

# Meltio Design Guidelines

Guidelines for materials and geometry to be printed with Meltio technology

v.4.3

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# 1. Material Overview

Meltio materials stands out as a recommendation for its additive manufacturing systems due to its verified quality and optimized profiles developed that can guarantee part properties. Meltio has developed a line of materials that have undergone rigorous research, development, and testing processes to ensure superior performance and reliable results.

Meltio materials covers a wide range of applications and industries, catering to diverse needs and requirements. From stainless steels and tool steels to titanium alloys and nickel-based superalloys, Meltio offers a comprehensive portfolio that enables users to tackle various manufacturing challenges, whether it is in aerospace, automotive, medical, or other sectors.

Meltio materials with verified profiles	Supported materials without verified profiles
Stainless Steel 316LSi	Other Stainless Steels
Stainless Steel 308LSi	
Stainless Steel 17-4PH	
Mild Steel ER70S	Carbon Steels
Tool Steel H-11	
Titanium 64	Other Titanium Alloys
Nickel 718	Nickel Based Alloys
Nickel 625	
Invar 36	

Check the material datasheet in Meltio [website](#).

Nonetheless, Meltio's technology is an open platform, offering unlimited third-party material choice. By embracing that, Meltio enables users to explore a wide range of materials that best suit their specific needs and applications.

This flexibility allows for greater customization and adaptability, as different materials possess unique properties such as strength, durability, conductivity, or heat resistance. Users can leverage this diverse selection of materials to create parts that meet the most demanding requirements across multiple industries.

Meltio's open platform approach facilitates collaboration and knowledge-sharing within the additive manufacturing community. Allowing users to experiment with different materials and suppliers, valuable insights and discoveries can be shared, fostering an environment of continuous improvement and advancement in the field.

## 1.1 Dual Material Compatibility

The chart below offers valuable insights into the compatibility of the different Meltio materials with each other in the context of dual wire printing. The compatibility of materials refers to their ability to effectively bond or adhere to one another during the printing process. By examining the table, users can assess the compatibility of different material combinations and make informed decisions regarding material selection for their specific applications.

Compatible Incompatible		Main Part Material (Wire 1)										
		316LSi	308LSi	17-4PH	Invar 36	In 625	In 718	H11	ER70S-6	Ti64	AlSi10Mg	CuCrZr
Substrate Material (Wire 2)	316LSi	Compatible							Incompatible		Compatible	
	308LSi	Compatible							Incompatible		Compatible	
	17-4PH	Compatible							Incompatible		Compatible	
	Invar 36	Compatible							Incompatible		Compatible	
	In 625	Compatible							Incompatible		Compatible	
	In 718	Compatible							Incompatible		Compatible	
	H11	Compatible							Incompatible		Compatible	
	ER70S-6	Compatible							Incompatible		Compatible	
	Ti64	Incompatible							Compatible		Incompatible	
	AlSi10Mg	Incompatible							Compatible		Incompatible	
	CuCrZr	Compatible							Incompatible		Compatible	

*Dual material compatibility chart*

## 2. Geometry Analysis: Design Rules

The following design rules are applied for all Meltio systems.

### 2.1. Near Net Shape (NNS) and Over-thickness

**Near Net Shape (NNS)** is an industrial term referring to manufacturing processes that produce a part very close to its final geometry, also known as the *net shape*. Although the part is nearly finished, additional machining or surface finishing is typically required to meet the final specifications and tolerances.

Meltio is considered a near-net-shape technology because it can produce components that closely match the final size and shape of the model. For this reason, adding over-thickness is essential to ensure that the final surface can be accurately machined without compromising the part's dimensions.

