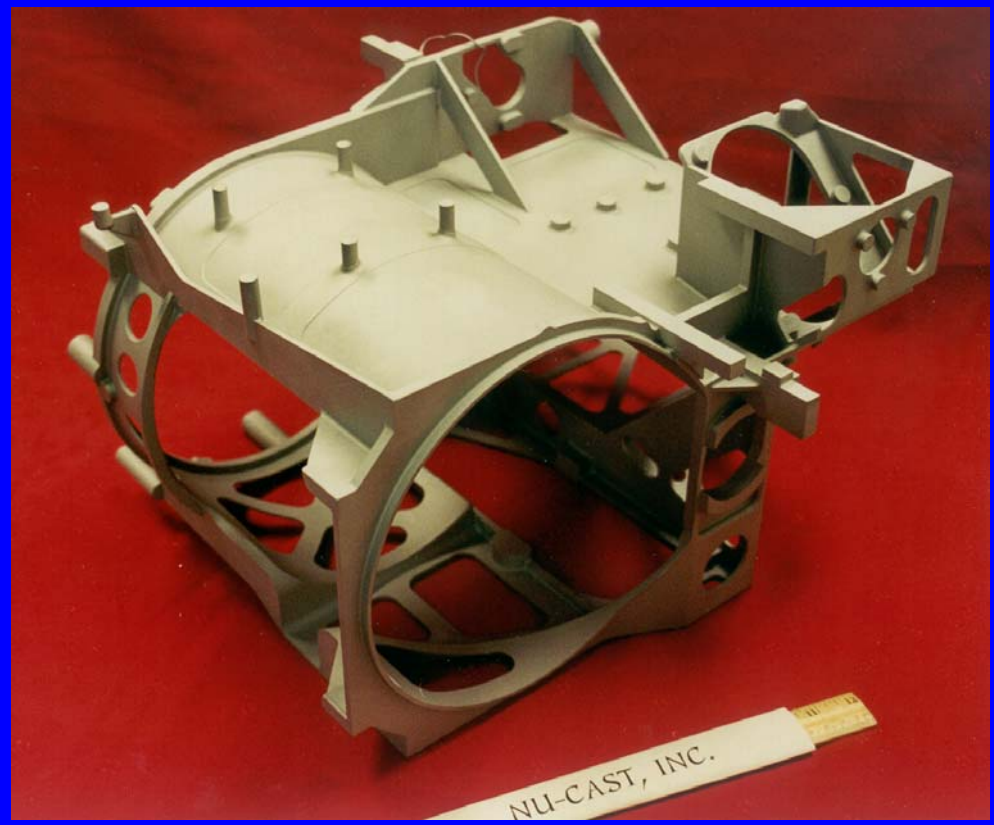
Electronic Housing
(Investment Casting)



Electronic Housing
(Investment Casting)

NU - CAST, INC





Optical Housing (Investment Casting)

NU - CAST, INC

SELECTED for F/A-18 UPGRADE

NEXT-GENERATION AIRBORNE/SHIPBOARD IFF TRANSPONDER

BAE SYSTEMS' Next-Generation Common Avionics Transponder is produced under contract for the F/A-18 MIDS Compatibility IFF Transponder Upgrade Program. Competitively selected over advanced versions of the AN/APX-100, BAE SYSTEMS' new IFF transponder incorporates all the advanced features required in today's global military/civil air traffic control environment. The transponder's open system architecture design and high-density FPGA technology ensure ongoing versatility and future utility through software upgrade only, without the risk and cost associated with hardware modifications.

The Next-Generation Common Transponder is configured for replacement of all AN/APX-100, AN/APX-101, AN/APX-108, AN/APX-72, AN/APX-64 and AN/UPX-28 transponder installations.

SELECTED BY U.S. NAVY/ARMY

AN/APX-117(V)
AN/APX-118(V)

