Meltio Tool Steel H11

Tool Steel H11 / 1.2343

Tool Steel H11 is one of the most commonly used tool steels. It is a hot-work steel that is used to make hot-working tools such as forging, die-casting, extrusion, and plastic molds due to its resistance to thermal fatigue cracking and high-temperature abrasion. In addition to hot-working tools, it is also used to produce cutting tools and in the aerospace industry for mechanical components.

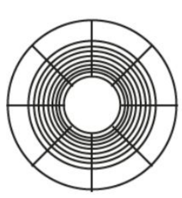
Properties	High Strength, High Temperature Resistance and High Hardness
Applications	Aerospace Components, Cutting Tools and prototypes and Molds and Dies

Wire Chemical Composition	Fe	C	Si	Mn	Cr	Mo	V
Weight Percent [%]	Bal.	0.38	1.0	0.4	5.0	1.1	0.45

Wire Density
7.81 g/cm³

Melting Point		
1753 K	1480 ºC	2700°F

Spool Specs



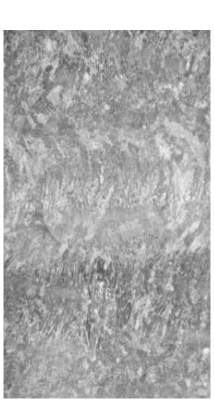
Meltio Materials are tightly spooled and packaged to ensure the best compatibility with Meltio systems.

Wire Diameter	1.0 mm
Weight on Spool	15 kg
Volume on Spool	1920 cm³
Spool Type	BS300
Wire Coating	Copper

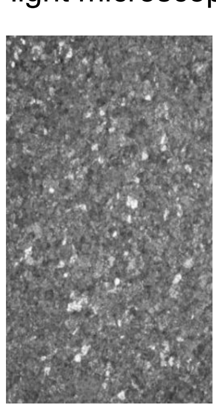
Relative density as 3D printed IR Laser	> 99.9%

Micrography

Tool Steel H11 displays tempered and fresh martensite, retained austenite, and columnar grain morphology aligned with the solidification front. Heat treatment reduces retained austenite and refines the grain to a primarily equiaxed shape, converting most of the martensite. Trace amounts of austenite may remain undetectable with light microscopy.



As-printed XY
100x Magnification



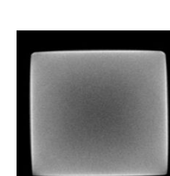
HT XY
100x Magnification

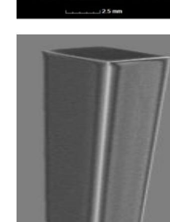
As-printed XY
100x Magnification

IR Laser	***Blue Laser***
*Tests Carried Out In IDONIAL info@idonial.com	

Tomography

Computed Tomography Scan of 3D printed sample part in H11 without detectable voids or defects. Resolution of 24 µm per pixel.





3D / Top View

Front View

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

Meltio Material Datasheet

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Deposition Parameters

The following printing parameters were obtained through rigorous testing. The **Infrared Profile** was derived from a 30 × 60 × 20 mm printed block, from which a 10 × 10 × 60 mm sample was extracted using EDM and analyzed via CT scan in an external laboratory. The **Blue Profile** was obtained from three scenarios (30 × 60 × 20 mm, 55 × 70 × 70 mm, and 250 × 250 × 30 mm) to ensure reliable unattended printing with maximum quality and energy density. Internally, samples were tested using Liquid Penetrant Testing (LPT) to evaluate surface-breaking defects on newly exposed internal surfaces after sectioning. Additional analyses, including Micrography, CT scan, and Structural testing, are conducted by an external lab.

These profiles are valid for 90% of solid parts, with a minimum part size of 30 × 30 mm. Their performance depends on geometry, overhangs, material, thickness, and base material. Profiles serve as a reference for specific applications, but operator expertise remains essential for achieving optimal print quality for the specific application. Adjustments may be necessary to overcome challenges or deviations from standard shapes.

