

**IN718**

2.4668 / AMS 5662 / ASTM B637 / AMS 2774 / ASTM F3055

***MATERIAL DATA SHEET***

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## MATERIAL

Nickel-based superalloys have been specifically designed to withstand extreme conditions in which other materials already fail. One of the most popular nickel-based superalloys is the precipitation-hardenable IN718. Whether it is static or dynamic loads, close to absolute zero or above 700 °C, corrosion, or creep – IN718 was made for this and brings a good weldability on top. This profile of properties makes IN718 an excellent choice for rocket and aircraft components, but also for stationary gas turbines or automotive exhaust systems.

## CHEMICAL COMPOSITION

### ASTM B637<sup>1</sup>

|      | Fe   | Ni    | Cr    | Ta+Nb | Mo   | Ti   | Co   | Al   | Si   | Mn   | Cu   | C    | P     | S     | B     | Nb | Pb | Bi | Se |
|------|------|-------|-------|-------|------|------|------|------|------|------|------|------|-------|-------|-------|----|----|----|----|
| Min. | Bal. | 50.00 | 17.00 | 4.75  | 2.80 | 0.65 |      | 0.20 |      |      |      |      |       |       |       |    |    |    |    |
| Max. |      | 55.00 | 21.00 | 5.50  | 3.30 | 1.15 | 1.00 | 0.80 | 0.35 | 0.35 | 0.30 | 0.08 | 0.015 | 0.015 | 0.006 | -  | -  | -  | -  |

### AMS 5662<sup>1</sup>

|      | Fe   | Ni    | Cr    | Ta+Nb | Mo   | Ti   | Co   | Al   | Si   | Mn   | Cu   | C    | P     | S     | B     | Nb   | Pb     | Bi      | Se     |
|------|------|-------|-------|-------|------|------|------|------|------|------|------|------|-------|-------|-------|------|--------|---------|--------|
| Min. | Bal. | 50.00 | 17.00 |       | 2.80 | 0.65 |      | 0.20 |      |      |      |      |       |       |       | 4.75 |        |         |        |
| Max. |      | 55.00 | 21.00 | -     | 3.30 | 1.15 | 1.00 | 0.80 | 0.35 | 0.35 | 0.30 | 0.08 | 0.015 | 0.015 | 0.006 | 5.50 | 0.0005 | 0.00003 | 0.0003 |

## POWDER PROPERTIES

|                             |                         |
|-----------------------------|-------------------------|
| Particle Size <sup>1</sup>  | 10 - 45 µm              |
| Mass Density <sup>2</sup>   | ≈ 8.2 g/cm <sup>3</sup> |
| Particle Shape <sup>3</sup> | Spherical               |

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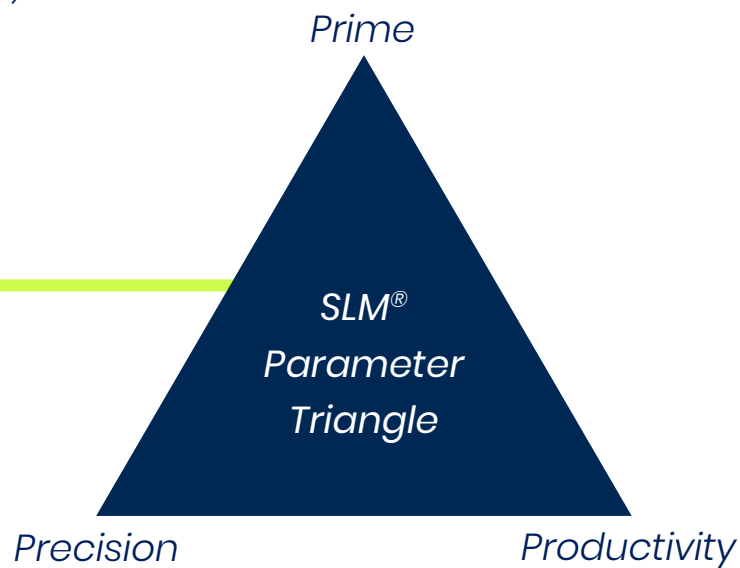
## SLM® PARAMETERS

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

1. The **SLM® machine** fitting your needs,
2. The **metal powder** that defines the later purpose and functionality of a part,
3. Precisely engineered **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 in three categories to you: from high-resolution complex details (**Precision**) up to the highest build rates (**Productivity**) or right in between (**Prime**).