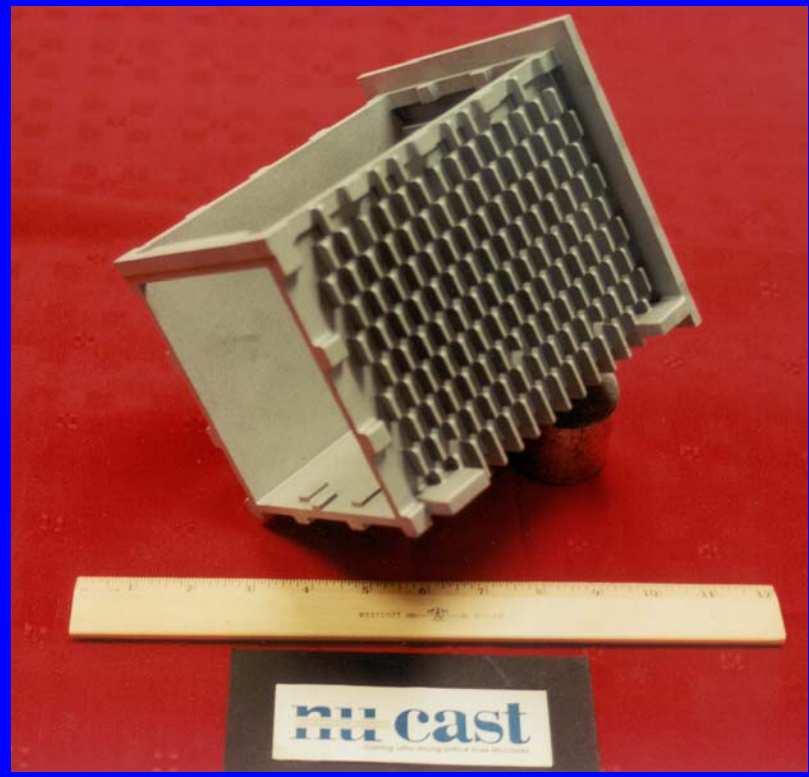
COMMON TRANSPONDERS (CXP)

BAE SYSTEMS' Common Transponder (CXP) was selected by the U.S. Navy/Army as their future transponder. The AN/APX-117(V) and AN/APX-118(V) incorporate all the advanced features required in today's global military/civil air traffic control environments. The transponder's open system architecture design and high density FPGA technology ensures ongoing versatility and future utility through software upgrade only, without the risk and cost associated with hardware modifications. The AN/APX-117(V) and AN/APX-118(V) are configured for replacement of all AN/APX-100, AN/APX-101, AN/APX-108, AN/APX-64, AN/APX-72 and AN/UPX-28 transponders.

Electronic Housings (Investment Castings)

NU - CAST, INC

Optical Housing
(Investment Casting)



Electronic Chassis
(Investment Casting)