The **Blue Profiles are under continuous development**, with updates released at least quarterly to enhance performance and reliability. The data presented reflects the current state, and improvements are ongoing. In case of doubts about performance or specific requirements, please contact the **Meltio Process Team** for guidance.

These printing parameters are available in **Meltio Horizon** and **Meltio Space** slicers latest release.

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 Laser 976 nm	**V.D.**	1100	5	10.0	1.0	1.0	6.37	220	141	18.05
Blue laser 450 nm	**Solid 1.0x1.0 Rev 22 2024-12-04**	1000	5	15.0	1.0	1.0	6.91	200	150	19.21

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Heat Treatment

Tool Steel H11 is an Air-Hardening tool steel which during 3D printing reaches its hardened state. In this state machinability is affected and there is a high risk of cracking due to the reduced ductility. Consequently, a heat-treatment cycle is typically necessary, except for cladding applications or small feature addition. The ideal cycle should begin with an annealing step prior to removing the part from the build plate. The material will be softened and free of internal stresses, making easy to machine. After machining, the part should then undergo hardening and a suitable tempering cycle to achieve the desired hardness.

Solution Annealing		Quenching		Tempering	
Argon atmosphere Heat up to 820ºC	Slow Cooling in oven to RT	Argon atmosphere Heat up to 1025ºC	Hold for 2h Forced Air-cooling to RT	(Example): Argon atmosphere Heat up to 550ºC	Hold for 1h Slow Cooling to RT (Repeat 2x)

Typical Parameters for a Sample of 160x60x30 mm

Mechanical Properties

Results show that specimens printed using Meltio's wire-laser metal 3D printed process perform at the same level as 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 1472)	**Meltio XZ Properties IR Laser (S.A + Q + T)**	**Meltio XZ Properties IR Laser (As Printed)**
Ultimate Tensile strength (UTS) [MPa]	1990	2087 ± 2	1830 ± 105
Yield strength [MPa]	1650	1735 ± 101	1170 ± 90
Elongation [%]	10	12.18 ± 0.19	3.46 ± 0.36
		Tests Carried Out In IDONIAL info@idonial.com	

The following Mechanical Properties were obtained, based on a printed block of 160x30x70 mm using the Verified Density Parametrization, from it 16 ASTM E8M samples were extracted using EDM and were analyzed by an external laboratory.

			UNE EN ISO 6507-1	
	Wire Properties	**Wrought Properties (ASTM 1472)**	**Meltio Properties IR Laser (S.A + Q + T)**	**Meltio Properties IR Laser (As Printed)**
Hardness [HRC]	57	53	51	52
			Tests Carried Out In IDONIAL info@idonial.com *Tests Carried Out in CETEMET* i+d+i@cetemet.es	

Based on a printed block of 30x60x20 mm using Verified Density Parametrization. A sample from this block of 10x10x60 mm was extracted using EDM, and was analyzed by an external lab.

** Meltio's current work on material characterization is carried out using the Meltio 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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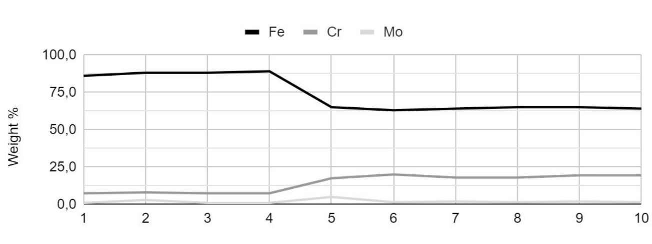
Cladding and Dual Material Applications With IR laser

Tool Steel H11 is highly resistant to wear, deformation and heat, which makes it an excellent material for cladding or dual material applications where not the entire component requires these properties. H11 steel has excellent weldability and can be used to form a dense and well-bonded coating layer that provides high wear resistance, high Hardness and temperature resistance as well as good corrosion resistance.

