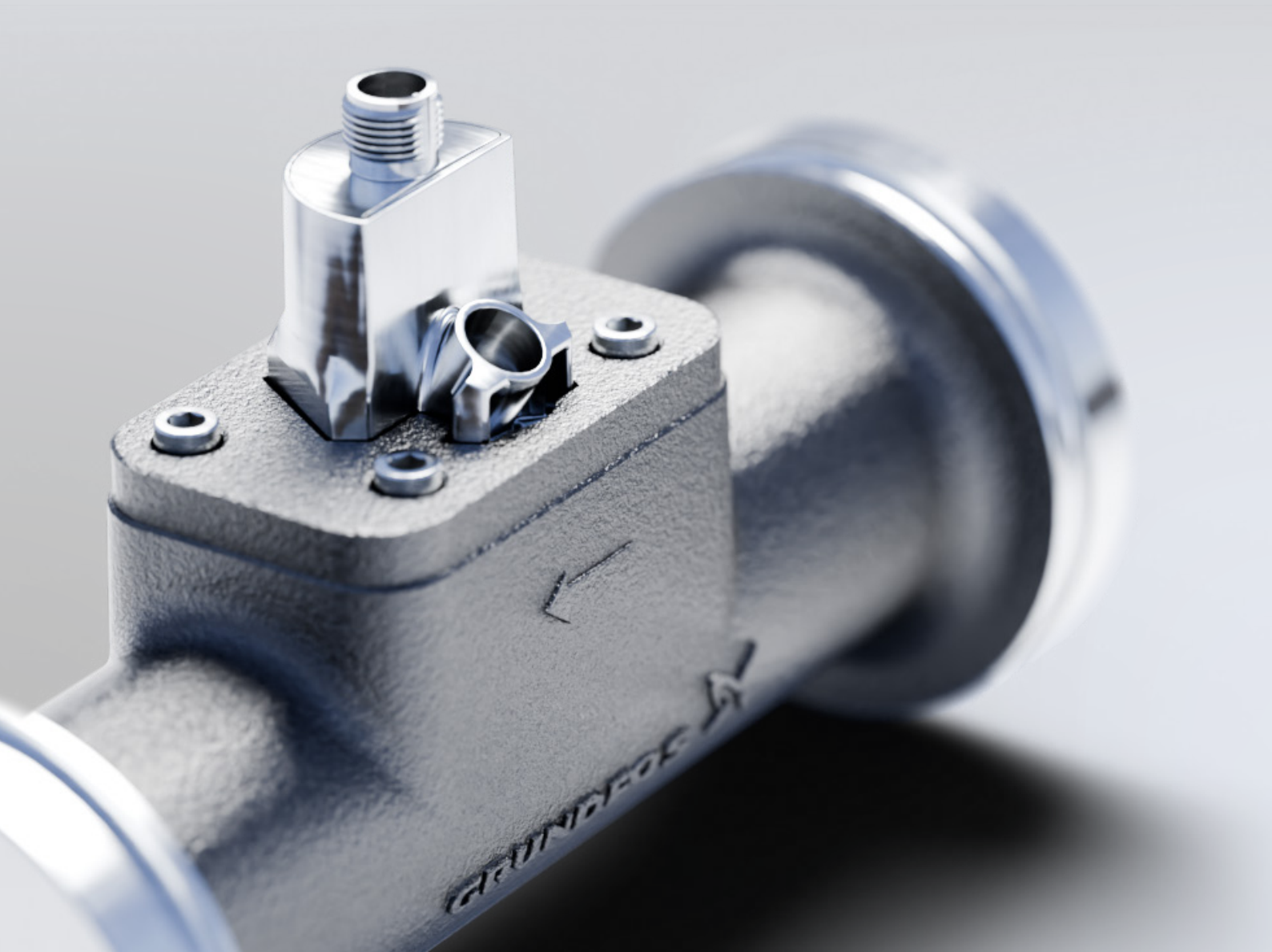


Metal Injection Moulding - STX M2.