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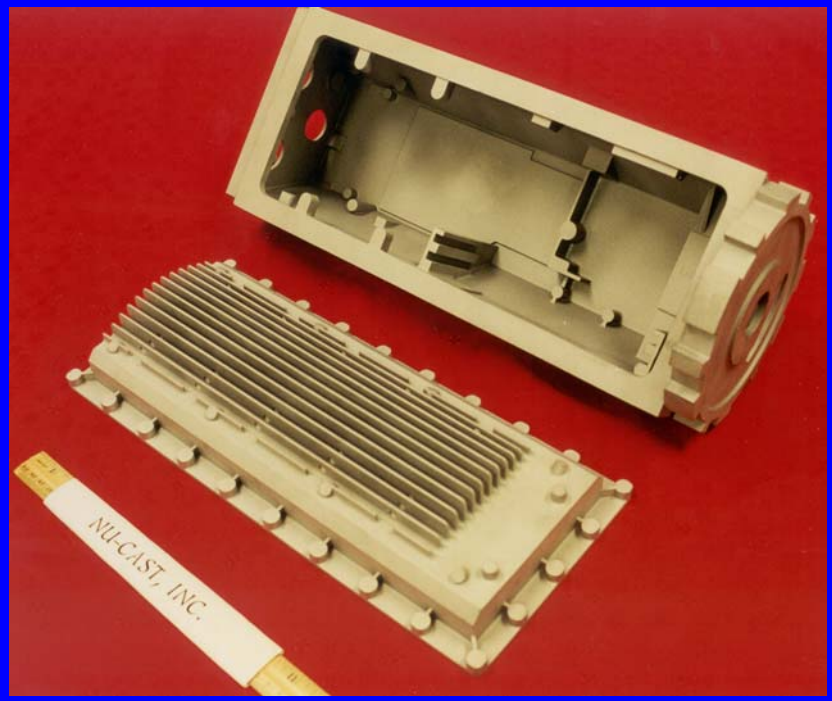
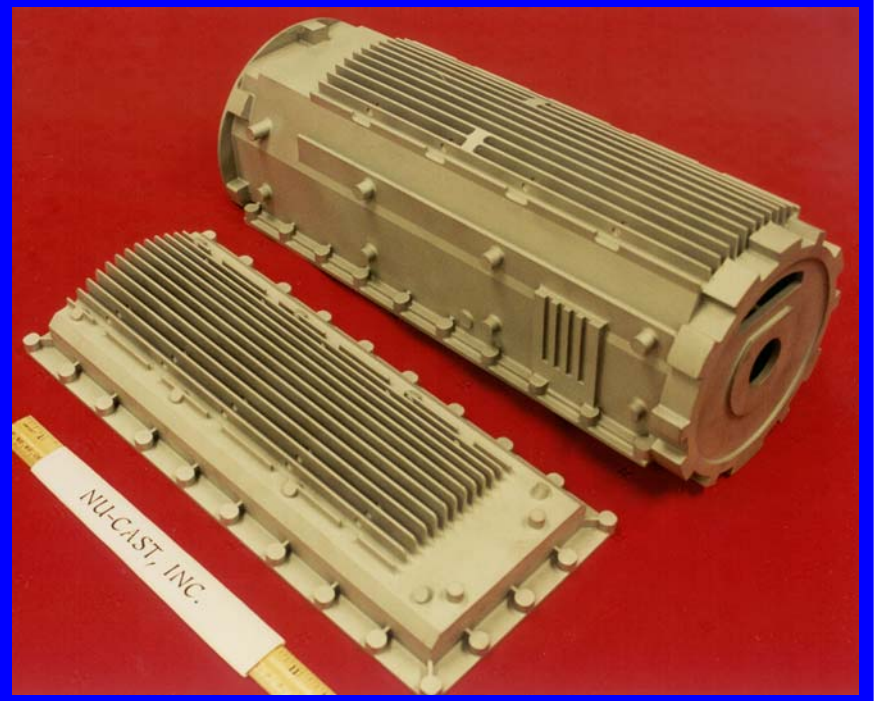
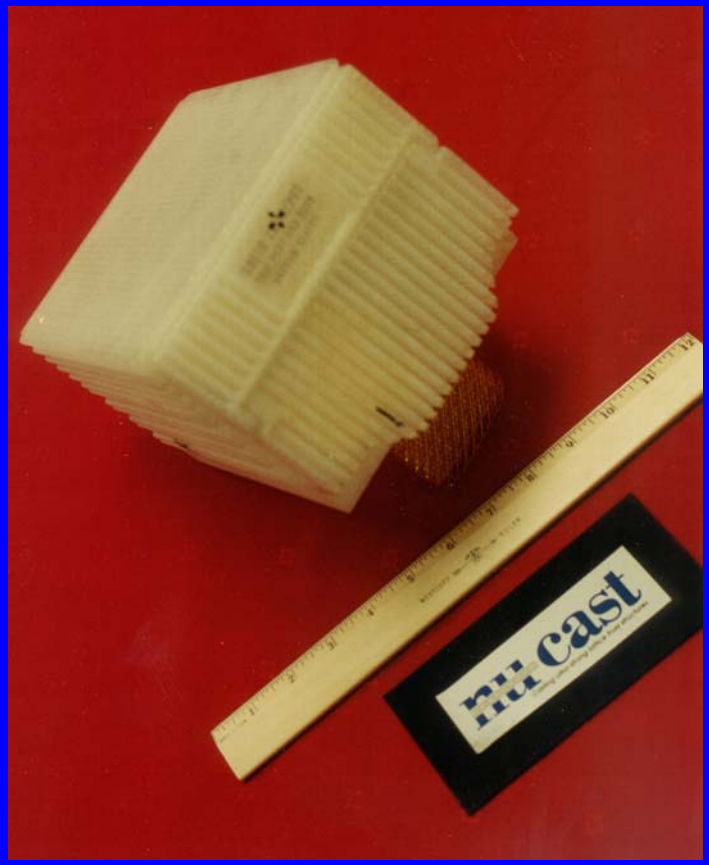




Missile Electronic Housing, Cover & Chassis
(Investment Casting)

NU - CAST, INC



Electronic Housings
(SLA”S)

Electronic Housings
(Investment Castings)

NU - CAST, INC

Housings
(SLA'S)

