SLM®
by Progold
POWDER ALLOYS
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Progold SLM® powder alloys have been researched to ensure maximum performance with the Realizer SLM 50 Desktop Machine. Thanks to the round shape of particles and specific particle-size, Progold SLM® powder alloys ensure precise laying on the working platform; their composition confers excellent wettability features, which is essential to achieve the maximum surface quality and item density possible.

PRODUCT
SLM® powders can be developed and customized based on specific needs, offering customers maximum availability and cooperation to achieve their company targets.
Our range of powder alloys was developed for exclusive use in goldsmith and jewellery sectors, giving maximum importance and attention to colour. Our powders are available in 750‰ gold in 2N, 3N and 4N standard colours, in nickel-free white gold, in red gold 5N standard colour, with particle-size smaller than 53 μm or 25 μm.

PACKAGING
SLM® powder packaging is made of a jar with a particular shape which was studied to avoid product leak during transportation, thus ensuring excellent conservation of powder also thanks to addition of a bag of hygroscopic salt to avoid moisture formation. A piston is included to keep the product isolated.

The label gives all the necessary information for an immediate and targeted research. To facilitate recognition we have added some icons representing color and fineness, in addition to specific indications on particle size and package tare.

SLM® powder is supplied in minimum batches of 5Kg and their multiples: 10, 15, 20 Kg and so on. This products is sold in 1 Kg packages.
HOW TO READ THE LABEL

WARNING
WARNING THE JAR CONTAINS A HYgroscOPiC SALT CapsuLe. Please reMOVE Before uSing.

SLM®
by Progold

SLM100
Powder alloy

100% Au

weight 1000g
batch No. 00000_01

ARTICLE ID
MANUFACTURING ID
GENRIC PRODUCT DESCRIPTION

CONTACT INFORMATION
AND CUSTOMER CARE

USE, COLOUR AND FINENESS

NET WEIGHT BATCH

DETAILED DESCRIPTION OF THE PRODUCT
Yellow gold 750‰ powdered alloy. Particles size dimensions are lower than 53 μm and have a regular spherical shape. The alloy is suitable for the production of items by means of SLM (Selective Laser Melting) Realizer technology. The alloy complies with 3N color defined by EN28654 regulation.
TECHNICAL SHEET

PRODUCT CODE AND FINENESS

SLM100 - (750)
Technical and usage details

Tab. 1 PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Colour</th>
<th>Colour coordinates</th>
<th>Bulk density</th>
<th>Particles distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>YELLOW JN</td>
<td>L* = 90.15, a* = 4.98, b* = 21.76</td>
<td>9.13 g/cm³</td>
<td>&lt; 63 μm</td>
</tr>
</tbody>
</table>

POWDER MAINTENANCE

SLM powdered alloys are packed and served to the customer in their optimal conditions, dried of moisture and packed in a special packaging that allows the powder to maintain its characteristics until it is used.

Once the package is opened, the customer shall keep the powder far from humid areas.

A possible humidity absorption from the powder may lead to a loss in flowing ability and, at worst, to be blocked inside the machine.

For this reason Progold advices, if the product has remained unused for a long period of time, to carry out a drying process before using it again.

The operations to be followed in order to dehydrate the product are the following:

- Lay flat the powder forming a thin layer on the bottom of a container which allows the humidity to be expelled avoiding, at the same time, powder dispersion.
- Dispose the containers in a static furnace at 120°C for approximately 2 hours.
- Once drawn from the furnace, the powder can be recovered and employed for SLM processing.

SIEVING

SLM100 powdered alloys particles have a lower than 55μm size. This product is performing if particles granometry is constantly kept under this value.

For this reason we suggest tosieve the powder after every working cycle, using <53 μm sieve.

If you want to speed up the recovery operation of the particle-size analysis, it is possible to use >75 μm or <100 μm sieves.

The frequency and choice of the sieves, however, is up to the customer.

NOTES

1. We point out that SLM powdered alloys are the result of many tests carried out with SLM-10 Realizer machine. The best performances of SLM powders are then exclusively guarantied with the combined use of Progold and Realkar.
**R&D RESEARCH&DEVELOPMENT**

SLM® powder alloys are Made in Progold during all their manufacturing process. SLM® powders are realised following in-house atomisation; powder alloys then undergo sieving and particle-size analysis to determine size and distribution of the particles. Thanks to our in-house atomisation process powders are customised based on specific needs.

**PARTICLE SIZE**

SLM® powder alloys in our product range are available with a particle size of

<table>
<thead>
<tr>
<th></th>
<th>SLM</th>
<th>SLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;53 µm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;25 µm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PRODUCT CARE**

SLM® powder alloys must not be stored below 5°C or above 25°C. Powder alloys should be stored in a cool and dry environment with moisture level control, away from direct sunlight and other heat sources. In the event of exposure to moist, we recommend drying treatment in a furnace at 120°C for 120 mins before use.

