wakefield-vette

Additive Manufacturing Vita 48.4 and 48.8

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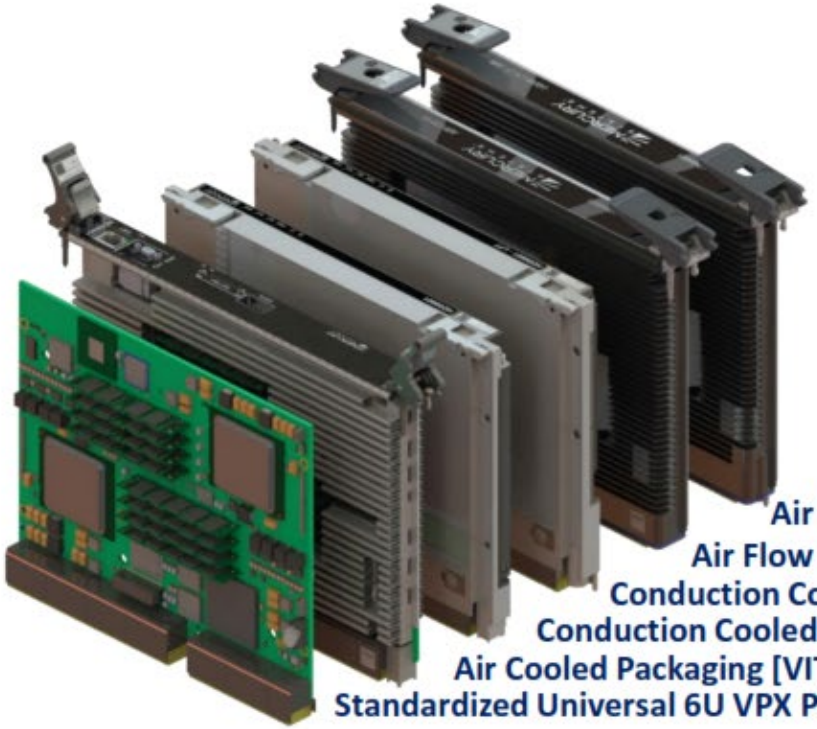
Additive Manufacturing Overview

- How it works
- Materials and their properties
- Advantages
- Combining Additive with Subtractive
- Applying the technology to LFT and AFT
- Optimization of design for AM over Traditional methods
  - MFAM – Modified for Additive Manufacturing
  - SFAM – Simulation for Additive Manufacturing
  - DFAM – Design for Additive Manufacturing

What is Vita 48 - LFT & AFT?

- Enhanced Ruggedized Design Implementation
- How to apply advanced cooling techniques to traditional VME or VPX Cards
- Vita 48.4 – Liquid Flow Through (LFT)
- Vita 48.8 – Air Flow Through (AFT)



Air Cool
VITA48.1

Air Flow By Packaging w/LFB [VITA 48.X]
Air Flow By Packaging [VITA 48.7]
Conduction Cooled Packaging w/LFT [VITA 48.X]
Conduction Cooled Packaging [VITA 48.2]
Air Cooled Packaging [VITA 48.1]
Standardized Universal 6U VPX PCBA