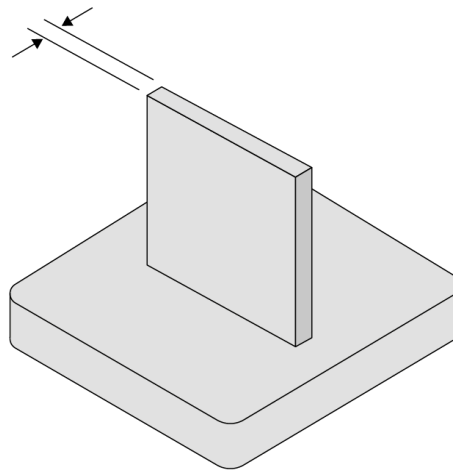


*As-printed vs machined surfaces*

Applying over-thickness generally involves modifying the 3D model in CAD to add material in the areas that will undergo finishing. A typical recommendation is to add 1.5 mm of extra material on surfaces that require low roughness and high dimensional accuracy after machining. However, this value may vary depending on the printing profile and the material used.

## 2.2. Minimum Wall Thickness achievable

Minimum Wall Thickness refers to the thinnest geometric wall that can be reliably printed, depending on the material and parameters.

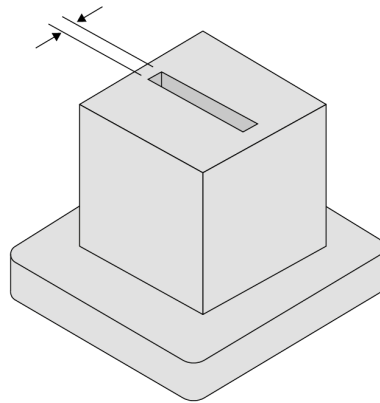


Minimum Wall  
Thickness: **2mm**

**Solution:** If the model contains walls below this limit, the CAD geometry must be modified to add material until the required minimum thickness is achieved. This additional material will be removed during post-processing.

## 2.3. Minimum Slot Width

Slot Width refers to the minimum separation between two vertical surfaces that can be printed without making contact. The minimum slot width is **2 mm**.

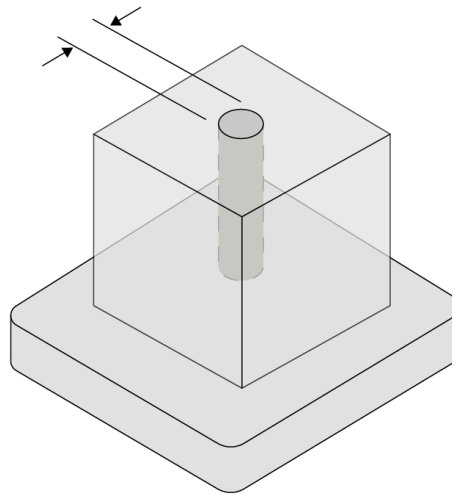


Minimum Slot  
Width: **2mm**

Slots printed at non-vertical angles require additional clearance, and larger layer heights also demand increased separation due to higher surface roughness. Whenever possible, slots should be designed at the largest feasible size to improve separation.

## 2.4. Minimum Vertical Hole Diameter

The minimum obstruction-free vertical hole diameter is **4 mm**.



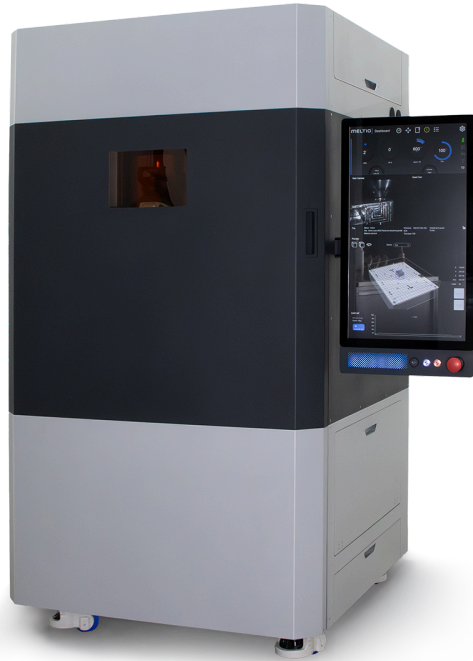
Minimum Vertical Hole  
Diameter: **4mm**

Whenever possible, holes should be designed at the largest feasible size to ensure proper separation. As with slots, holes printed at non-vertical angles require additional clearance, and larger layer heights also demand increased separation due to higher surface roughness.

