Meltio Invar 36

Invar 36 / Alloy 36 / 1.3990

Invar is a type of nickel-iron alloy that is known for its unique properties, including low coefficient of thermal expansion and high dimensional stability over a wide range of temperatures. These characteristics make it a valuable material in various applications that require precision and stability, such as precision instruments, scientific measuring devices, cryogenics, composite molds and aerospace components.

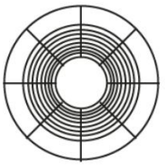
Properties	Extremely low coefficient of thermal expansion and High Strength at low temperatures
Applications	Aerospace, Precision Components and Cryogenic Components

Wire Chemical Composition	Fe	C	Ni	Mn	Nb	Ti
Weight Percent [%]	Bal.	0.35	36.0	1.0	2.5	1.0

Wire Density
8.10 g/cm³

Melting Point		
1613 K	1340 °C	2445°F

Spool Specs



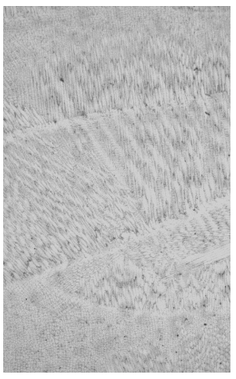
Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1851 cm³
Spool Type	BS300
Wire Coating	Uncoated

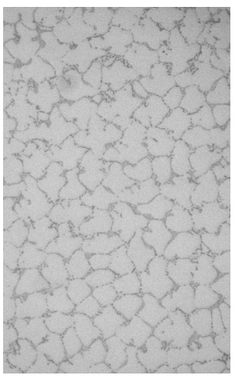
Relative density as 3D printed IR laser	99.99%

Micrography

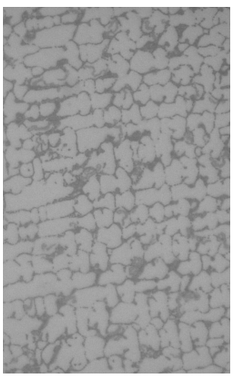
The as printed microstructure of Invar is heterogeneous and mostly austenite with nickel dissolving in γ-Fe.



As-printed XZ
100x Magnification



As-printed XZ
1000x Magnification

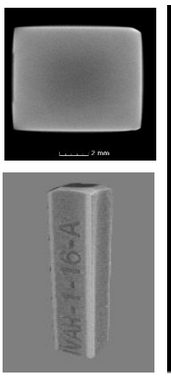


As-printed XY
1000x Magnification

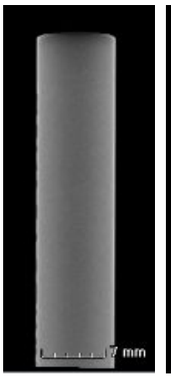
IR Laser
Test Carried Out In ADIMME *aidimme@aidimme.es*

Tomography

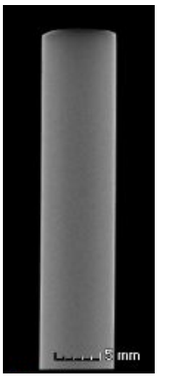
Computed Tomography Scan of 3D printed sample part in Invar without detectable voids or defects. Resolution of 24 µm per pixel.



3D / Top View



Left View



Front View

IR Laser
Test Carried Out In CATEC *info@catec.aero*

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Heat Treatment

Owing to the use of Invar in precision components, it is often recommended to subject it to an annealing heat-treatment after 3D printing. This is necessary as the 3D printing process introduces residual stresses, which affects the material's performance. After annealing, the sample should pass through an aging process to improve and achieve suitable mechanical properties.

Annealing

Protective atmosphere Heat up to 800ºC	Hold for 1h Cooling to RT

Aging

Protective atmosphere Heat up to 425ºC	Hold at 425ºC during 2h Cooling in oven to RT

Typical Parameters for a Sample of 160x60x30 mm

Deposition Parameters

The following fully dense printing parameters were obtained, based on a printed block of 30x60x20 mm. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed using CT Scan on an external lab. Please use the provided “Materials Handbook” to know better the printing parameters relation and their effect on part density. These printing parameters are available in our slicers Meltio Horizon and Meltio Space.

Technology	Revisión name	Laser Power [W]	Velocity [mm/s]	Argon Flow [l/min]	Layer Height [mm]	Layer Width [mm]	Wire Speed [mm/s]	Input Energy Density [J/mm3]	Deposition Rate [g/h]	Volume rate [cc/h
IR 976 nm	**V.D.**	1100	7.5	10.0	0.8	1.0	7.46	183	183.33	22.59

Mechanical Properties

Results show that specimens printed using Meltio’s wire-laser metal 3D printed process perform at a high level when compared to samples made with conventional manufacturing methods. Testing is carried out in the less favorable XZ Direction to ensure the values are applicable across complete part.

		UNE EN ISO 6892-1
	Wrought Properties (ASTM A658)	**Meltio XZ Properties IR Laser (As Printed)**
Ultimate Tensile strength (UTS) [MPa]	500	522 ± 14
Yield strength [MPa]	241	337 ± 22
Elongation [%]	31	24 ± 2
		Tests Carried Out in CETEMET i+d+i@cetemet.es

		UNE EN ISO 6507-1
	Wrought Properties (ASTM A658)	**Meltio Properties IR Laser (As Printed)**
Hardness [HV-30]	127	147
		Tests Carried Out In IDONIAL info@idonial.com

** Meltio’s work on material characterization is carried out using the Meltio M450 and M600 and it remains under constant development. Specifications provided herein may not reflect the latest state of our research. For further information and questions please contact us via info@meltio3d.com.*

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