Gimbal & Housing
(SLA'S

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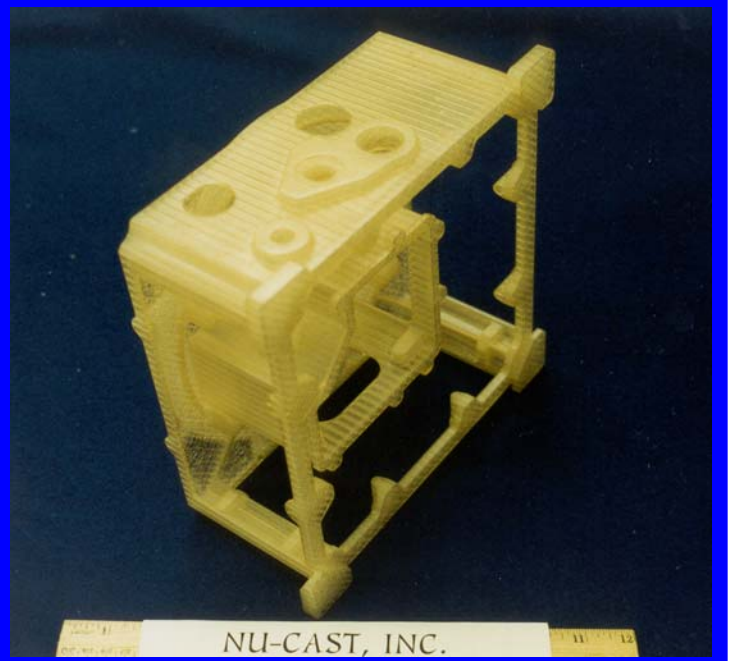
Housing & Covers, ATIRCM
(SLA'S)



Housing, Support, ATIRCM
(SLA)

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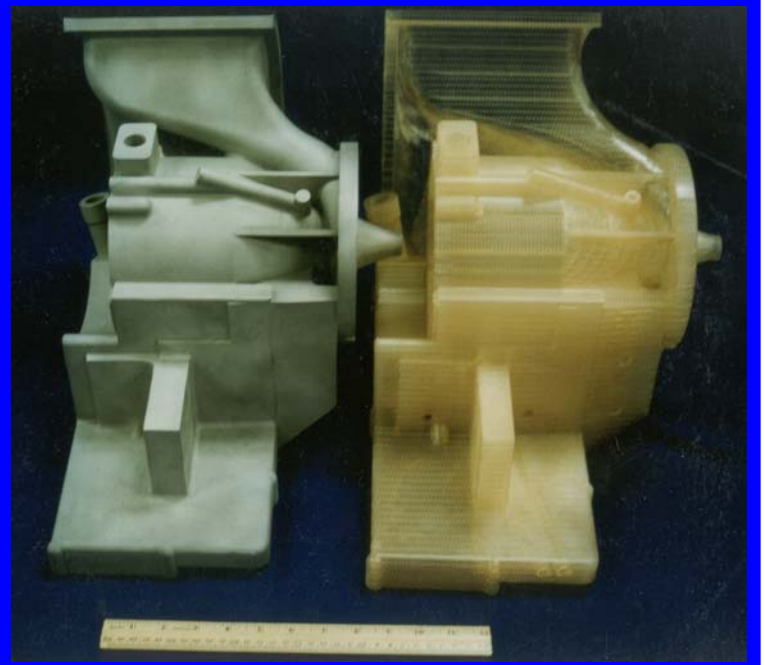
Housing
(Investment Casting & SLA)



Housing
(Investment Casting & SLA)

