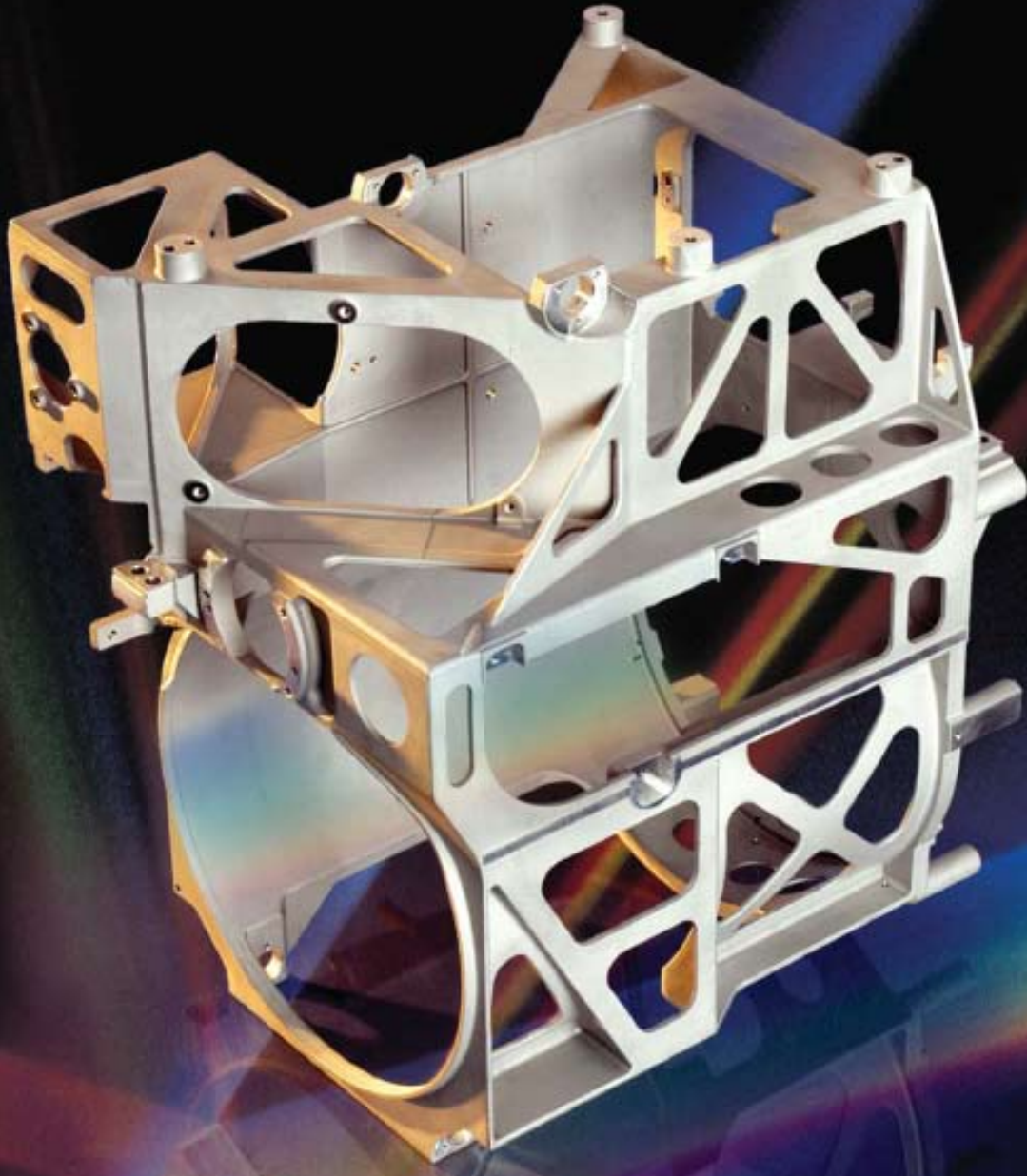




# NU-CAST

*An International Aluminum Investment Casting Company*



# THERMAL TRANSFER CONFIGURATIONS

Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast

*Nu-Cast, Inc. is a completely integrated privately owned American Company. Founded by Mr. D. Don Mc Kitterick, President, in 1985 and located in Londonderry, NH. Nu-Cast, Inc. is an International leader in the manufacture of precision aluminum investment castings. We are ANSI/ASQ/ISO 9000:2000, and AS9100 certified, and also work to MIL-I-45208 and as such are committed to continuous improvement.*

*Nu-Cast produces high quality castings by the lost wax process while using a proprietary ceramic shell system. Our castings can be manufactured using hard tooling or by using wax or resin models generated from electronic data.*

*We are the recognized world leader in manufacturing RAPID PROTOTYPE CASTINGS from SLA patterns for pre-production, R & D, and short run projects. Our expertise in this area significantly reduces time to market for our customers products.*

