



Invar 36®

ASTM F1684 / DIN 1715-1

MATERIAL DATA SHEET



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MATERIAL

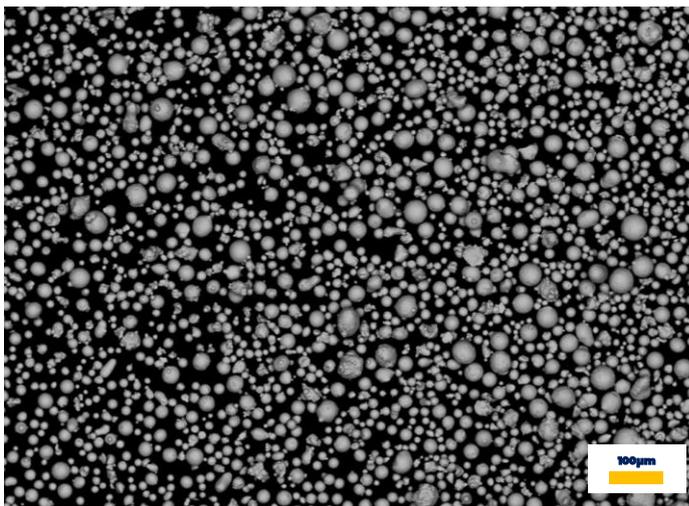
The *invariance* of changing dimensions at various temperatures gives Invar 36® its name. The nickel-iron alloy has an extremely low coefficient of thermal expansion and, therefore, offers exceptional dimensional stability. Invar 36® is suited whenever utmost precision is required at changing temperatures, such as in optical systems, aircraft controls, and parts in cryogenic atmospheres.

CHEMICAL COMPOSITION

DIN 1715 ¹					
	Fe	Ni	Mn	Si	C
Min.		35.00			
Max.	Bal.	37.00	0.50	0.50	0.10

POWDER PROPERTIES

Particle Size ¹	10-45 µm
Mass Density ²	≈ 8.1 g/cm ³
Particle Shape ^{3,4}	Spherical, typical batch morphology displayed below



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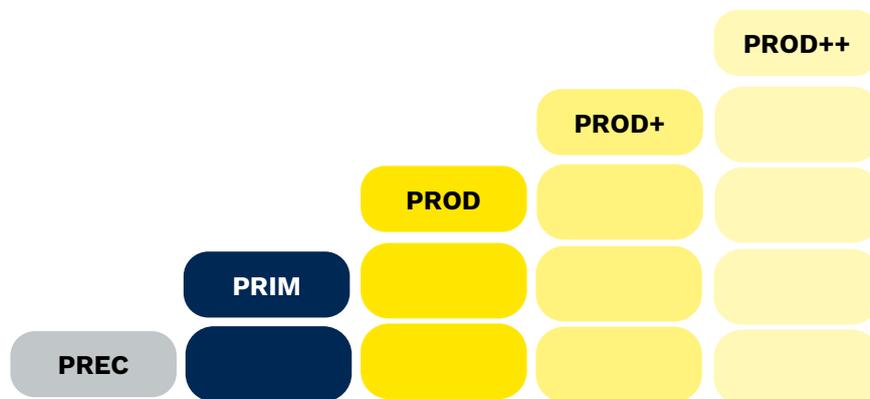
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NIKON SLM® PARAMETERS

It only takes 3 tools to make you successful with metal additive manufacturing:

1. The **NIKON SLM® machine** fitting your needs,
2. The **metal powder** that defines the later purpose and functionality of a part,
3. Precisely engineered **NIKON SLM® parameters** as the missing link.

Our open parameters are the result of our vast experience in multi-laser technology and a diligent development and qualification procedure. They are key to produce fully functional parts with properties you can expect and rely on – whether you are new to AM or a large-scale production operator. We offer them to you in the following categories: **Precision (PREC)** for high-resolution complex details, **Prime (PRIM)** for balanced properties with improved productivity and **Productivity (PROD)** for the highest build rates. Pushing boundaries is in our work culture, we can also offer a new dimension of productivity on selected materials with **Productivity+ (PROD+)** and **Productivity++ (PROD++)** parameters.



MATERIAL QUALIFICATION

As one of the inventors of the selective laser melting process, we impose the most comprehensive test procedures on ourselves: hundreds of samples, multiple systems, various powder batches, numerous heat-treatments, machined vs. near-net-shape tensile specimens, several surface roughness conditions and angles, fatigue behavior, corrosion investigation, creep testing... Did we miss anything? Get in touch with us!