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SLA PATTERNS

TOP: THAAD Optical Sensor Housing
BOTTOM: Pump Housing

Thrust Deflector Housing

LEFT: Deflector, Investment Casting
RIGHT: Deflector, SLA Pattern

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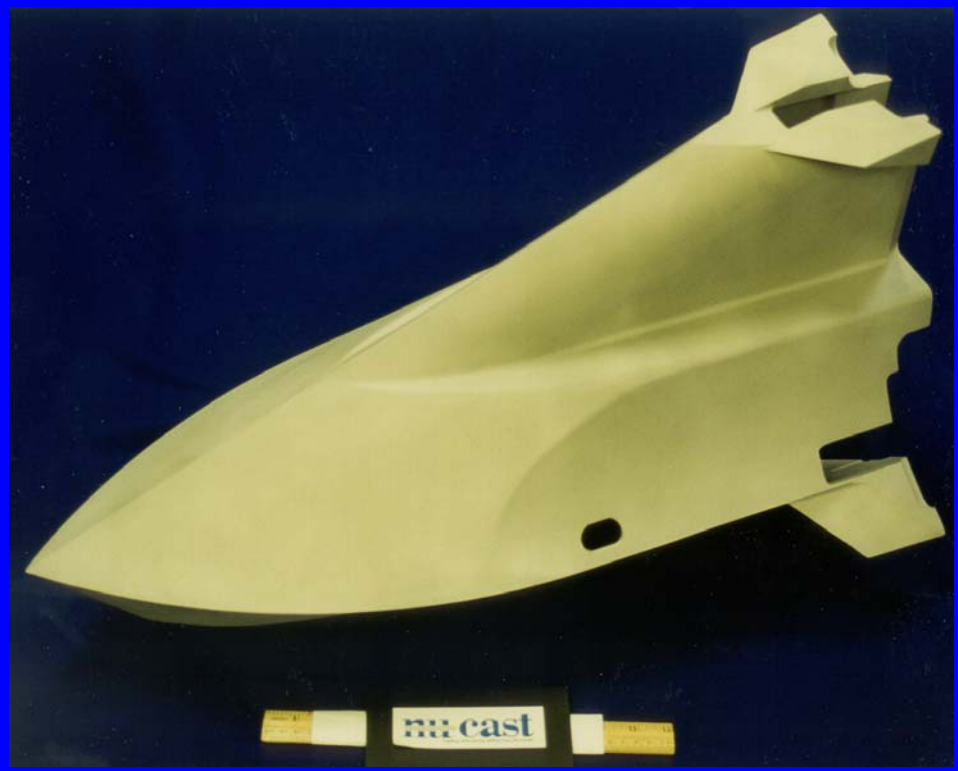
Electronic Housings
(Investment Castings)

FLIR Optical Housings, Inv. Casting
(Casting Design/Engineering By Proto Engineering)

TOW Optical Housing, Inv. Casting
(Casting Design/Engineering/Conversion By Proto Engineering)

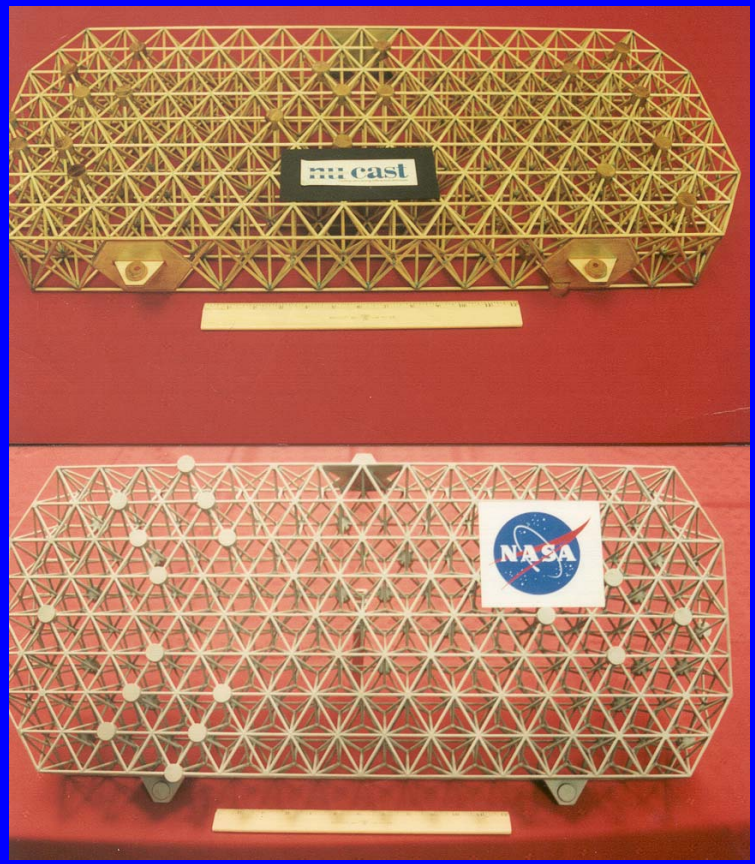
NU - CAST, INC



Rail, A/C Missile Launcher Housing
(Investment Casting)

Rail, A/C Missile Launcher Housing
(Investment Casting)

NU - CAST, INC



Optical Bench, “3D” Truss, Offner Relay Test, NASA/GSFC (SBIR II)

Wood Prototype (Top), Investment Casting (Bottom)

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J. Bowkett With SMEX • Lite ,NASA/GSFC

(Wood Prototype, Other Samples In Background)