In cases where there is a deviation between the printed geometry and the CAD model and subsequent machining is required, the drilling tool may be forced toward the existing printed hole, especially if the feature is misaligned. Additionally, deep holes can generate vibrations during drilling, leading to machining defects. For these reasons, we sometimes recommend closing small holes in the CAD model even if they meet the minimum printable conditions.

## 3. Systems utilizing 3-axis configuration

### 3.1. Fundamental geometry limitations



*Meltio M600 ([Meltio M600 Industrial Metal 3D Printer](#))*

**Print Envelope [mm]:** 300 × 400 × 600.

**Largest Build Plate [mm]:** 300 × 400.

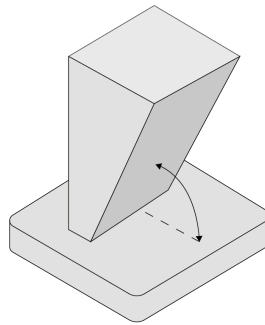
### 3.2. Criteria on part size and weight to assess suitability

**Dimensions:** Greater than 10 mm in all axes for simple geometries, depending on the material.

**Weight:** Up to 150 kg.

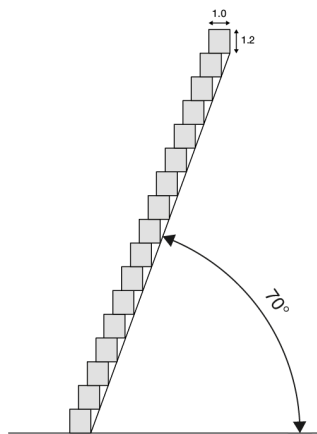
### 3.3. Maximum Admissible Overhang

Represents the maximum overhang that can be done without the need of printing support.

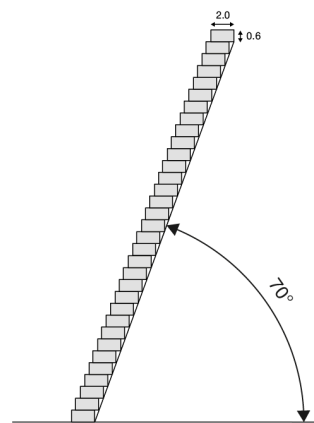


Maximum Admissible  
Overhang Angle: **70°**

If the overhang gets steeper than that, support material will be required for 3D printing. Meltio's LMD process achieves the largest overhangs at low layer heights. Low layer heights increase the line width, leaving a higher area of overlapping between the beads, enhancing the stability of building the overhanging feature. Nevertheless, this effect is affected by the material chosen.



Layer Height: **1.2mm**  
Layer Width: **1mm**



Layer Height: **0.6mm**  
Layer Width: **2mm**

*Example of a single bead overhang print showing how individual layers overlap each other.*

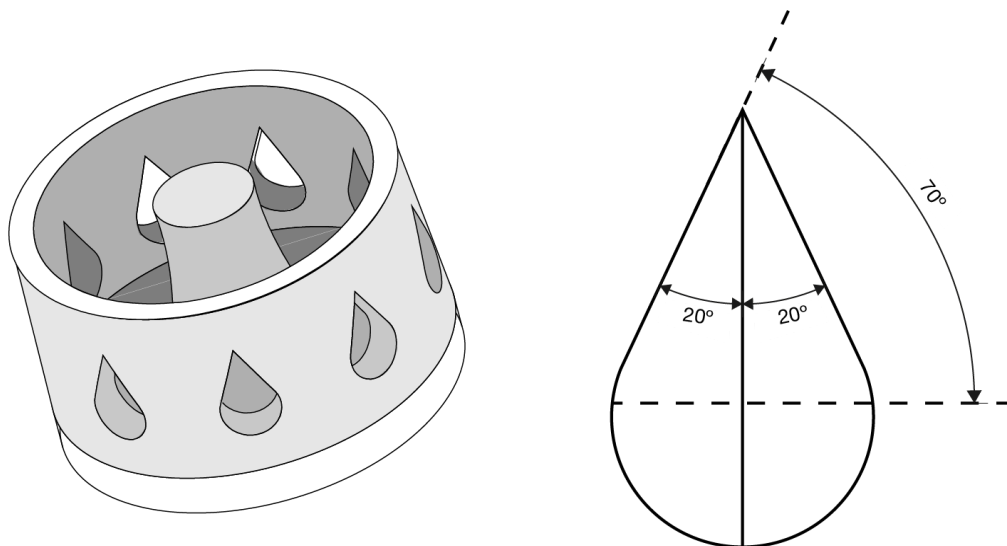
It is important to highlight that a larger layer height is more economically interesting because it reduces the print time. As Meltio Wire LMD is a near-net shape process and most of the parts require machining, it is usually faster and cheaper to produce the part in larger layer heights and machine a minimal amount of additional material once the component has been printed.

