Meltio Stainless Steel 316L

ER316LSI / G 19 12 3 L Si / 1.4430

Austenitic steel with excellent durability, low reactivity and adequate elevated temperature properties. The alloy has a low carbon content which makes it particularly recommended when there is a risk of intergranular corrosion. Thus, parts manufactured with SS316L are an excellent choice in corrosion prone applications.

General Properties

Wire Diameter	Weight on Spool	Spool Type	Wire Coating	Melting Point	Wire Density	Recom. Build plate	Drive Wheels	Inertization[4]
1.0 mm	15 kg	BS300	Uncoated	1398 ºC	8.0 g/cm³	304 Steel	1.0 V-Groove	Local

Standard Chemical Composition

Fe	C	Si	Mn	Cr	Ni	Mo
Bal.	0 - 0.03	0.65- 1.0	1.0 - 2.5	18.0 - 20.0	11.0 - 14.0	2.0 - 3.0

Specification: AWS A5.9 ER316LSi
ISO/ASTM 52942:2020: Group B [6]

Tested Print Profiles

Laser	Profile name	Meltio TRL[5]	Laser Power [W]	Energy Density [J/mm3]	Deposition Rate [g/h]	Volume rate [cc/h]	Relative Density [%]	Max Pore/Defect [µm]
976 nm	**Verified Density**	Proven	1100	122.22	259	32.38	99.7	-
450 nm	**Rev 10 2025-06-20**	Qualified	1000	83.33	361	45.57	99.97	185 / 266
	Rev3 2025-06-24	Qualified	1400	59.52	483	60.48	-	-

* 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 [1]

ASTM E8/E8M UNE EN ISO 6892-1 UNE EN ISO 6507-1	Wire	Infrared Laser				Blue Laser 1.0kW			
		Heat Treatment		As Printed		Heat Treatment		As Printed	
		XY	XZ	XY	XZ	XY	XZ	XY	XZ
Ultimate Tensile Strength [MPa]	620	556 ± 8	547 ± 8	643 ± 6	655 ± 11	665 ± 55	641 ± 47	659 ± 10	586 ± 77
Yield Strength [MPa]	420	215 ± 3	253 ± 17	429 ± 16	347 ± 28	334 ± 64	332 ± 50	521 ± 21	474 ± 22
Elongation [%]	35	65 ± 1	62 ± 2	38 ± 2	41 ± 4	46 ± 14	46± 18	37.7 ± 3	17.7± 15
Hardness [HV-30]	-	192	192	198	-	-	WIP	173	-

Reference Standards

	Cast *(ASTM A743)*	Cast *(ASTM A403)*	Wrought *(ASTM A473-24)*	Wrought *(ASTM A351)*
Ultimate Tensile Strength [MPa]	485	515	450	550
Yield Strength [MPa]	205	208	170	260
Elongation [%]	30	40	40	35
Hardness [HV-30]	-	215	-	225

Fatigue [2]

ASTM E466 (XZ)	Infrared Laser		Blue Laser	
	As printed	Heat Treated	As Printed	Heat Treated
Stress Range [Mpa]	220	190	WIP	WIP
Nº of Cycles (Nf)	5x10^6			
Stress Ratio (R)	-1			

Meltio Material Datasheet

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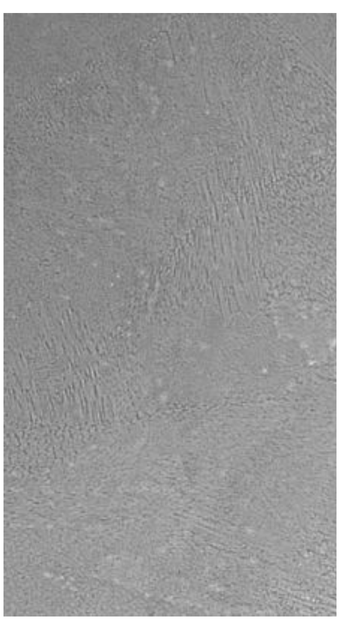
Internal Structure [3]

Micrography

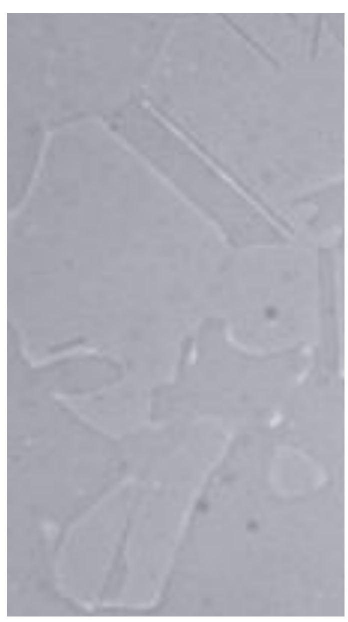
IR: The as-built SS316LSi samples show a microstructure with both cellular and columnar dendritic solidification mode. In as printed condition we find around 5.6% ferritic structures which are reduced to 0.2 % after heat-treatment of re-austenization.