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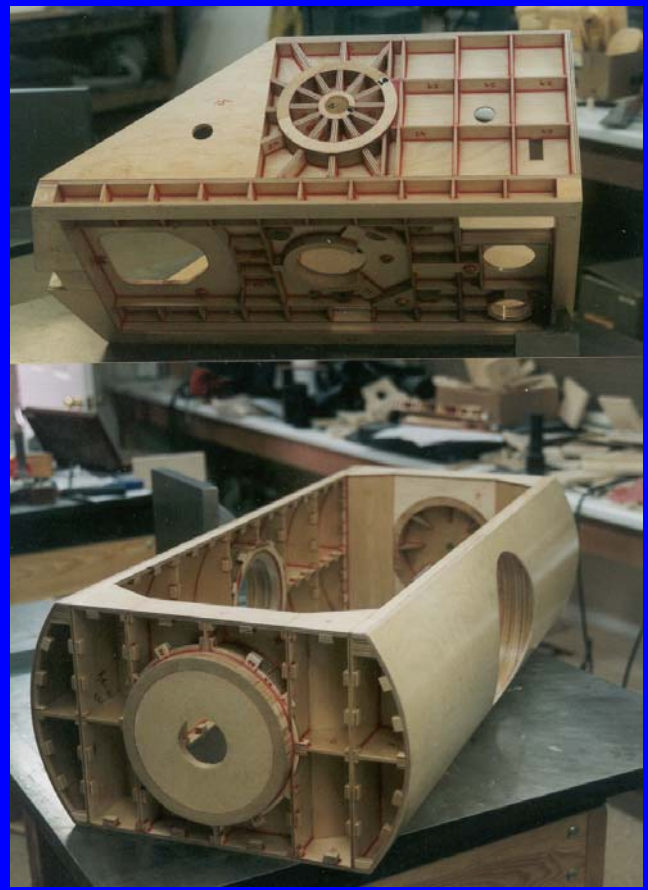
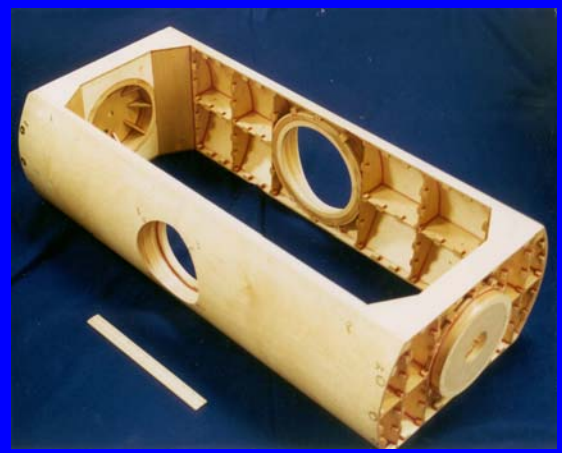
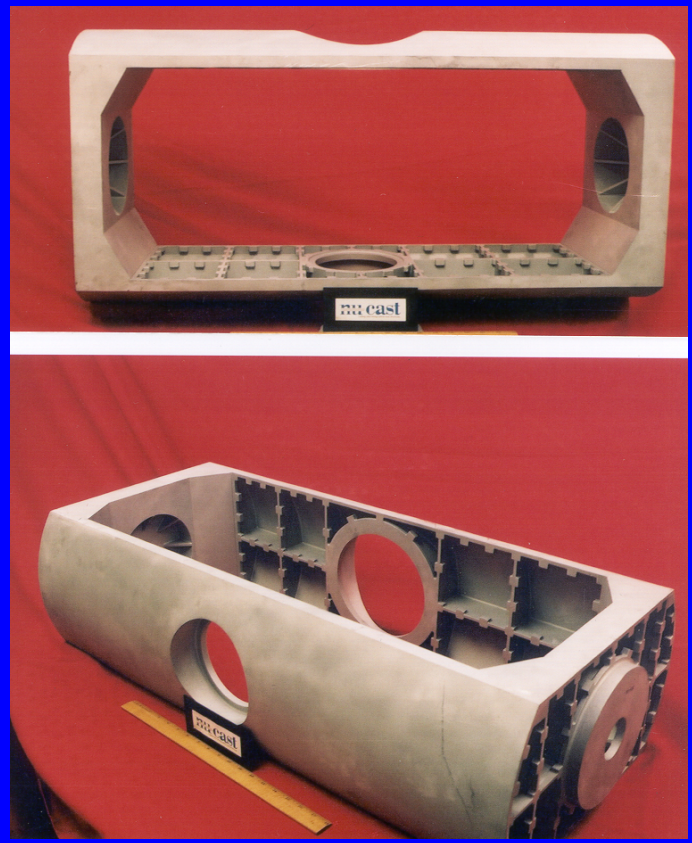