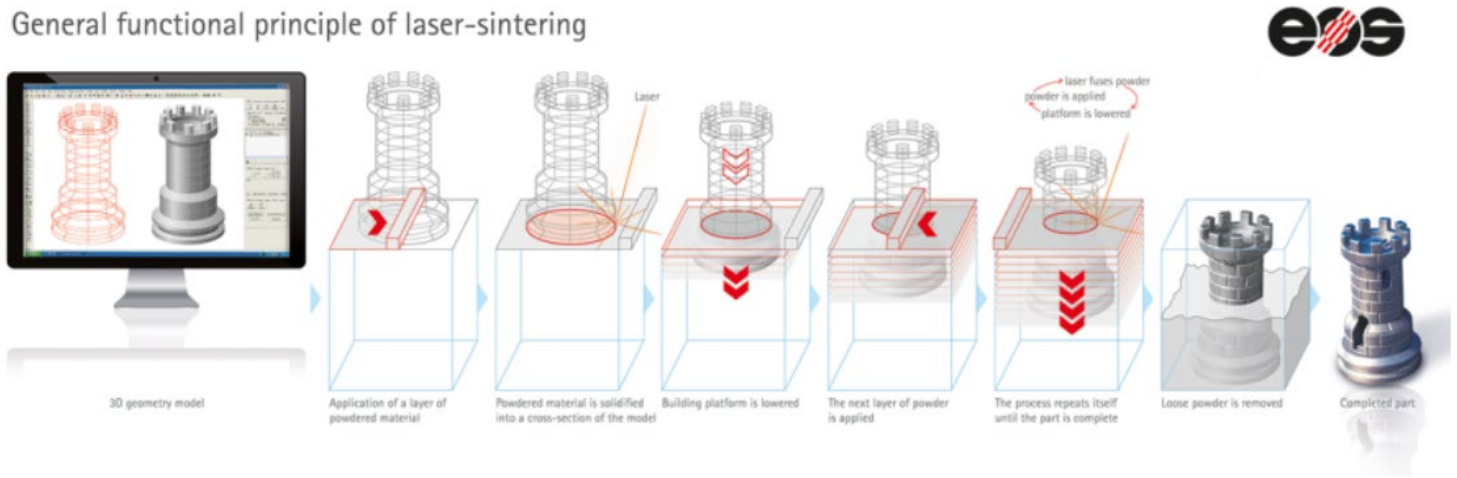
OpenVPX3U
Conduction Cool VITA48.2
Safety Mission Computer

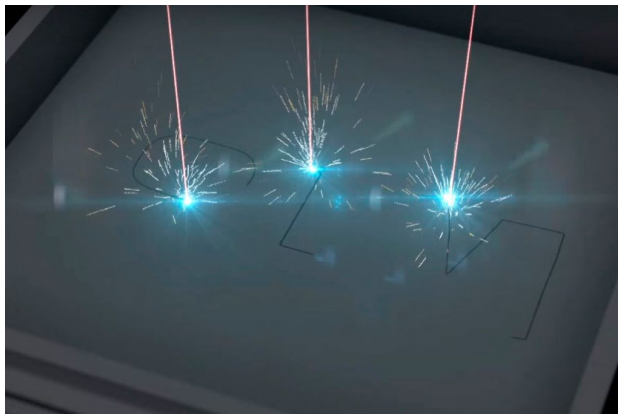
AIRFLOW-BY™
VITA48.7

Conduction Cool w/LFT
VITA48.2

Core Technologies: How to melt the metal

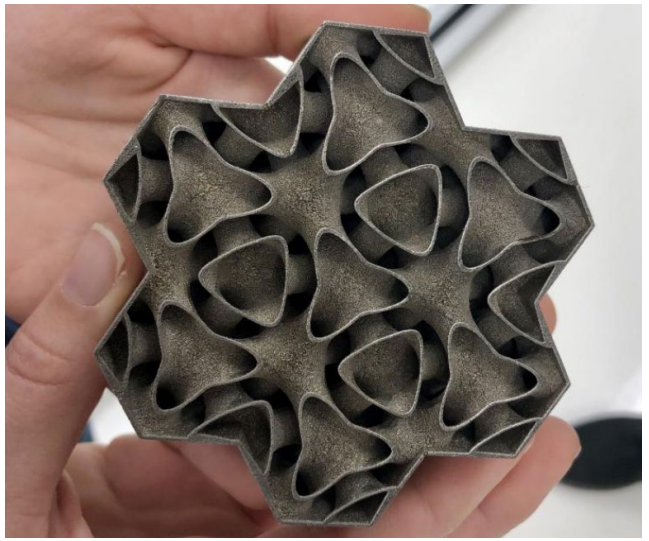
- **Most widespread technologies use powdered metals to make parts layer-by-layer**
  - 20-70 micron diameter powders are spread in a thin layer.
  - Laser, or an electron beam, fuses/melts the powder only where the part will be.
  - The part is subsequently lowered, and a new layer of powder is delivered.
  - Once the part is complete it is still encased in powder.
  - Part is removed and powder is removed from all channels.
  - There are multitudes of variables that can be controlled for growth and feature optimization.