### 3.4. Horizontal Cooling Channels / Horizontal Holes

Horizontal holes cannot be printed with a round profile as they form a very steep overhang and bridge at the top. Therefore, two options are available.

#### 3.4.1. Teardrop Profile

Changing the cross-section to a teardrop shape reduces the maximum overhang angle to a manageable degree. This option is suggested if horizontal holes or cooling channels are unavoidable and can not be accessed for machining in post-processing.



### 3.4.2. Elimination and fabrication during post-processing

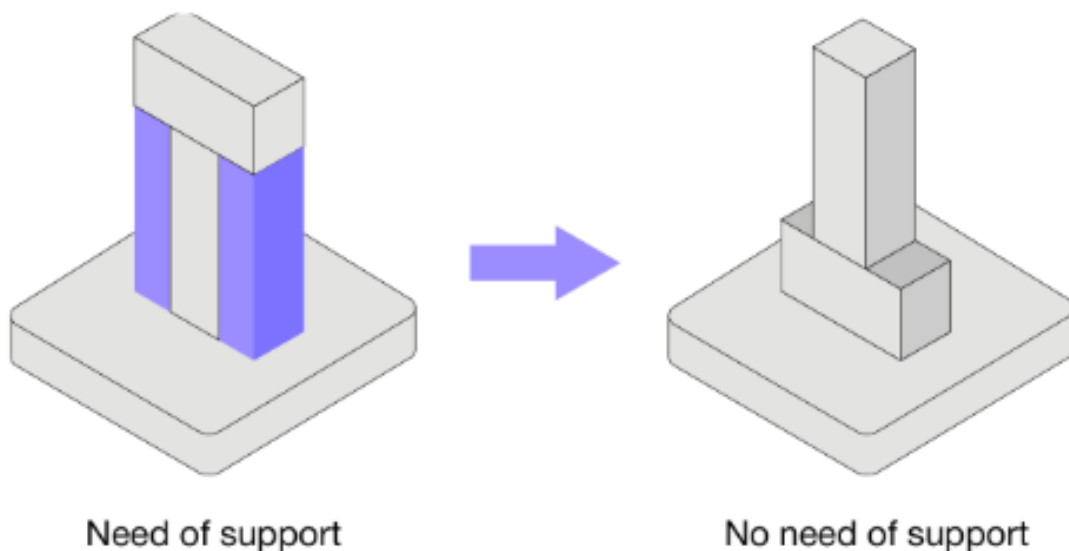
In most cases, the easiest option is to remove the horizontal hole entirely in the CAD program and to machine it during post-processing.

To facilitate machining, it is recommended to fill the hole and show the perimeter of the circle.