Elemental Distribution

Composition mapping of H11 cladding on SS316L. Measurements were spaced 150 µm. Apart with measurement 5 coinciding with the interface of the two materials.

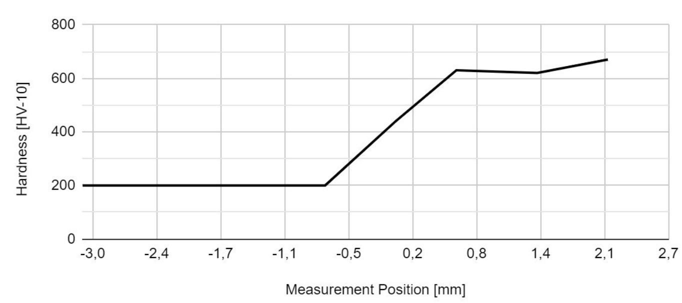
Measurement [Position]	Mo [wt%]	Cr [wt%]	Mn [wt%]	Fe [wt%]	Ni [wt%]
1	1.0	7.5	1.0	86.0	4.0
2	3.0	8.0	2.0	88.0	4.0
3	1.0	7.5	1.0	88.0	2.0
4	1.0	7.5	1.0	89.0	2.0
Interlayer					
5	5.0	17.5	1.0	65.0	10.0
6	1.5	20.0	1.0	63.0	14.0
7	2.0	18.0	2.0	64.0	11.0
8	1.5	18.0	1.0	65.0	13.0
9	2.0	19.5	1.0	65.0	11.0
10	1.5	19.5	1.0	64.0	12.0



Hardness Profile

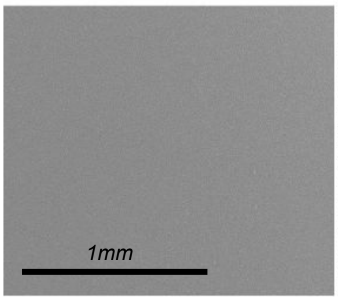
Hardness was measured across the material transition and results indicate that a single cladding layer is sufficient to achieve good and stable properties.

Hardness [HV10]	Distance [mm]	Material [txt]
670	2.1	Tool Steel H11
620	1.4	
630	0.6	
440	0.0	**Interlayer**
200	-0.7	Stainless Steel 316L
200	-1.4	
200	-1.8	
200	-2.2	
200	-3.1	

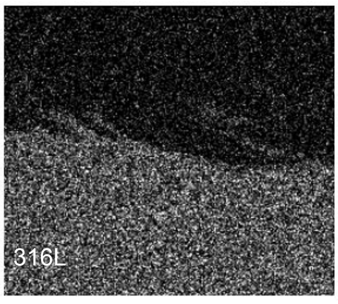


Elemental Mapping

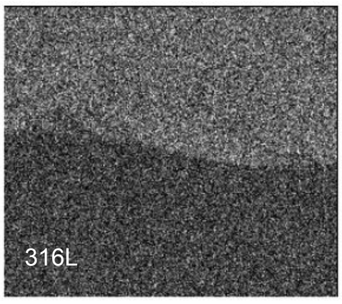
Elemental (EDX) Mapping is employed to characterize the dilution of the two materials. Meltio used as printed Stainless Steel 316L as the substrate without post processing. Results show low dilution between SS316L and H11.



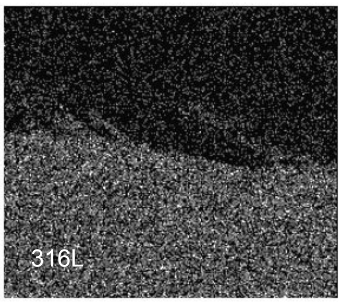
Cladding interface layer XZ
Electron Microscopy



Cladding interface layer XZ
Chromium EDX Map



Cladding interface layer XZ
Iron EDX Map



Cladding interface layer XZ
Nickel EDX Map

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