**CUSTOMER SERVICE**

Progold experience is available for customers to provide real and dynamic consulting and customer service. Problem solving is the keyword of Progold’s customer service.

A specialised service on the choice of the Progold powder alloy more suitable to meet specific customer needs and assist them in selecting the best setting to achieve the best result possible.

Realizer SLM 50 machine works non-stop in our R&D laboratories allowing us to recreate the state of production of the customer, solving any issues as quickly as possible.

Our specialised technicians carry out backup activities (a service at our customer’s disposal) and set-up the operating parameters of the machine so we are always ready to share them with the customer. Because our main target is to maximise work performance to meet customer’s requests.

A two-way communication: question and immediate answer, photos, pictures and further analysis result in a higher state of interaction between customer and Progold.

Thanks to real-time communication through chat with the technical office, we offer customer service, advices and suggestions to avoid practical mistakes and defects in the realisation of the finished product. To ensure maximum problem solving customers can also share and exchange files with Progold specialised technicians.

A tool to notify us of any complaints or poor service is available online: any suggestion and indication to improve our products and services are welcome.

Please visit our website often: you will find all the necessary information on our technicians and/or salespeople in your country or at the most important fairs of the gold and silver sector.
PRODUCTION

Sales of SLM™ powders is only dealt with in account of manufacture. Powder manufacturing takes place following receipt of precious material sent by the customer. Manufacturing organization of SLM™ powder alloys follows five guidelines:

QUALITY
CERTIFIED RAW MATERIALS
RAW MATERIAL QUALITY CONTROL
IN’HOUSE ATOMISATION
SIEVING
PARTICLE-SIZE ANALYSIS
CHEMICAL ANALYSIS OF ALLOY COMPOSITION

TRACEABILITY
RAW MATERIALS
WORKING CYCLE
FINISHED PRODUCT

PRODUCT CHAIN CONTROL
ERP IT SYSTEM: IT ENSURES CONSTANT QUALITY AND PRODUCT DUPLICATION

TECHNOLOGICAL INNOVATION
CONSTANT IMPLEMENTATION OF SPECIFIC MANUFACTURING STAGES
PRODUCTION MACHINE CUSTOMISATION

KNOW HOW
KNOWLEDGE
KNOW WHAT TO DO
KNOW WHAT TO BE

SLM™ is the result of meticulous attention paid to all production stages: raw materials undergo strict and constant quality checks to ensure standards are met and are solely supplied by certified producers. The alloy is atomised in-house to ensure constant quality and product duplication. The resulting powder undergoes a strict sieving process to achieve specific particle size. Production management has been combined with ERP IT system which oversees the working cycle of each product on a daily basis - from component control and dosage to product homogenisation process and packaging. A series of markers enables us to classify and trace the product in any moment, therefore allowing us to make targeted recalls in the event of non-compliance.

We see technological innovation as essential because it allows us to constantly improve production, raw materials supply but especially to optimize their management and production.

We use our know how for an ever ending customization of the technologies we use.

Every single product is sold only after testing and undergoing strict analyses to achieve better and constant results.
SLM: THE TECHNOLOGY

FROM INVESTMENT CASTING TO SELECTIVE LASER MELTING

In the last few years, the traditional investment casting technique has evolved and improved reaching direct casting of wax or resin objects produced with RP (Rapid Prototyping) techniques. These techniques have allowed us to overcome the geometrical limitations of lost wax injections in rubber moulds (direct investment casting).

RP techniques have taken these improvements to a whole new level by allowing us to perform the same work directly on the metal with RM (Rapid Manufacturing) techniques.

We have now reached the SLM (Selective Laser Melting) technique, the new frontier of goldsmith technology.

Why are we moving towards Selective Laser melting?
To look FORWARD.

SLM Selective Laser Melting

This technique consists in the deposition of a thin layer of powder on a working platform which is melted by a laser which follows specific instructions from the model we want to produce. This operation is repeated over and over again for a number of times equal to the number of layers in which the 3D computer designed model is subdivided.

It’s an ideal technique in the case of objects where surface esthetical features, lightness and freedom of shape are important.

Why should we add SLM to our production organization?
So that TOMORROW we can say we chose it YESTERDAY.

1. Progold Powder alloy
2. Powder released from the container
3. The wipers lay down the powder on the working platform
4. The wiper takes its original position
5. Laser melting from 3D model
6. Completed objects
7. Finished objects on the working platform
INNOVATIVE FEATURES
The features implicit in the SLM technology allows us to overcome the current limits of traditional and direct investment casting, i.e. type of alloys, minimum batch, freedom of shape, surface characteristics and environmental impact.