Pushing Boundaries. Engineering Possibilities.



STX M2 MIM.

STX M2 MIM is a molybdenum-tungsten high speed steel based on the AISI M2 standard. It is used in a large array of different combinations - everything from cutting tools to high wear applications.

M2 is generally hard to machine, making the MIM technology suitable. STX M2 MIM parts only need a final finish treatment or they can be used as sintered.

The hardness of the part can be adjusted in the sintering process, so in a lot of cases the secondary heat treatment can be skipped. Hardness up to 58 HRC has been achieved as sintered.

Corrosionwise sintered M2 is worse than the block equivalent material. After sintering the material is virgin and has no oxide layer protecting the part, so any parts manufactured in the material need to be planned for handling and transport.

Chemical Specification

The chemical composition of STX M2 MIM after sintering is as follows. (Measured in % of weight)

C	Cr	Mo	W	V	Fe
0.08-1.05%	3.75-4.5%	4.5-5.5%	5.5-6.75%	1.75-2.2%	Balanced

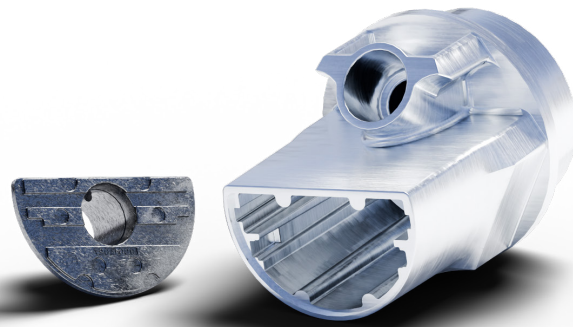
Figur 1: Chemical Specification for STX M2 MIM

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 time 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 guidance however, we have made a

	Sintered	Heat Treated
Density [% of theoretical]	≥99	≥99
Yield Strength R _{p0.2} [MPa]	≥800	≥800
UTS R _m [MPa]	≥1200	≥1200
Elongation [%]	≥1	≥1
Hardness [Hv10] (HRC)	≥520 (50 HRC)	≥820 (64 HRC)

Figur 2: Typical Properties for STX M2 MIM

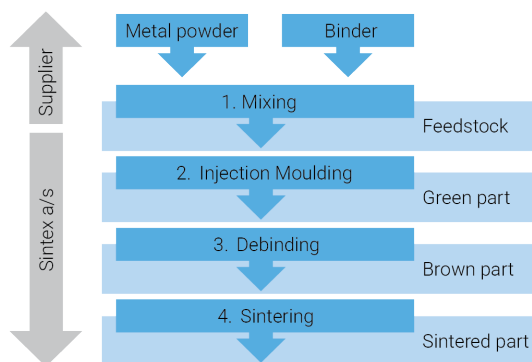
Feedstock

The feedstock consists 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 shrinks 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. This is the case for M2 MIM as well.

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.



Figur 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 treatments 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

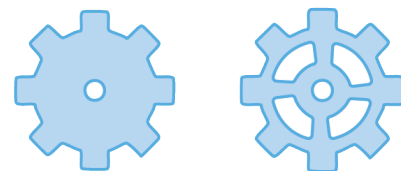
There are some basic rules that can both help evaluate the component for the MIM process but also help in the initial phase of designing the tool and molding. These are:

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

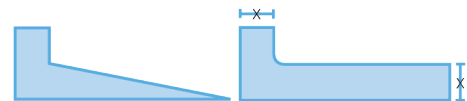
Smaller or larger components have been made, tolerances have been smaller but then you are outside the comfort zone of the process.

Besides these basic rules there are also general design guidelines. These are illustrated and shortly described in figure 4.

Problematic solution and the better solution
Wall thickness 0.2-0.6 mm - core out - save material



Homogeneous wall thickness (0.2-0.6 mm)



Reduce sharp corners (problematic for feedstock flow)



Minimize overhang (problematic in sintering)



Figur 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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