Meltio Material Datasheet

Meltio Aluminum 4046

AlSi10Mg / G AL 4046(AlSi10Mg) / 3.2381

Aluminum 4046 is an aluminum-silicon alloy wire designed for welding applications. With a high silicon content, it provides excellent fluidity, reducing the risk of hot cracking and ensuring smooth, uniform weld beads. This alloy is commonly used for welding aluminum castings and automotive applications. It offers good corrosion resistance and moderate mechanical properties, making it suitable for applications requiring high-quality, strong welds.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization[3]
1.2 mm	7 kg	B300	Uncoated	577 - 630 ºC	2.7 g/cm³	Ti64	1.2 U-Groove	Full Chamber

Standard Chemical Composition

Al	Si	Fe	Cu	Mn	Mg	Zn	Be	Ti
Bal.	9.0-11.0	< 0.50	< 0.03	< 0.4	0.2-0.5	< 0.1	<0.0003	< 0.15

Specification: EN ISO 18273
ISO/ASTM 52942:2020: Group D [5]

Tested Print Profiles

Laser	Profile name	Meltio TRL[2]	Laser Power [W]	Energy Density [J/mm3]	Deposition Rate [g/h]	Volume rate [cc/h]	Relative Density [%]	Max Pore/Defect [µm]
450 nm	**Hollow 1P Rev 10 2025-02-25**	Develop	1000	23.15	420	155.52	-	-
	Solid Rev 11 2025-06-27	Develop	1400	54.01	182	67.42	-	-
	Hollow 1P Rev 1 2025-06-24	Develop	1400	23.15	415	153.56		
	Hollow 2P Rev 12 2025-07-11	Develop	1400	46.67	160	59.6		

* Printing profiles available in our official Slicers: **Meltio Horizon** for standalone Printers and **Meltio Space** for Laser Integration Kits.
** Profiles developed for the 1.4Kw blue head will be available for Meltio Space for laser integration kits.

Structural Properties

ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Blue Laser			
		Heat Treatment		As Printed	
		XY	XZ	XY	XZ
Ultimate Tensile Strength [MPa]	140	WIP	WIP	WIP	WIP
Yield Strength [MPa]	70	WIP	WIP	WIP	WIP
Elongation [%]	4	WIP	WIP	WIP	WIP
Hardness [HV-30]	-	-	-	-	WIP

Reference Standards

	Casting *(ISO R2147)*
Ultimate Tensile Strength [MPa]	300
Yield Strength [MPa]	170
Elongation [%]	2.5
Hardness [HV-30]	115

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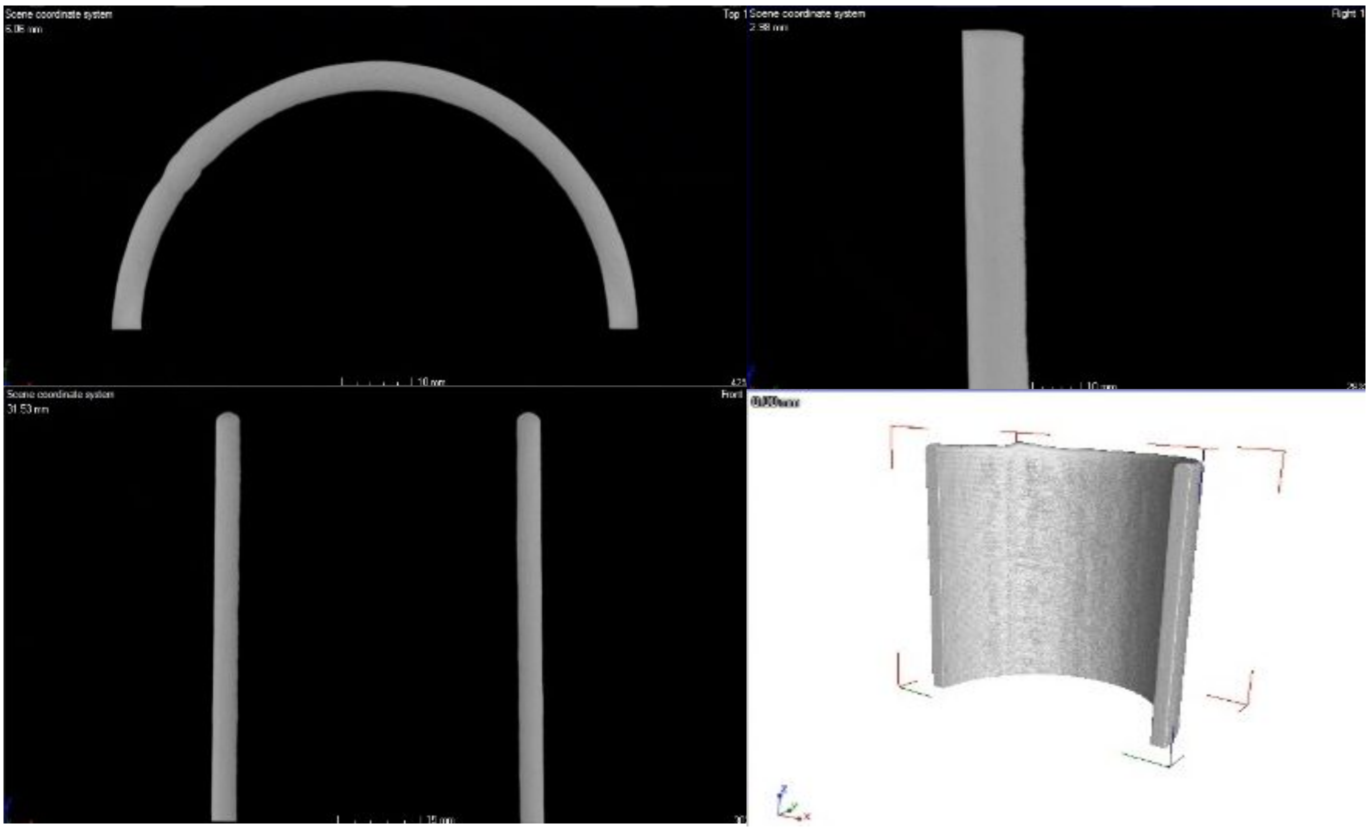
Internal Structure [1]