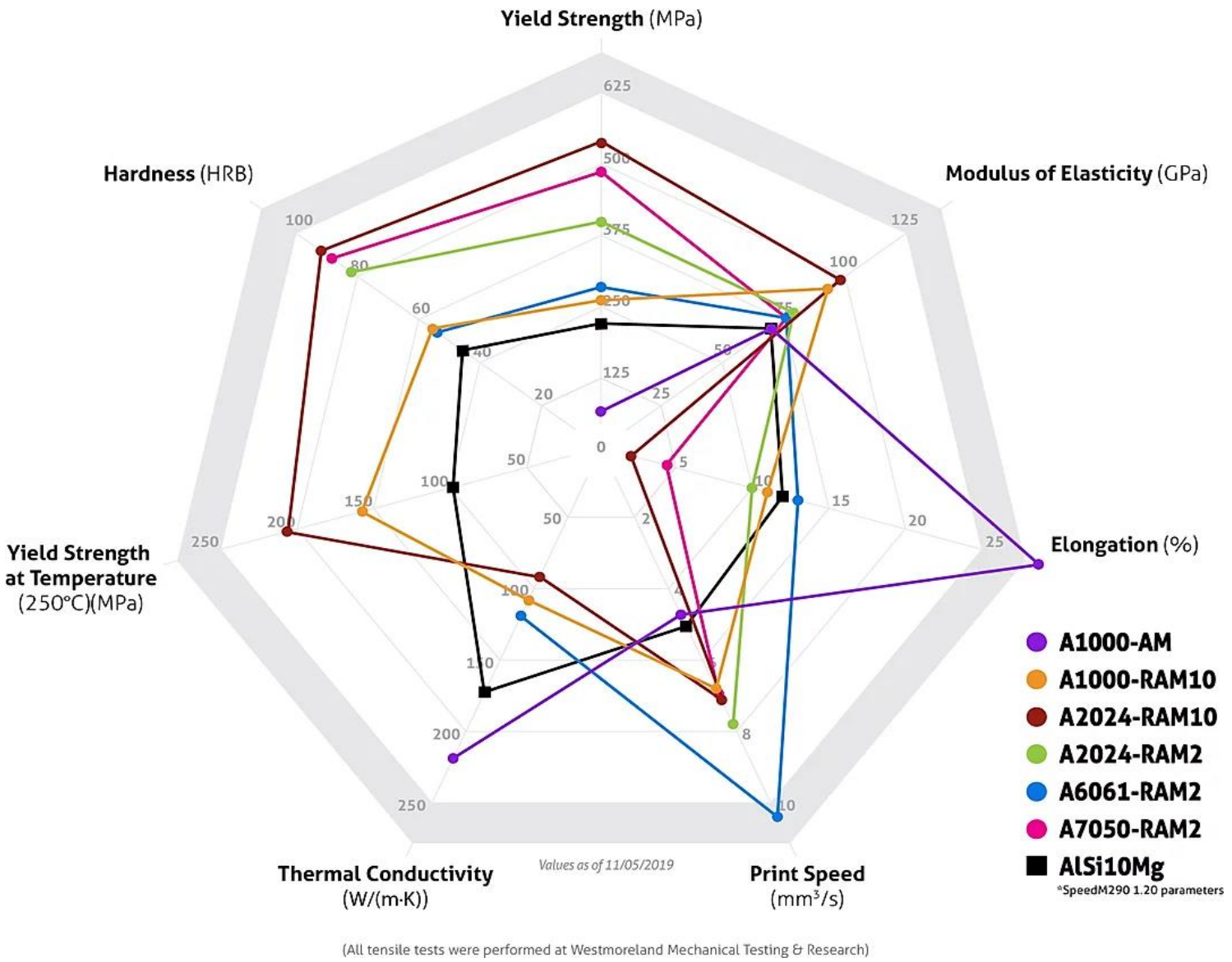
Advantages of metal additive manufacturing (AM)

