Design and Build Preparation Guidelines for Additive Manufacturing of Jewellery
Jewellery manufacturing has evolved greatly and now Additive Manufacturing (AM) processes are being used to overcome geometrical limitations of traditional casting methods. AM techniques have opened up design possibilities by allowing highly complex geometries to be created directly from 3D CAD data within hours and without any tooling.

The potential for this cutting-edge technology to unleash creative freedom in the jewellery industry is very exciting, and designers and manufacturers have only just scratched the surface of what is possible when imagination and technology come together. Stay tuned!
AM offers a wealth of flexibility for the jewellery designer, but design choices are needed to optimise the surface finished product. Always keep in mind the scale of the finished item – avoid large areas of minute detail as anything less than 0.4mm thick will not cast if it is spread over too large an area.

Walls that are too thin and tall cannot be cast, so for a short section a wall thickness of 0.4mm minimum is recommended, but for safety a wall thickness of at least 0.5mm is more practical.

Round holes over 4mm in diameter will need fixtures, “eye” shaped holes do not need fixtures.
Build Preparation

In metal AM, fixtures are metal structures that prop up the item to be built as well as ensuring construction of all its details. They are required for most downward facing surfaces (at less than 30° from the build platform) because the powder alone is not sufficient to hold the melted powder in place during the laser exposure.

Be aware that they can leave a mark or scarring when they are removed, which will then require extra cleaning and finishing. So ideally the design should be self-supporting where possible and the number of fixtures should be minimal. They should be in a place that can be reached by files, emery boards, etc., otherwise removal of these could result in poor surface finish.

Fixtures are used to:
- **Improve build effectiveness** – supporting the weight and features of the design
- **Assist mechanical influence** – by providing reinforcement, stability of the piece on the platform
- **Reduce thermal effects** – by improving heat transfer and reducing thermal stresses
- **Improve surface finish** – by supporting surfaces that are near or close to being horizontal. Such surfaces typically will not build without fixtures and/or they will have degraded or unattractive looking surfaces.
Post-processing

The orientation of your piece will determine how many fixtures you require. The more fixtures you have, the higher the time and clean-up cost will likely be and the more post-processing stages you will need. The first stage is fixture removal and manual preparation to remove all witness marks, smoothing, and filing might also be needed. Automated smoothing and then automated polishing, and then mechanical polishing can be used to improve the global look of the piece. Finally you will always have to hand polish your piece to make it shine.

DID YOU KNOW?
The Precious project will be producing a helpful guide to show when and how much mechanical finishing/polishing is needed and what kind of surface quality you can expect.
When submitting 3D design files of pieces to be built, care should be taken over the quality of the design itself as well as the export file format as this can impact quality, time, effort, and cost if not done appropriately. There should be no naked edges, open holes or open ends ie the designs should be ‘watertight’. That is to say models cannot have unintended piercings or gaps.; holes are acceptable as long as the edges are sealed. A naked edge occurs when surfaces touch, or nearly touch, but are not joined.

DID YOU KNOW?
Many current AM software support different file formats such as Parasolid, STEP, .stl, .3dm, .dwg, .iges, so try to avoid file format conversion and keep everything in its original design format – check with your AM manufacturer for their preferred format.
Checklist

In order to create the best AM finished piece, ask yourself the following questions:

<table>
<thead>
<tr>
<th>CLEAN-UP EFFORT</th>
<th>MECHANICAL INFLUENCE</th>
<th>COST</th>
<th>EFFICIENCY</th>
<th>QUALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>• How much surface clean-up of fixtures or surface smoothing is needed?</td>
<td>• Will my piece be structurally stable during build?</td>
<td>• How much will my piece cost to build?</td>
<td>• Do I have a time or quantity constraint?</td>
<td>• Will the piece’s surfaces and dimensions be accurate?</td>
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<td>• Are there critical areas that should not be treated with care?</td>
<td>Effects of poor heat transfer can lead to surface discoloration on Titanium and Gold for example. It can also cause the pieces to peel off or separate from the platform (delamination).</td>
<td>Changing build orientation can significantly affect fixturing, clean-up effort, build time, surface quality and cost.</td>
<td>This affects build efficiency and the number of pieces that can be built at one time. So how many pieces can be packed on a build platform? Build efficiency is also affected by the orientation of the pieces.</td>
<td>• Will the surfaces look good and saleable?</td>
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<td>• Do I need additional geometry to make clean-up easier? For example, gripping/holding spigots.</td>
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<td>• Will my features be represented as intended after build and post-processing?</td>
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