## MATERIAL QUALIFICATION

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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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### PRECISION SLM® 280

|  |  |
|--|--|
| Parameter Set                              | IN718_SLM280_PREC_MBP3_V1.0 (30 µm)              |
| Machine Compatibility                      | SLM® 280 2.0, SLM® 280 Production Series (400 W) |
| Validated Data Preparation                 | Materialise SLM Build Processor                  |
| Theoretical System Build Rate <sup>4</sup> | 23.3 cm <sup>3</sup> /h (Twin)                   |
| Minimum Relative Density <sup>5,7</sup>    | 99.8 %   |

### Mechanical Properties<sup>6</sup>

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)<sup>7</sup>

#### Non-heat-treated

| Machined   | Tensile strength<br>R <sub>m</sub> [MPa] |      | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|------------|--|------|---|-----|------------------------------|-----|
|            | M  | MIN  | M   | MIN | M                            | MIN |
| Horizontal | 1065                                     | 1055 | 785                                       | 775 | 27                           | 25  |
| Vertical   | 975                                      | 950  | 655                                       | 635 | 32                           | 28  |

### Hardness<sup>8</sup>

M: Mean | MIN: Minimum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Vickers hardness<br>HV10 |     |
|----------|--------------------------|-----|
|          | M                        | MIN |
| As built | 300                      | 290 |

### Surface Roughness<sup>9</sup>

M: Mean | MAX: Maximum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Roughness average<br>Ra [µm] |     | Mean roughness depth<br>Rz [µm] |     |
|----------|------------------------------|-----|---------------------------------|-----|
|          | M                            | MAX | M                               | MAX |
| As built | 6                            | 11  | 32                              | 59  |

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### PRIME SLM® 280

|  |  |
|--|--|
| Parameter Set                              | IN718_SLM280_PRIM_MBP3_V1.0 (60 µm)              |
| Machine Compatibility                      | SLM® 280 2.0, SLM® 280 Production Series (400 W) |
| Validated Data Preparation                 | Materialise SLM Build Processor                  |
| Theoretical System Build Rate <sup>4</sup> | 53.6 cm <sup>3</sup> /h (Twin)                   |
| Minimum Relative Density <sup>5,7</sup>    | 99.6 %   |

### Mechanical Properties<sup>6</sup>

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)<sup>7</sup>

#### Non-heat-treated

| Machined   | Tensile strength<br>R <sub>m</sub> [MPa] |     | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|------------|--|-----|---|-----|------------------------------|-----|
|            | M  | MIN | M   | MIN | M                            | MIN |
| Horizontal | 1010                                     | 975 | 690                                       | 640 | 28                           | 26  |
| Vertical   | 930                                      | 895 | 600                                       | 580 | 36                           | 31  |

### Hardness<sup>8</sup>

M: Mean | MIN: Minimum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Vickers hardness<br>HV10 |     |
|----------|--------------------------|-----|
|          | M                        | MIN |
| As built | 280                      | 270 |

### Surface Roughness<sup>9</sup>

M: Mean | MAX: Maximum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Roughness average<br>Ra [µm] |     | Mean roughness depth<br>Rz [µm] |     |
|----------|------------------------------|-----|---------------------------------|-----|
|          | M                            | MAX | M                               | MAX |
| As built | 9                            | 11  | 55                              | 73  |

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### PRECISION SLM® 500

|  |                                     |
|--|-------------------------------------|
| Parameter Set                              | IN718_SLM500_PREC_MBP3_V1.0 (30 µm) |
| Machine Compatibility                      | SLM® 500 1.3 (400 W)                |
| Validated Data Preparation                 | Materialise SLM Build Processor     |
| Theoretical System Build Rate <sup>4</sup> | 46.6 cm <sup>3</sup> /h (Quad)      |
| Minimum Relative Density <sup>5,7</sup>    | 99.8 %                              |