DB - 110 Recce Roll Frame & Optical Bench

(Wood Prototypes)

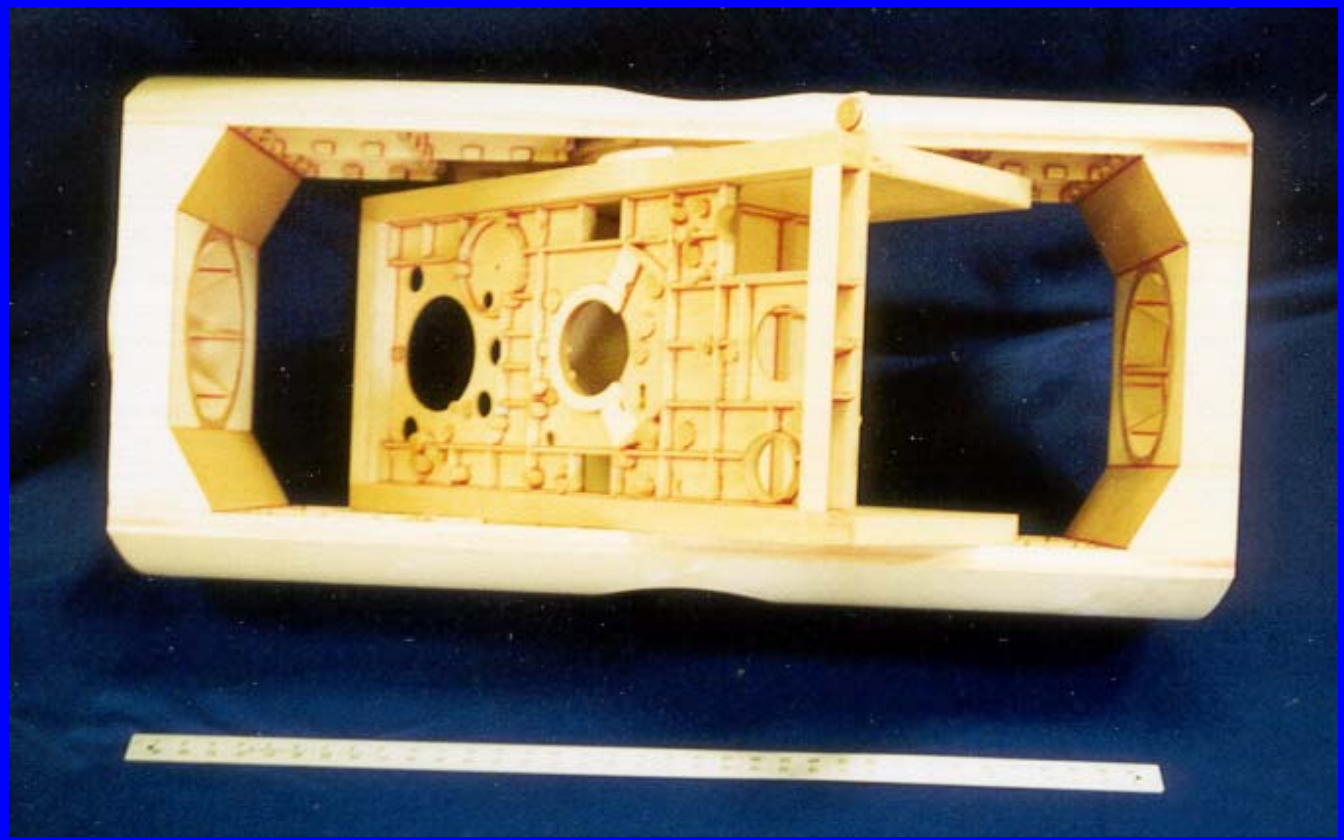
NU - CAST, INC



DB - 110 Roll Frame (Goodrich Recce System)

(Investment Casting Designed By Proto Engineering)