## 3.5. Overhang Solutions

### 3.5.1. Printing orientation

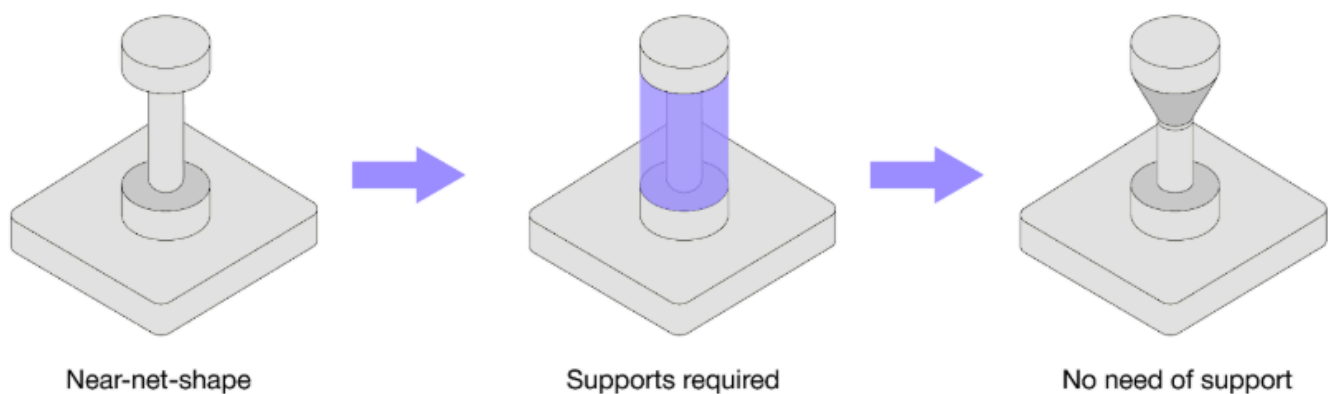
To print a part, its orientation should be selected in order to reduce the use of support. Also, it should be considered using the build plate as part of the model if allowed by the geometry to reduce printing time and spare material.



### 3.5.2. Modify part in CAD

If the overhanging area is non-functional and can be modified, it is strongly recommended to redesign the geometry so that it complies with the design rules (overhang  $< 70^\circ$  from the horizontal axis). If the area is functional and cannot be altered, subsequent machining remains a valid option.

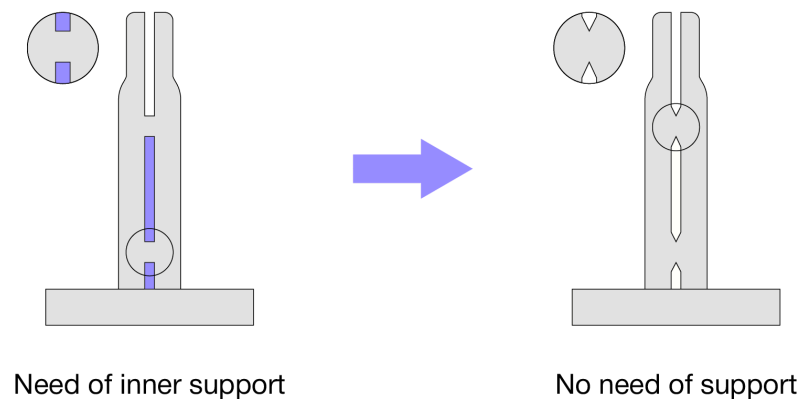
The desired net shape is shown on the left, and the modified version that complies with the design rules is shown on the right. Only a small amount of additional material is required compared to generating supports in the slicer.



### 3.5.3. Smooth transition at bridges

LMD printing processes cannot bridge gaps due to the low viscosity of the molten material. Therefore, as with the previous modification, any bridged section must be supported using wedge supports.

In the example below, the same part contains two bridged sections. The first is printed using slicer-generated support, which completely seals the gap, whereas the second uses wedge supports that preserve the part's functionality.



### 3.5.4. Add support material

Printing supports can be machined away after manufacturing. When working with high-value materials, it may be advisable to print supports using a different, lower-cost material that is also easier to remove.

When possible, we typically recommend Mild Steel for this purpose (refer to the [dual-wire combination chart](#)).

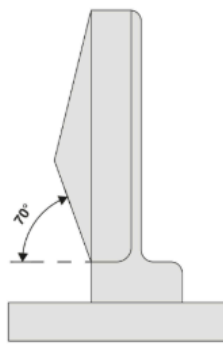
#### **CAD-Generated Support**

Creating supports directly in CAD provides full control over their geometry and parameters, resulting in more efficient and tailored support structures.

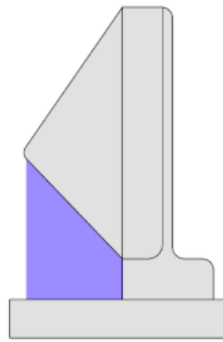
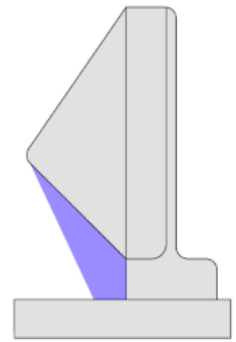
#### **Slicer-Generated Support**

Meltio Horizon/Space can automatically generate supports for surfaces that exceed the maximum overhang angle. While this is an easy method, it is not the most efficient, as supports are always placed vertically.