*Through the pursuit of excellence, Nu-Cast has received numerous awards from our customers. The NASA "Commitment to Excellence", "Industry Advocate of the Year" award, and many OEM "Supplier Excellence" and "Preferred Supplier" awards are just a few of the rewards of our commitment and hard work.*

*At Nu-Cast, we recognize that teamwork is the key to success. It is the teamwork with our customers and the Nu-Cast team that has allowed us to maintain a high level of performance and continue to be a leader in the investment casting industry.*

*Experience, commitment to quality, engineering innovation, and unparalleled customer satisfaction makes Nu-Cast the right choice for your precision aluminum casting requirements.*

As an ISO 9001:2000 & AS9100:2004 certified company; Quality assurance is designed into every step of our processes. Our commitment and dedication to product quality makes Nu-Cast a supplier that you can trust and depend on for all your aluminum casting needs.



Whether your technical issue is weight, cooling or complex geometry Nu-Cast is a leading supplier of precision investment castings of all sizes, including thin wall construction, integral cooling or intricate design.

## COMPLEX GEOMETRIES

*Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast*



Castings applications include: aerospace, military, optical benches and housings, electronic housings, medical diagnostic and test equipment and commercial uses.



Nu-Cast uses the latest 2D & 3D CAD modeling applications allowing direct design transfer between NCI and our customers.



Reduces the need for multiple machine set-ups.



# SPECIALISTS IN RAPID PROTOTYPE CASTINGS

## *SLA and other Rapid Prototype Technologies*

In today's highly competitive business environment, time to market is critical. Fast tracking of rapid prototypes significantly reduces process time. This allows Nu-Cast to meet the customer's required delivery dates, putting our customers ahead of their competition.



Nu-Cast uses the latest aluminum investment castings technologies to meet or exceed your custom casting specifications.



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

## SPACE FLIGHT APPLICATIONS

Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast Nu-Cast

Nu-Cast, Inc and NASA engineering worked together to produce high strength aerospace castings derived from computer generated prototype patterns to meet the challenges of space flight hardware.



Functional designs without mass Investment castings can be designed to achieve the greatest strength with minimum weight by removing all unnecessary mass from the structure.



In our main facility we can provide house tooling, x-ray, penetrant, welding and heat treating. Nu-Cast also utilizes the latest technology such as CNC-CMM to assure the ultimate in quality.



**ISO 9001:2000 & AS 9100:2004 Certified**

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# NU-CAST — MESSENGER SPACECRAFT

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## Investment Casting of the Integrated Electronics Module (IEM) chassis for the MESSENGER spacecraft

MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) is a mission to orbit the planet Mercury. The MESSENGER spacecraft is designed and developed by the Johns Hopkins University Applied Physics Laboratory, and is the first to orbit the planet Mercury.

The Integrated Electronics Module (IEM), as shown in Figure 1, is the central control unit of the entire spacecraft. It operates the spacecraft, stores data, and autonomously detects and mitigates onboard faults. There are two IEMs onboard the spacecraft for redundancy.

Aluminum investment casting has been selected, from the traditional hog-out method, and the oven-brazed method, as the fabrication technique for the IEM chassis, to meet the design requirements and to reduce the fabrication cost. The monolithic structure from casting technique is more reliable structurally, and is superior in thermal performance.

We visited NU-CAST in November 2000 during the process of searching a candidate foundry for the chassis fabrication. We were impressed by the casting expertise NU-CAST has demonstrated, its well-established processes, and quality control.

NU-CAST has fabricated the pre-engineering chassis for the MESSENGER IEM, as shown in Figure 2. We have conducted suites of vibration tests with the mock-up PWBs and are satisfied with the performance of the chassis. We are in the process of ordering three (3) flight chassis from NU-CAST. STEREO, another spacecraft also designed and developed by

JHU/APL is considering using aluminum investment casting for its IEM fabrication.



Figure 1: The MESSENGER IEM

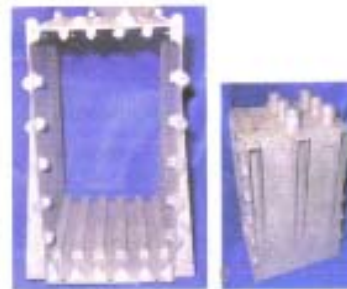


Figure 2: Aluminum Casted IEM Chassis

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# TOLERANCES & ALLOYS

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## 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 industries. 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	44/55	2/4	Hot short alloy, very low castability, configuration sensitive. Applications: Highstrength castings (Design only in consultation with foundry).
C355	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 temperatures, such as turbine engine parts, pumps, ect.
A356	T6	MIL-A-21180 AMS-4218	33/42	27/32	2/5	Moderate strength, excellent castability, weldability and pressure tightness. Applications: Housings, chassis and castings 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.
D712	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 cost 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 degree 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 configurations 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 Ra  
Premium-63 Ra

**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.