STX 316L MIM

STX 316L MIM is an austenitic stainless steel based on the AISI 316L standard. It is commonly used in corrosive environments. Worldwide the AISI 316 is the second most used austenitic grade after AISI 304, However in MIM the 304L grade is not readily available, so the AISI 316L is used in all applications, where AISI 304L would be used.

The STX 316L MIM subgrades come in a wide variety. Different properties can be achieved, e.g. some grades are better for polishing, some for geometrical stability. The selection of grade for the final product is done with close regards to the requirements of the part.

Chemical specification

The chemical composition of STX 316L MIM after sintering is as follows. (Measured in % of weight).

C	Cr	Ni	Mo	Mn	Si
< 0.03 %	16-18 %	10-14 %	2-3 %	< 2 %	< 1 %

Figure 1: Chemical specification for STX 316L MIM

Typical properties

Properties can vary and can of course be adjusted to your application needs. It is however important to remember, that the properties are intercorrelated - demands on certain properties will offset values for other properties. If you e.g. have a need for higher hardness then it will influence elongation to a lower value. You have to be willing to forego other properties, if you have high demands in one area.

The challenge is to know what kind of properties are needed. Especially if it is the first times working with MIM. Many drawings are not designed with MIM in mind, but rather regular machining.

The best solution to this issue is to use our many years of design and production experience. Please consult our experts early in the process for further discussions and information regarding material selection and not least design possibilities. For some guide dance however, here are the typical properties of finished sintered parts:

	Sintered
Density [% of theoretical]	≥ 98
Yield strength Rpo.2 [MPa]	150 - 200
UTS Rm [MPa]	450 - 510
Elongation [%]	≥ 50
Hardness [Hv10] (HRC)	≥ 120

Figure 2: Typical properties for STX 316L MIM

Feedstock

The feedstock consist of a binder system mixed with metal powders in a certain concentration. The higher you are able to load the binder system with powder, the less the part shrink in the end. There is however an upper threshold of around 63% powder in such a system, since above that there is so much metal that a metal "bridge" is formed when mixing it and this will cause inhomogeneity. Hence in order to stay away from this limit, most feedstocks consist of around 60% powder and 40% binder.

Within the chosen material, the powders can also be of different types and give different properties. We divide them in 3 groups: Prealloy, Master alloys and Engineering alloys. Each of them has different strengths and weaknesses - all is in the details on how the powders work during sintering. Please see figure 3 below. The final powder is selected to match the components desired.

Figure 3: Strength and weaknesses of the various powder types and comparison hereof

Property	Pre-alloy	Master-alloy	Engineering alloy
Density	Very good	Good	Good
Polishability	Very good	Less good	Less good
Moldability	Good	Very good	Very good
Surface finish as sintered	Good	Very good	Very good
Geometrical stability	Less good	Good	Very good
Material price	Very good	Good	Less good

= Very good = Good = Less good

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The MIM process and MIM components

The MIM process is in reality just 3 simple steps after the feedstock has been mixed and supplied - namely molding, debinding and sintering. The process and the intermediate parts are illustrated below.

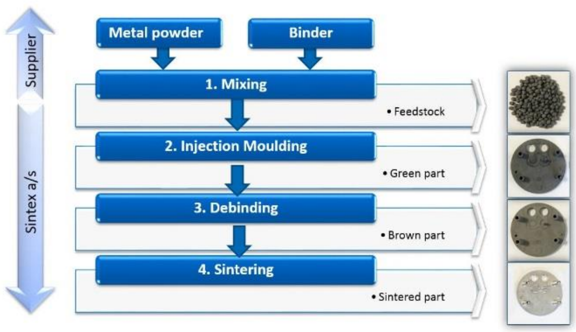

Figure 4: Illustration of the MIM process

Metal Injection Moulding is a fantastic unique technology, but it might not be the best choice for your component. It is a complex technology and some parts are less suited for MIM even though it is such a simple process.

In our opinion the best way to consider is to involve MIM experts early in the process. Some considerations may be able to be changed early in the process, plus the unique feature of MIM - to be able to combine several components in one - may also be considered.

One to one conversion of previous metal parts to MIM parts is generally not a good idea. For the best result, all possibilities should be considered. Savings on assembly processes or finishing treathments might be the parameters that make the MIM process attractive financially as well.

Another possibility, worth mentioning as an example, is to have logo, batch or serial number recessed in the parts.

Basic considerations & Design guidelines

There are some basic rules that can both help evaluate the component for the MIM process but also help in the initial face of designing the tool and molding. These are:

- Component weight 0.1 – 250 g
- Tolerance level (+/- 0.5% of the nominal value)
- Think geometry - how is it possible to place part during sintering?

Smaller or larger components have been made, tolerances have been smaller but then you are outside the comfort zone of the process.

Besides these basic rules there are also general design guidelines. These are illustrated and shortly described in figure 5.

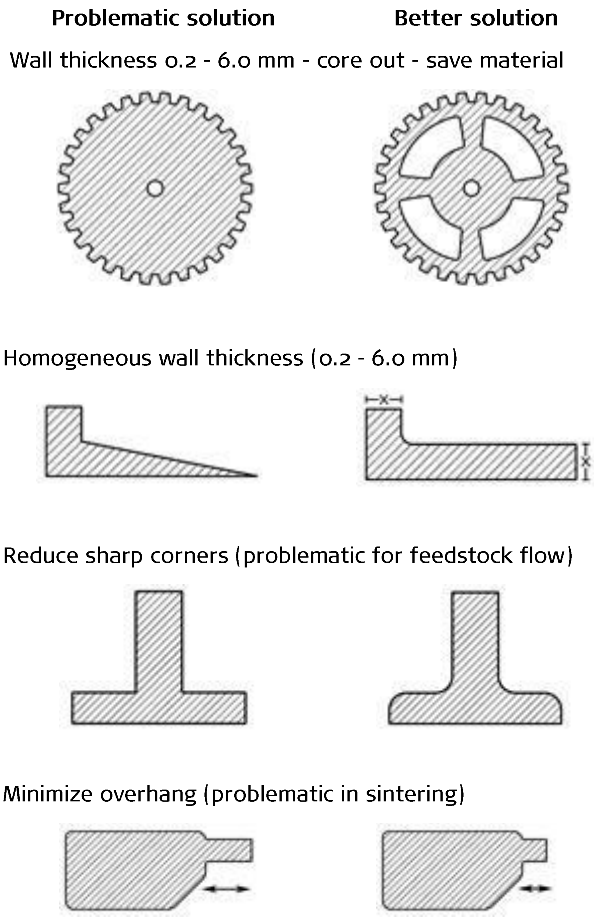

Figure 5: Design guidelines

Results

The data for STX 316L MIM shown in this data sheet has been obtained in cooperation with our feedstock suppliers in accordance with ISO standard 22068. It is not possible to directly attribute all the results to specific components, as parameters such as powder flow, component size and geometry can have an effect on the properties of the individual components.

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