- **Geometric Freedom**
  - Design for the solution not how it can be made
- **Significantly complex shapes are possible**
- Not constrained by tool paths
- **Hidden or internal features**
- Tunable design capabilities
- Reduce costs on non-revenue generating parts
- Can be fully automated
- **Large lead time and cost advantage over brazing**
- Prototype faster without tooling investment
- Digital inventory and Legacy Parts
- **Weight Savings**
- Power is tunable to desired properties
- **Simplified Assemblies**
  - Complex assemblies that can be printed as one part
  - Reduces assembly time, part count and manufacturing steps



Materials Comparison – Possible Customization

- Typically trade off between strength and thermal conductivity
- Print speed is key factor in cost



(All tensile tests were performed at Westmoreland Mechanical Testing & Research)

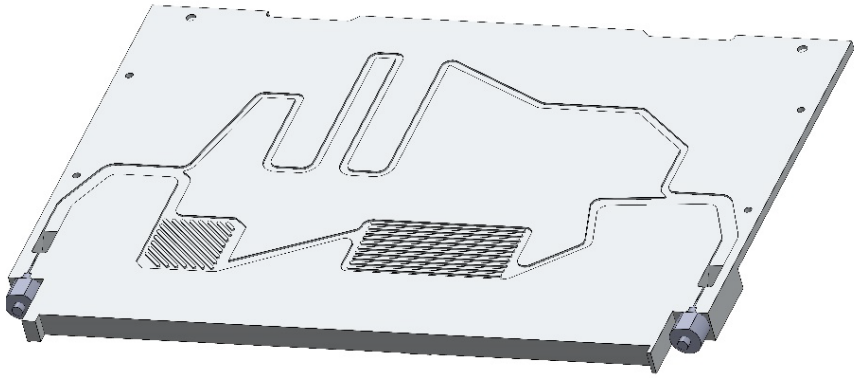
Process and Materials

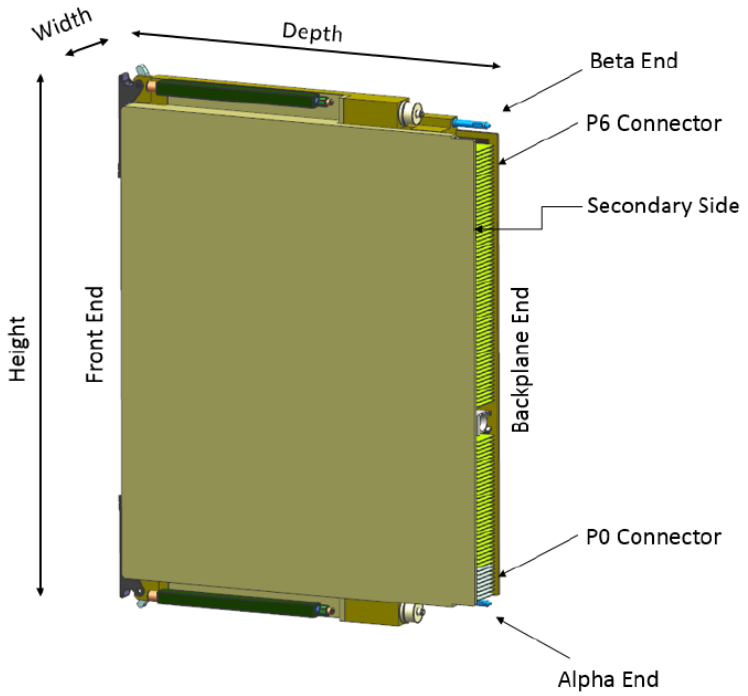
- As-printed strength is high and density should be nearly 99%+, but typically thermal conductivity is lower
- Post-processing heat treatment reduces stress an increase thermal performance