TYPE OF ALLOYS
SLM technique is very flexible. It truly is this same flexibility that enables us to process several types of alloys like Gold, Silver, Platinum, Palladium, Titanium, Steel, etc. The possibility to work with different alloys is a clear advantage of SLM.

MINIMUM BATCH
SLM overcomes quantity limits. It is possible to produce a single specimen thereby meeting the requirements of an ever more demanding market. Customization in the goldsmith sector enables us to overcome the old limitations which did not allow ad hoc production for a single customer without incurring in high management costs. Overcoming quantity limits sees a sharp reduction in costs.

FREEDOM OF SHAPE
Design takes a new meaning and shape limitations cease to exist in the goldsmith sector. Seasons succeed: architecture, music, fashion change. What we like changes and even jewels, at a different pace, reflect this continuous evolution. Jewelers are aware of the changes in the world and feel and interpret these changes in taste and behavior. Their jewels undergo radical changes in their shape, volume, design, creating new styles and trends. Jewels produced with this technique can be much lighter than the same jewels produced with common goldsmith techniques. It is also possible to produce hollow objects with extremely thin walls without the usual problems of cast filling typical of traditional or direct investment casting. Thanks to their lightness, new jewels produced using this technology can overcome the great limitation of cost which is typical of precious metal sector, meeting new market demands. But the SLM technology goes even further: complex and massive shapes can be produced without unwanted shrinkage defects.

SURFACE CHARACTERISTICS
The quality of the objects produced has no match. You won’t find any shrinkage defects or gas inclusions which have always been present in objects produced with traditional investment casting. The lack of these defects is due to the fact that with the SLM technique the alloy in powder does not come into contact with any foreign material, i.e. the casting crucible and alloy hardening. The latter, which is the moment when shrinkage defects appear, takes place for such a small share of the alloy that shrinkage cavities do not really appear.

ENVIRONMENTAL IMPACT
In a world ever more sensitive to environmental issues we must not underestimate the importance of the possibility to optimize all operations to minimize environmental impact. Differently from the current investment casting techniques, with the SLM the pollution caused by the investment and the wax is null and power consumption is drastically reduced.

Why a jewel with freedom of shape?
To let DESIGN be free to create.
PARTNERSHIP

PROGOLD & REALIZER

Progold has been working on this project as a trailblazer for the past four years. We are the first company to have tested the possibility of using SLM technology in the production cycle of a jewel. Meeting Realizer has been paramount in deciding and choosing to develop this important and innovative project. This partnership, which sees a different degree of integration between the companies involved, was born to pursue the evolution of this technology in the goldsmith sector as a common target. The support, knowledge and technological experience of Progold and Realizer have enabled to make important steps in setting up this technology. Progold’s powder alloys are the result of constant research and continuous improvements to achieve the set target of creating a technologically advanced product with excellent mechanical and chemical-physical properties. The morphology of Progold’s powders has been designed to perform perfectly when used with the Realizer SLM 50 machine, which in turn has been programmed based on the exclusive mechanical, chemical, physical and morphological characteristics of Progold’s powders. This synergy was born to offer excellent results.

Why choose Progold powders?
To choose TECHNOLOGY and INNOVATION.
COLOUR ICON LEGEND

<table>
<thead>
<tr>
<th>Colour</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Au</td>
<td>It denotes the yellow colour of the powder alloy</td>
</tr>
<tr>
<td>Au</td>
<td>It denotes the red colour of the powder alloy</td>
</tr>
<tr>
<td>Au</td>
<td>It denotes the white colour of the powder alloy</td>
</tr>
</tbody>
</table>

COLOUR DESIGNATION: EU DIRECTIVE

<table>
<thead>
<tr>
<th>COLOUR DESIGNATION</th>
<th>CHEMICAL COMPOSITION (‰)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Au</td>
</tr>
<tr>
<td>0N</td>
<td>585‰</td>
</tr>
<tr>
<td>1N</td>
<td>585‰</td>
</tr>
<tr>
<td>2N</td>
<td>750‰</td>
</tr>
<tr>
<td>3N</td>
<td>750‰</td>
</tr>
<tr>
<td>4N</td>
<td>750‰</td>
</tr>
<tr>
<td>5N</td>
<td>750‰</td>
</tr>
</tbody>
</table>

COLOUR

Colour is one of the main requirements a gold alloy must meet. This paragraph wants to clarify how to read and interpret chromatographic coordinates.

The tables show the values of 3 chromatographic coordinates ($L^*$, $a^*$, $b^*$) which, when compared, highlight even the slightest differences amongst alloys with the same colour shade.

"$L^*$" letter is for colour glossiness: the higher the values, the higher light reflection by metal is and consequently brightness and glossiness of surfaces.