Blue: The microstructural analysis of stainless steel SS316LSi reveals a primarily austenitic FCC matrix with a minor presence of delta ferrite (δ) as a secondary phase. In the As-Built condition, the structure is dominated by solidification dendrites, with δ-ferrite forming initially and partly transforming into austenite upon cooling. Residual δ-ferrite remains in interdendritic regions, often displaying vermicular or lath-like morphologies. After thermal treatment (HT), partial dissolution of dendrites occurs, enabling the formation of austenitic grains. In these recrystallized zones, δ-ferrite tends to accumulate along grain boundaries, while in non-recrystallized areas, it remains in interdendritic regions.

IR Laser

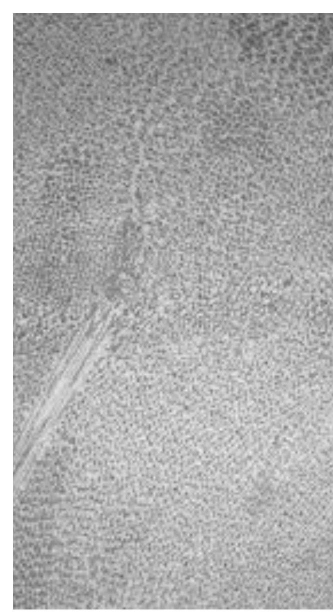


As-printed XY
100x Magnification

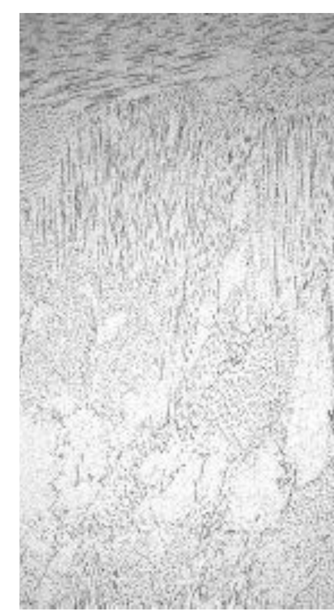


HT XY
100x Magnification

Blue Laser



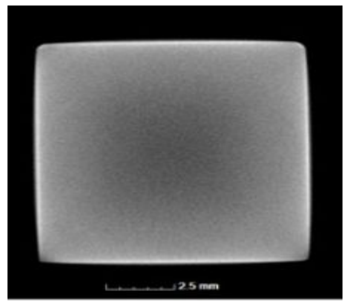
As-printed XY
100x Magnification



HT XY
100x Magnification

Tomography

CT Scan of 3D printed sample part in SS316L using IR Laser without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top View

Front View

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1.Structural Properties

Tensile Tests

Specimens printed using Meltio's wire-laser metal 3D printed process perform at the same level as samples made with conventional manufacturing methods. Results show low deviations and near isotropic properties even in the as-printed state without the application of heat-treatments.

Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization for IR Laser and a printed block of 95x155x55 mm using the **Rev 9 2024-12-05** profile for the Blue laser, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL* info@idonial.com)

Hardness

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM. from it UNE-EN ISO 6507-1 and was analyzed by an external lab. (IR laser were carried out by *IDONIAL* info@idonial.com and Blue laser were carried out by *CETEMET* i+d+i@cetemet.es).

Heat Treatment

With SS316L it is not mandatory to perform a heat-treatment after 3D printing for general use case applications. As-built Meltio SS316L parts show a mainly austenitic structure with some small ferrite content. This Ferrite content may be adjusted via re-austenization to fit the requirements of a specific application. Applying the heat-treatment a 99.8% austenitic structure structure can be achieved. SS316L may also be stress relieved between 450°C and 500°C without affecting its microstructure.

Re-austenization

Protective atmosphere	1050°C	Maintain for 2h	Cooling to RT

Typical Parameters for a ASTM E8M cylinder sample of 4 mm diameter and 10 mm long extracted by EDM from a printed block for Tensile Tests

2.Fatigue Life

Specimens printed using Meltio's wire-laser metal 3D printing process can withstand high fatigue cycles, performing at the same level as samples produced using conventional manufacturing methods. The results also indicate that specimens exhibit good fatigue behaviour even in the as-printed state, without the application of heat treatments.

Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E466 samples were extracted using EDM and were analyzed by an external laboratory. (*IDONIAL* info@idonial.com)

3.Internal Structure

Micrography

The micrography were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and **Rev 9 2024-12-05** profile for the Blue laser. The metallographic analysis followed ASTM E3-11:2017 standards, ensuring proper preparation and examination of the microstructure and were analyzed by an external laboratory. (*IDONIAL* info@idonial.com)

Tomography

The tomography images were obtained from a 10x10x60 mm printed block using the Verified Density Profile for IR laser and were analyzed by an external laboratory. (*CATEC* info@catec.aero)

Relative Density

Characterizing materials for its Blue Laser technology using 300x400x60 mm 304L steel build plates. Relative density and pore size are evaluated through micrography following NASA-STD-6030 "Additive Manufacturing Requirements for Spaceflight Systems," based on a 250x250x30 mm printed specimen. The results comply with NASA-STD-6030, showing an overall porosity fraction below 0.25% by volume and were analyzed by an external laboratory. (*IDONIAL* info@idonial.com , *CETEMET* i+d+i@cetemet.es , AIMEN comunicacion@aimen.es)

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4.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 15 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.

5.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 4,** 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.

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

The metallic material specified in this technical data sheet is classified in accordance with 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 316LSi is designated within Group B, corresponding to austenitic stainless steels.