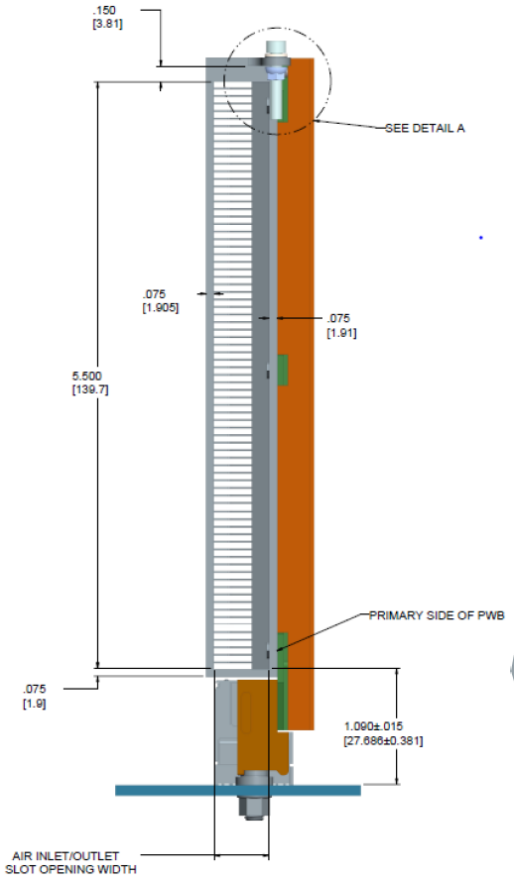
	Condition	UTS (Mpa)	Yield (Mpa)	Elongation	Thermal Conductivity (W/m-K)
AlSi10Mg (Printed)	As Built	450	280	4%-8%	160
	Stress Relieved	270	160	8%-14%	173
	T6	320	256	8%	173
6061RAM2 (Printed)	As Built	250	226	1%-4%	---
	T6	290	250	12%	~120
6061 (Billet)	T6	310	276	12-17%	167
6101 (Billet)	T6	221	193	19%	218
6063 (Billet)	T6	241	214	12%	200