"$a^*$" letter is for the chromatographic coordinate which with a negative sign leans towards green and with a positive sign towards red.

"$b^*$" letter is the chromatographic coordinate which with a negative sign leans towards blue and with a positive sign towards yellow.

CIELab COLOUR SPACE

$L^* = 100$ (white)
$L = 0$ (black)
APPLICATION
Realizer SLM 50 Desktop Machine

SLM® powder alloys are the result of several tests carried out with Realizer SLM 50 desktop machine. The best performance of our powders is ensured exclusively with the combined use of Progold and Realizer products.

APPARENT DENSITY

The apparent density of a powder is given by the ratio between powder weight and the bulk space occupied by it. It is expressed in gr/cm³. Apparent density depends on several factors, i.e. particle-size fractions present in the powder, its morphology and atomisation process used.

PARTICLE-SIZE DISTRIBUTION

Before being sold, SLM® powders are analysed with a laser particle-sizer to measure the size of their particles. Every powder has therefore a different particle-size distribution which depends on some important values:
- Dv10/μm: equivalent to maximum size of 10% powder;
- Dv50/μm: equivalent to maximum size of 50% powder;
- Dv90/μm: equivalent to maximum size of 90% powder.

Gold and silver powders used with the SLM are sieved using sieves of 53 μm or 25 μm which make it possible to achieve particles with a max size equal to the sieve used.
SLM® POWDER ALLOYS PRODUCT RANGE
PRODUCT RANGE

Au
750‰ YELLOW

SLM100
750‰ yellow gold powder alloy. Particles are smaller than 53 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 3N colour defined by EN28654 norm.

SLM101
750‰ yellow gold powder alloy. Particles are smaller than 25 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 3N colour defined by EN28654 norm.

SLM110
750‰ yellow gold powder alloy. Particles are smaller than 53 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 2N colour defined by EN28654 norm.

SLM111
750‰ yellow gold powder alloy. Particles are smaller than 25 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 2N colour defined by EN28654 norm.

SLM112
750‰ yellow gold powder alloy. Particles are smaller than 53 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 4N colour defined by EN28654 norm.

SLM113
750‰ yellow gold powder alloy. Particles are smaller than 25 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 4N colour defined by EN28654 norm.

PHYSICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>FINENESS</th>
<th>APPARENT DENSITY</th>
<th>PARTICLE-SIZE</th>
<th>COLOUR COORDINATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>g/cm³</td>
<td>µm</td>
<td>L°</td>
</tr>
<tr>
<td>SLM100</td>
<td>750</td>
<td>9.13</td>
<td>0+53</td>
</tr>
<tr>
<td>SLM101</td>
<td>750</td>
<td>8.85</td>
<td>0+25</td>
</tr>
<tr>
<td>SLM110</td>
<td>750</td>
<td>9.21</td>
<td>0+53</td>
</tr>
<tr>
<td>SLM111</td>
<td>750</td>
<td>9.09</td>
<td>0+25</td>
</tr>
<tr>
<td>SLM112</td>
<td>750</td>
<td>9.05</td>
<td>0+53</td>
</tr>
<tr>
<td>SLM113</td>
<td>750</td>
<td>8.89</td>
<td>0+25</td>
</tr>
</tbody>
</table>
Au
750‰ WHITE

SLM102
750‰ palladium white gold powder alloy. Particles are smaller than 53 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy is nickel-free.

<table>
<thead>
<tr>
<th>PHYSICAL CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fineness</td>
</tr>
<tr>
<td>‰</td>
</tr>
<tr>
<td>SLM102</td>
</tr>
<tr>
<td>SLM103</td>
</tr>
</tbody>
</table>

Au
750‰ RED

SLM104
750‰ red gold powder alloy. Particles are smaller than 53 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. This alloy respects 5N colour defined by EN28654 norm.

<table>
<thead>
<tr>
<th>PHYSICAL CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fineness</td>
</tr>
<tr>
<td>‰</td>
</tr>
<tr>
<td>SLM104</td>
</tr>
<tr>
<td>SLM105</td>
</tr>
</tbody>
</table>
950‰ platinum powder alloy. Particles are smaller than 25 μm and have a regular round shape. This alloy is suitable for the production of objects using Realizer SLM (Selective Laser Melting) technology. The platinum alloy can be highly hardened after proper heat treatment.

### Physical Characteristics

<table>
<thead>
<tr>
<th>FINENESS %</th>
<th>APPARENT DENSITY g/cm³</th>
<th>PARTICLE-SIZE μm</th>
<th>COLOUR COORDINATES L* a* b*</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLM114</td>
<td>950</td>
<td>11,5</td>
<td>0 ± 53</td>
</tr>
</tbody>
</table>