If none of the proposed solutions are suitable, **5-axis printing should be considered.**

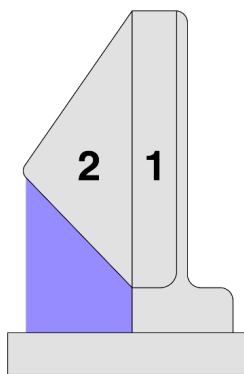


Without support

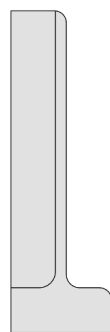
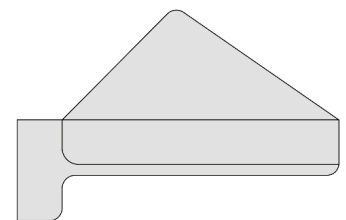
Slicer generated  
supportCAD designed  
support

### 3.5.5. Multi-Step Strategy for Non-Printable Overhangs

Depending on the geometry, the part can be divided into separate bodies and assigned different printing strategies and orientations for each section. This approach can help overcome otherwise impossible overhangs and significantly reduce the need for support. **5 Probing functions for Feature Addition and Repairing** are available for the M600.



Final Part

1° Printing  
orientation2° Printing  
orientation

## 4. 5-Axis & 6-Axis Systems: CNC and Robot Integrations

Since all Meltio systems share the same Meltio deposition head, the previously described design guidelines can be fully applied to multi-axis manufacturing. However, thanks to the capabilities of 5-axis and 6-axis systems, the toolhead can be aligned with the optimal manufacturing direction. This allows for higher admissible overhang angles, reducing the amount of support material required, or even eliminating supports entirely through the use of Meltio Space strategies.

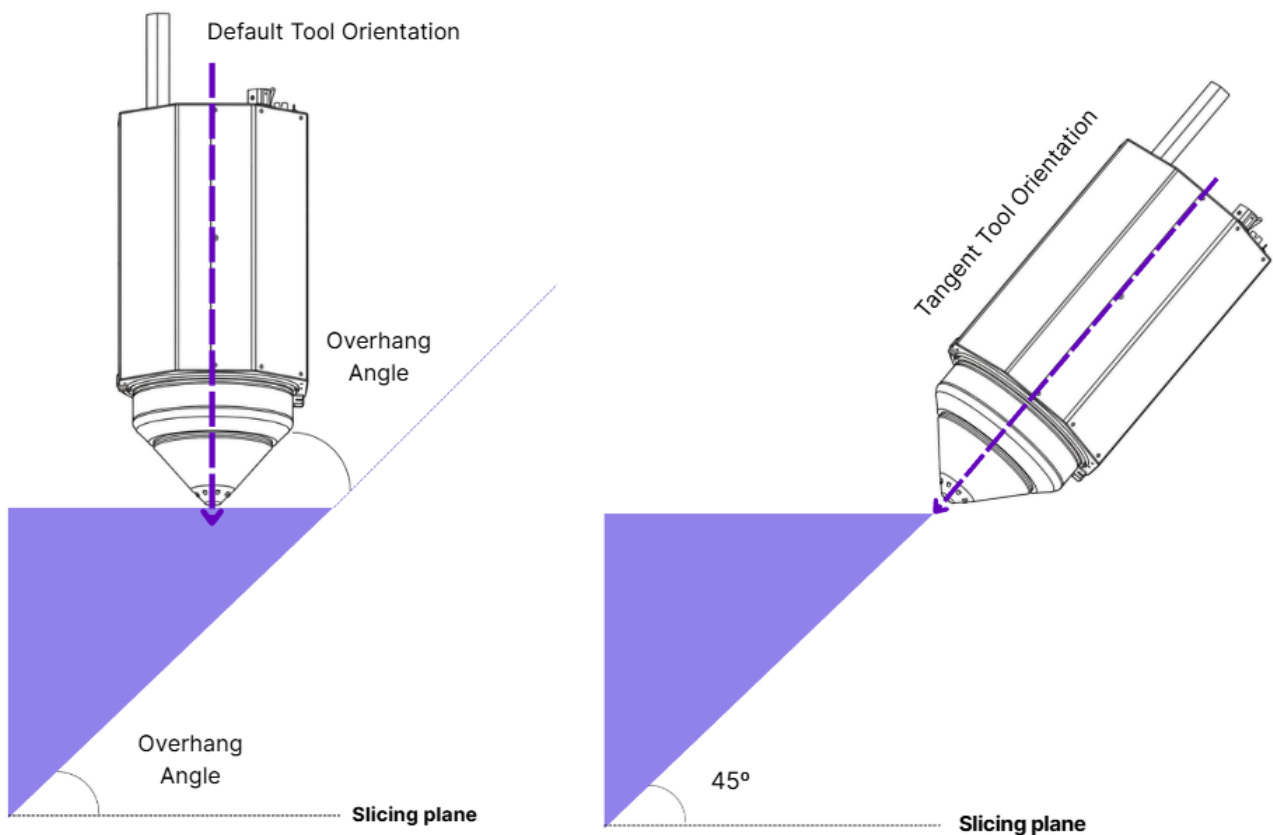
Collisions between the deposition head and the part, build plate, or any component of the robot cell must be carefully evaluated, as not all geometries offer the same accessibility or allow the same orientation angles.