Combining Additive with Subtractive – Vita 48.4 – 48.8

- Folded fin, internal liquid channels and custom chassis all possible

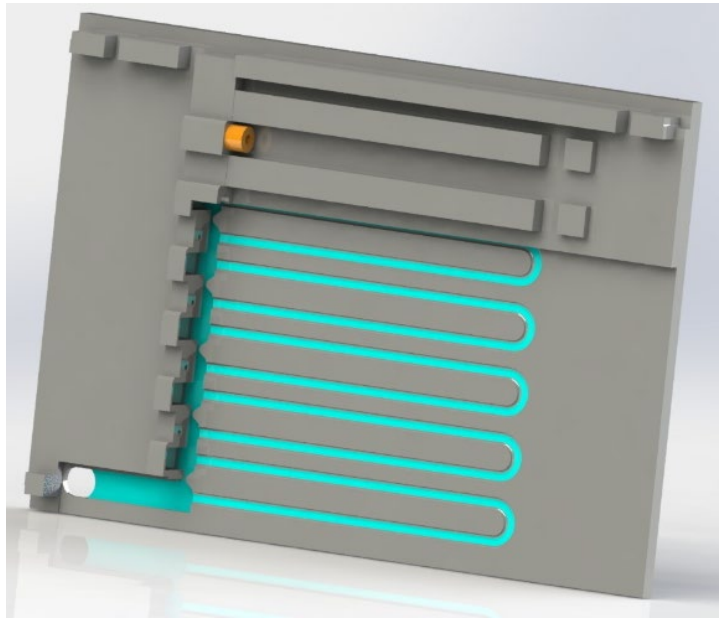


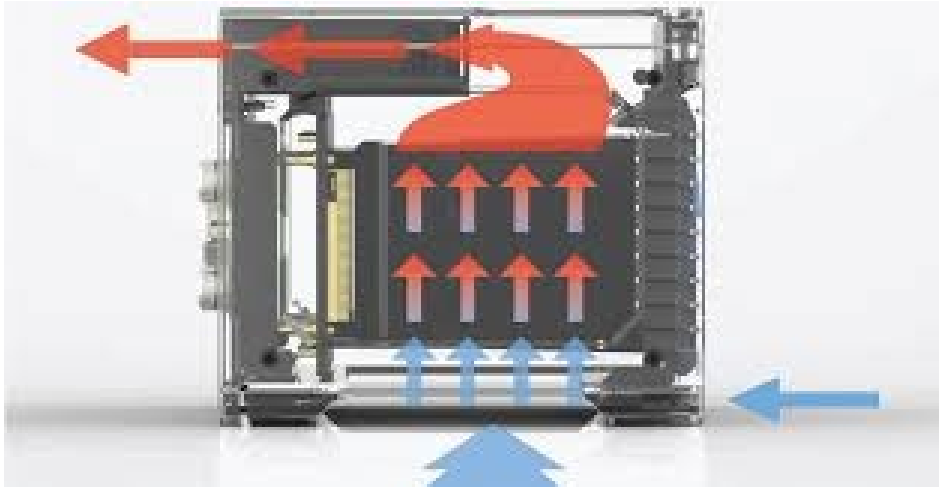


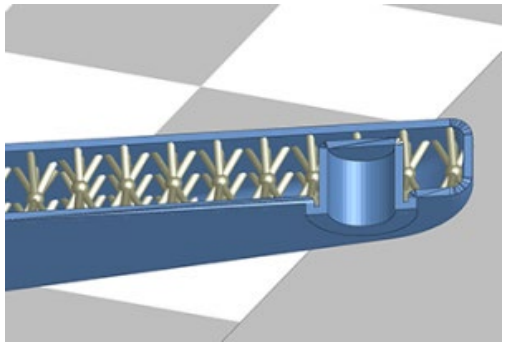


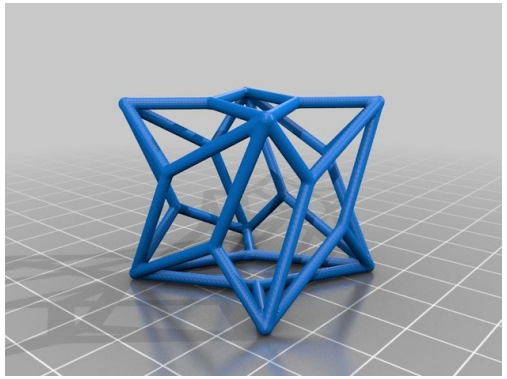
Applying the Technology to VITA 48.4 LFT and 48.8 AFT

- **LFT Chassis**
  - High mix – Low Volume is ideal for AM
  - Multi layered cooling channels possible inside chassis wall



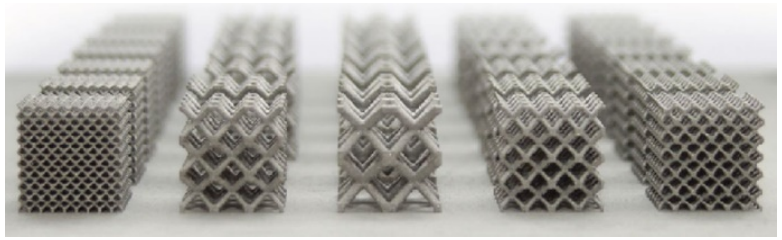






Optimization of design over traditional methods

- **MFAM – Modifying for Additive Manufacturing**
- **SFAM – Simulation for Additive Manufacturing**
- **DFAM – Design for Additive Manufacturing**
  - CFD, Heat Transfer Analysis, FEA, Fatigue Analysis, AM Simulation
- **Processing/Printing –**
  - Slow printing during channel printing and at start/stop of surfaces
  - Fast printing bulk structures
- **Internal Structures**
  - In liquid path for increased thermal performance
  - Chemical honing
  - Power Removal



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Thank you