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SLM® 280 PRECISION

Parameter Set	Invar_36@_SLM280_PREC_MBP3_V1 (30 µm)
Machine Compatibility	SLM® 280 2.0, SLM® 280 Production System (400W)
Validated Data Preparation	Materialise SLM Build Processor
Theoretical System Build Rate ⁵	20.0 cm ³ /h (Twin)
Minimum Relative Density ^{6, 8}	99.9 %

MECHANICAL PROPERTIES⁷

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)⁹

Non-heat-treated

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	445	430	355	340	31	27
Vertical	390	375	330	320	37	32
Near-Net-Shape						
Vertical	385	375	325	295	38	34

Heat-treated (ANN)⁹

	Tensile strength R _m [MPa]		Yield strength R _{p0.2} [MPa]		Elongation at break A [%]	
	M	MIN	M	MIN	M	MIN
Machined						
Horizontal	445	430	305	295	33	29
Vertical	385	355	290	275	41	32

HARDNESS¹⁰

M: Mean | MIN: Minimum (95% Population Coverage / 95% Confidence Level)⁹

	Vickers hardness	
	HV5	
	M	MIN
As built	146	141

SURFACE ROUGHNESS¹¹

M: Mean | MAX: Maximum (95% Population Coverage / 95% Confidence Level)⁹

	Roughness average		Mean roughness depth	
	Ra [µm]		Rz [µm]	
	M	MAX	M	MAX
As built	9	14	53	84

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DISCLAIMER

The properties and mechanical characteristics apply to powder that is tested and sold by Nikon SLM Solutions, and that has been processed on Nikon SLM Solutions machines using the original Nikon SLM Solutions parameters in compliance with the applicable operating instructions (including installation conditions and maintenance). The part properties are determined based on specified procedures. More details about the procedures used by Nikon SLM Solutions are available upon request.

The specifications correspond to the most recent knowledge and experience available to us at the time of publication and do not form a sufficient basis for component design on their own. Certain properties of products or parts or the suitability of products or parts for specific applications are not guaranteed. The manufacturer of the products or parts is responsible for the qualified verification of the properties and their suitability for specific applications. The manufacturer of the products or parts is responsible for protecting any third-party proprietary rights as well as existing laws and regulations.

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MDS_Material_2025-12.1_EN

NOTES

- ¹ With respect to powder material. Compositions stated as mass or weight percent.
- ² Material density varies within the range of possible chemical composition variations.
- ³ According to DIN EN ISO 3252:2023.
- ⁴ Secondary Electron Image of a typical powder batch
- ⁵ Theoretical system build rate = layer thickness x scan speed x hatch distance x number of lasers. The value represents a comparable indicator but remains a theoretical value after all. It does expressively not reflect true build rates, which are influenced by part geometry, ratio between hatch and contour areas, area of exposure, recoating times, and more.
- ⁶ Optical density determination at test specimens by light microscopy according to internal specification. Relative density may vary depending on part geometry, orientation, volume, and other process factors. Population coverage: 99 %, confidence level: 99 %.
- ⁷ Tensile testing was performed in accordance to DIN EN ISO 6892-1:2020 B and conducted at room temperature. Samples are either machined before testing or tested in near-net-shape without any surface finishing (geometry according to DIN 50125:2016-D6x30). Samples labelled "Horizontal" correspond to a polar angle of $\theta = 90^\circ$; samples labelled "vertical" correspond to a polar angle of $\theta = 0^\circ$ (DIN EN ISO/ASTM 52921). Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder. Population coverage: 95 %, confidence level: 95 %.
- ⁸ Minimum values are set by using tolerance interval method, which is a statistical approach based on the input of population coverage (PC) and confidence level (CL). Tolerance intervals ensure that a certain percentage of samples within a batch will be above the minimum value with a certain probability, e.g. the probability that 95 % of all samples will be above the stated minimum value (within a defined batch and tested according to mentioned specifications) is 95 %.
- ⁹ Heat treatment for stabilization of thermal expansion: Annealing for 0.5 h at 880 °C followed by water quenching. Then annealing for 1 h max +15 min at 300 °C, followed by air-cooling. Finally, heating to 100 °C and slow cooling for 48 h in the oven.
- ¹⁰ Hardness testing according to DIN EN ISO 6507-1:2024. Measurement direction "2" according to VDI 3405 2.1. Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.
- ¹¹ Roughness measurement on vertical walls according to DIN EN ISO 4288:1922; $\lambda_c = 2.5$ mm. Glass bead blasting is an additional post-processing step after corundum blasting. Values include overlap samples, i.e. multiple lasers work simultaneously on one specimen. All data is derived from standardized SLM Solutions qualification jobs. Samples are built out of both virgin powder as well as used powder.

CONTACT

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