### Mechanical Properties<sup>6</sup>

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)<sup>7</sup>

#### Non-heat-treated

| Machined   | Tensile strength<br>R <sub>m</sub> [MPa] |      | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|------------|--|------|---|-----|------------------------------|-----|
|            | M  | MIN  | M   | MIN | M                            | MIN |
| Horizontal | 1055                                     | 1030 | 760                                       | 725 | 27                           | 25  |
| Vertical   | 970                                      | 955  | 660                                       | 630 | 33                           | 29  |

### Hardness<sup>8</sup>

M: Mean | MIN: Minimum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Vickers hardness<br>HV10 |     |
|----------|--------------------------|-----|
|          | M                        | MIN |
| As built | 305                      | 295 |

### Surface Roughness<sup>9</sup>

M: Mean | MAX: Maximum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Roughness average<br>Ra [µm] |     | Mean roughness depth<br>Rz [µm] |     |
|----------|------------------------------|-----|---------------------------------|-----|
|          | M                            | MAX | M                               | MAX |
| As built | 6                            | 8   | 31                              | 47  |

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### PRIME SLM® 500

|  |                                     |
|--|-------------------------------------|
| Parameter Set                              | IN718_SLM500_PRIM_MBP3_V1.0 (60 µm) |
| Machine Compatibility                      | SLM® 500 1.3 (400 W)                |
| Validated Data Preparation                 | Materialise SLM Build Processor     |
| Theoretical System Build Rate <sup>4</sup> | 107.3 cm <sup>3</sup> /h (Quad)     |
| Minimum Relative Density <sup>5,7</sup>    | 99.7%                               |

### Mechanical Properties<sup>6</sup>

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)<sup>7</sup>

#### Non-heat-treated

| Machined   | Tensile strength<br>R <sub>m</sub> [MPa] |     | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|------------|--|-----|---|-----|------------------------------|-----|
|            | M  | MIN | M   | MIN | M                            | MIN |
| Horizontal | 1010                                     | 990 | 700                                       | 670 | 28                           | 25  |
| Vertical   | 940                                      | 915 | 610                                       | 590 | 35                           | 30  |

### Hardness<sup>8</sup>

M: Mean | MIN: Minimum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Vickers hardness<br>HV10 |     |
|----------|--------------------------|-----|
|          | M                        | MIN |
| As built | 275                      | 265 |

### Surface Roughness<sup>9</sup>

M: Mean | MAX: Maximum (95 % PC / 95 % CL)<sup>7</sup>

| As built | Roughness average<br>Ra [µm] |     | Mean roughness depth<br>Rz [µm] |     |
|----------|------------------------------|-----|---------------------------------|-----|
|          | M                            | MAX | M                               | MAX |
| As built | 6                            | 9   | 32                              | 48  |

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## PRECISION NXG XII 600

|  |                                     |
|--|-------------------------------------|
| Parameter Set                              | IN718_NXG600_PREC_MBP3_V1.0 (30 µm) |
| Machine Compatibility                      | NXG XII 600                         |
| Validated Data Preparation                 | Materialise SLM Build Processor     |
| Theoretical System Build Rate <sup>4</sup> | 140.0 cm <sup>3</sup> /h            |
| Minimum Relative Density <sup>5,7</sup>    | 99.8 %                              |

## Mechanical Properties<sup>6</sup>

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)<sup>7</sup>

### Non-heat-treated

|                | Tensile strength<br>R <sub>m</sub> [MPa] |     | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|----------------|--|-----|---|-----|------------------------------|-----|
|                | M  | MIN | M   | MIN | M                            | MIN |
| Machined       |  |     |   |     |                              |     |
| Horizontal     | -  | -   | -   | -   | -                            | -   |
| Vertical       | 970                                      | 940 | 655                                       | 630 | 31                           | 25  |
| Near-Net-Shape |  |     |   |     |                              |     |
| Vertical       | 940                                      | 910 | 620                                       | 575 | 34                           | 29  |

## Hardness<sup>8</sup>

M: Mean | MIN: Minimum (95 % PC / 95 % CL)<sup>7</sup>

|          | Vickers hardness<br>HV10 |     |
|----------|--------------------------|-----|
|          | M                        | MIN |
| As built | 300                      | 295 |