NU - CAST, INC

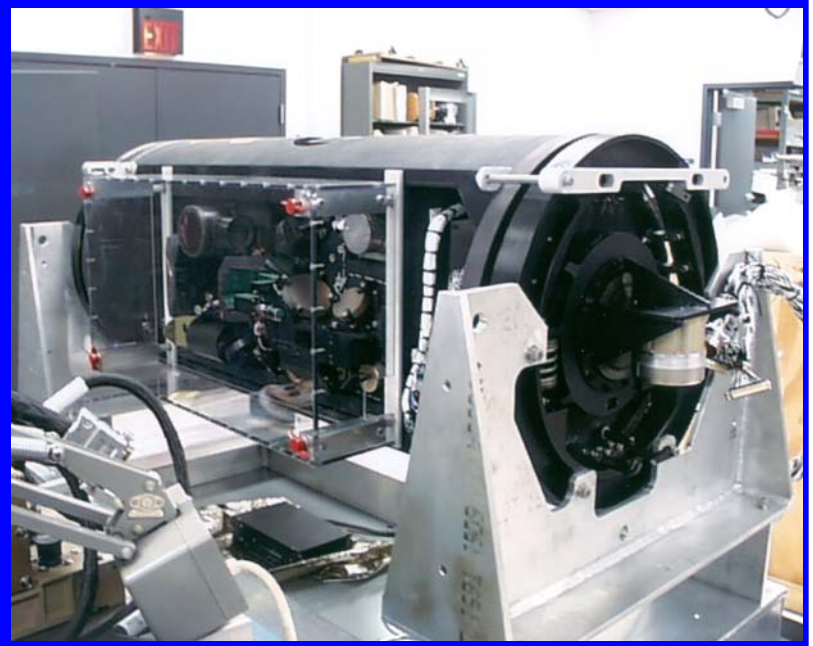


DB - 110 Recce System, Goodrich Roll Frame & Optical Bench

(Wood Prototypes)

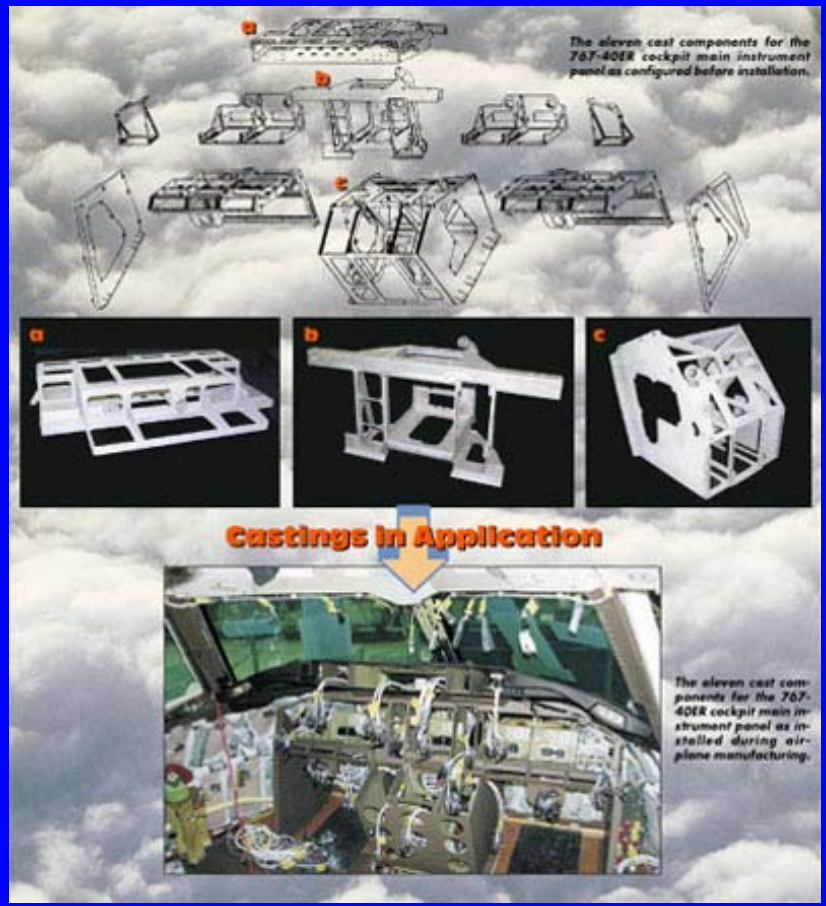
NU - CAST, INC

DB - 110 Recce System
(Camera Assembly On Fixture)



DB - 110 Recce System
(Camera Assembly On Fixture)

NU - CAST, INC



Boeing 767-40ER A/C Cockpit (Cast Conversion)

NOTE: Conversion Reduced 296 Part Numbers To 53 (With 11 Casting Assemblies) & Cost By 50 %

Boeing 767 A/C Main Landing Gear Door Uplock Support (Cast Conversion)

NOTE: Conversion Eliminated 27 Part Numbers

Boeing 777 A/C Outboard Overhead Stow Ben End Frame (Cast Conversion)