Tomography

CT Scan of 3D printed sample part in Aluminum 4046 using Blue Laser without detectable voids or defects. Resolution of 24 µm per pixel.



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1.Internal Structure

Tomography

The tomography images were obtained from a 80x80x200 mm printed hollow cylinder using the **Rev 10 2025-02-25** Profile for Blue laser and were analyzed by an external laboratory. (*CATEC* *info@catec.aero*)

2.Meltio TRL Classification System

The manufacturing process of Copper and Aluminum using Meltio's Blue Laser technology has certain limitations. Currently, thin-walled geometries (produced in a single pass) can be reliably manufactured. However, solid or bulky components present challenges due to variations in material behavior and thermal properties as the volume and mass increase. While small solid volumes of these materials can be printed, scalability remains an area of ongoing development.

Additionally, the technological readiness of Copper and Aluminum printing is currently between **Technology Readiness Level (TRL) 3 and 5,** indicating that it is still in the experimental validation and optimization stages. In contrast, other Meltio materials, such as steels, nickel and titanium alloys, have reached higher maturity levels, ranging from TRL 7 to 9, with validated applications in industrial environments.

To clearly communicate the development and readiness level of materials within the Meltio ecosystem, an internal classification system has been established, aligned with the standard Technology Readiness Levels (TRL). This framework offers a structured reference for customers, partners, and integrators regarding the current validation stage and industrial applicability of each material.

Meltio Tier	TRL	Description
Meltio Explore	1–3	Exploratory phase focused on researching new alloys and process configurations. Designed for R&D environments aiming to push the boundaries of the technology.
Meltio Develop	4–6	Active development stage. Functional results have been achieved, with evolving process parameters. Suitable for concept validation and pre-industrial applications.
Meltio Qualified	7-8	Material and process qualified for demanding applications. High repeatability and reliability, ready for integration into real-world production environments.
Meltio Proven	9	Fully validated in industrial settings. Material used in end-use parts with proven performance in actual production. Represents the highest level of technological maturity.

3.Inertization

Inertization of Meltio M600 machinery can be performed in two ways: localised inertisation or full chamber inertization. Both options are designed to ensure a controlled environment during the 3D printing process and prevent oxygen contamination of reactive materials.

Localised Inertization:
In this mode, the shielding gas is supplied locally through the shield nozzle located in the deposition head, with a flow rate of approximately 20 L/min. This method is suitable for most applications where oxygen control in the work area is necessary without requiring a completely isolated environment.

Full Chamber Inertization:
For more demanding applications, it is possible to perform a full chamber inertization. In this case, the chamber must be preconditioned before the printing process is started, reaching an oxygen concentration of 50 ppm. It is essential to control the oxygen concentration in the chamber, as reactive materials can absorb oxygen even when the part is hot, not only when it is in the melt pool.

The choice of inertisation method depends on the properties of the material to be used and the specific requirements of the printing process, ensuring the highest quality and integrity of the manufactured parts.

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4.Storage and Preservation

To ensure optimal material performance, coils should be stored in a clean, dry environment, protected from humidity and corrosive agents.
During long-term storage, the material may develop a **natural passive layer**, which could affect feeding or deposition performance.
In marine or high-humidity environments, or if the material will remain **unused for several weeks or months**, it is recommended to use **vacuum-sealed or plastic packaging** to prevent oxidation and preserve the surface condition.

5. Material Classification (ISO/ASTM 52942:2020)

The metallic material specified in this technical data sheet is classified in accordance with the ISO/ASTM 52942:2020 – Additive Manufacturing — Metallic Materials — Classification. This standard defines a harmonised system for the designation and categorisation of metallic materials used in additive manufacturing, ensuring consistent identification and traceability.

Grade 4046 is designated within **Group D**, corresponding to aluminium-silicon alloys.