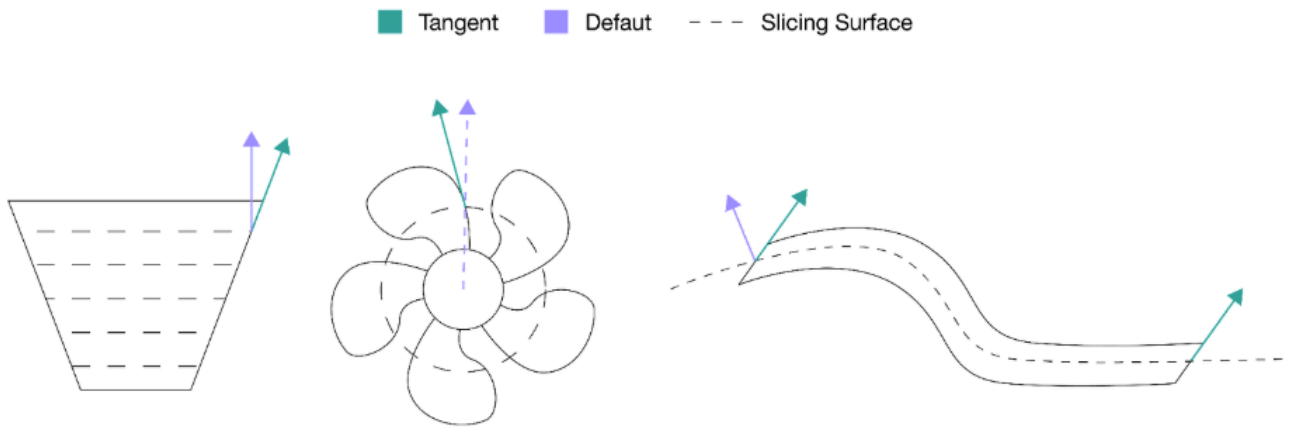
While it is not feasible to define a universal rule that avoids all potential collisions, certain general considerations regarding the dimensions of the Meltio Engine toolhead can help prevent many of them.