## Surface Roughness<sup>9</sup>

M: Mean | MAX: Maximum (95 % PC / 95 % CL)<sup>7</sup>

|          | Roughness average<br>Ra [µm] |     | Mean roughness depth<br>Rz [µm] |     |
|----------|------------------------------|-----|---------------------------------|-----|
|          | M                            | MAX | M                               | MAX |
| As built | 6                            | 9   | 37                              | 55  |



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## PRIME NXG XII 600

|  |                                     |
|--|-------------------------------------|
| Parameter Set                              | IN718_NXG600_PRIM_MBP3_V1.0 (60 µm) |
| Machine Compatibility                      | NXG XII 600                         |
| Validated Data Preparation                 | Materialise SLM Build Processor     |
| Theoretical System Build Rate <sup>4</sup> | 328.5 cm <sup>3</sup> /h            |
| Minimum Relative Density <sup>5,7</sup>    | 99.7%                               |

## Mechanical Properties<sup>6</sup>

M: Mean | MIN: Minimum (95 % population coverage / 95 % confidence level)<sup>7</sup>

### Non-heat-treated

|                | Tensile strength<br>R <sub>m</sub> [MPa] |     | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|----------------|--|-----|---|-----|------------------------------|-----|
|                | M  | MIN | M   | MIN | M                            | MIN |
| Machined       |  |     |   |     |                              |     |
| Horizontal     | -  | -   | -   | -   | -                            | -   |
| Vertical       | 930                                      | 890 | 585                                       | 550 | 34                           | 26  |
| Near-Net-Shape |  |     |   |     |                              |     |
| Vertical       | 915                                      | 890 | 580                                       | 545 | 34                           | 28  |

### Heat-treated (HIP + Solution Annealing + Ageing)<sup>10</sup>

|                | Tensile strength<br>R <sub>m</sub> [MPa] |      | Yield strength<br>R <sub>p0.2</sub> [MPa] |     | Elongation at break<br>A [%] |     |
|----------------|--|------|---|-----|------------------------------|-----|
|                | M  | MIN  | M   | MIN | M                            | MIN |
| Machined       |  |      |   |     |                              |     |
| Horizontal     | -  | -    | -   | -   | -                            | -   |
| Vertical       | 1285                                     | 1270 | 985                                       | 955 | 24                           | 17  |
| Near-Net-Shape |  |      |   |     |                              |     |
| Vertical       | 1255                                     | 1215 | 985                                       | 945 | 21                           | 11  |

## Hardness<sup>8</sup>

M: Mean | MIN: Minimum (95 % PC / 95 % CL)<sup>7</sup>

|                            | Vickers hardness |     |
|----------------------------|------------------|-----|
|                            | HV10             |     |
|                            | M                | MIN |
| As built                   | 280              | 275 |
| Heat-treated <sup>10</sup> | 420              | 405 |

## Surface Roughness<sup>9</sup>

M: Mean | MAX: Maximum (95 % PC / 95 % CL)<sup>7</sup>

|          | Roughness average |     | Mean roughness depth |     |
|----------|-------------------|-----|----------------------|-----|
|          | Ra [µm]           |     | Rz [µm]              |     |
|          | M                 | MAX | M                    | MAX |
| As built | 8                 | 12  | 46                   | 70  |

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## DISCLAIMER

The properties and mechanical characteristics apply to powder that is tested and sold by SLM Solutions, and that has been processed on SLM Solutions machines using the original 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 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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## NOTES

- <sup>1</sup> With respect to powder material. Compositions stated as mass or weight percent.
- <sup>2</sup> Material density varies within the range of possible chemical composition variations.
- <sup>3</sup> According to DIN EN ISO 3252:2001.
- <sup>4</sup> 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.
- <sup>5</sup> 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 %.
- <sup>6</sup> Tensile testing was performed in accordance to DIN EN ISO 6892-1:2017 B and conducted at room temperature. Samples are machined before testing (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 %.
- <sup>7</sup> 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 %.
- <sup>8</sup> Hardness testing according to DIN EN ISO 6507-1:2018. 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.
- <sup>9</sup> Roughness measurement on vertical walls according to DIN EN ISO 4288:1998;  $\lambda_c = 2.5$  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.
- <sup>10</sup> HIP according to ASTM F3055 / ASTM F3301, followed by HIP solution annealing + aging according to AMS 2774 (S1750DP).

## CONTACT

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