**Note:** *Meltio Space has been developed to provide a wide range of printing strategies and integrated collision checks, enabling the creation of safe and efficient toolpaths for robotic integrations.*

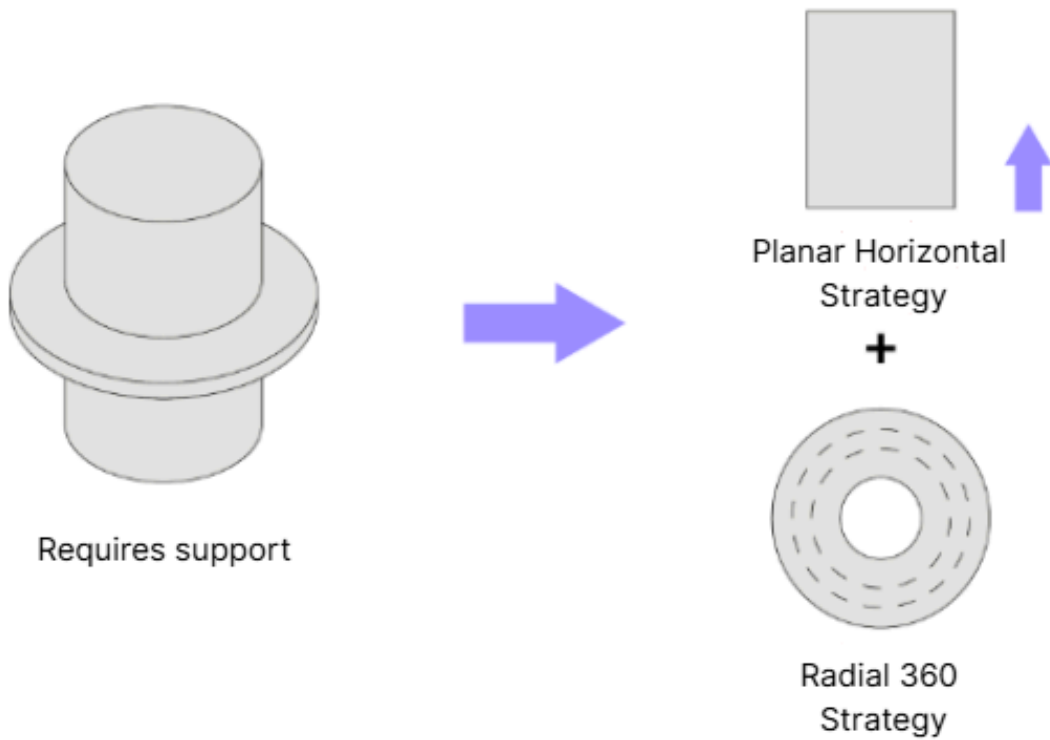
## 4.1. Overhang Angles | Tangential Orientation

The higher degrees of freedom in multi-axis systems allow the Meltio deposition head to be reoriented. A Tangent Tool Orientation aligns the head with the overhanging areas of the part, increasing the maximum allowable overhang angle to approximately  $45^\circ$  from the default orientation (depending on the material).





Furthermore, by combining this freedom of movement with strategic subdivision of the part into multiple bodies, additional strategies can be employed to overcome even greater overhang challenges.



## 4.2. Limitations of Robot Integrations in Bridge Printing

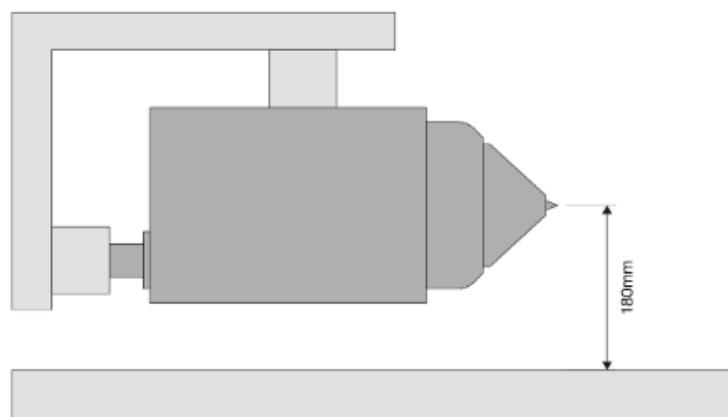
Currently, robot integrations face limitations when printing bridges or enclosed spherical features, mainly due to the risk of collisions between the deposition head and previously printed sections of the part. The recommended solution is to redesign the geometry to incorporate the printable overhang strategies described in this document. However, it is essential to perform collision checks even when supports are used to avoid any potential crash.

## 4.3. Head's Clearance

### 4.3.1. Minimum Safety Distance

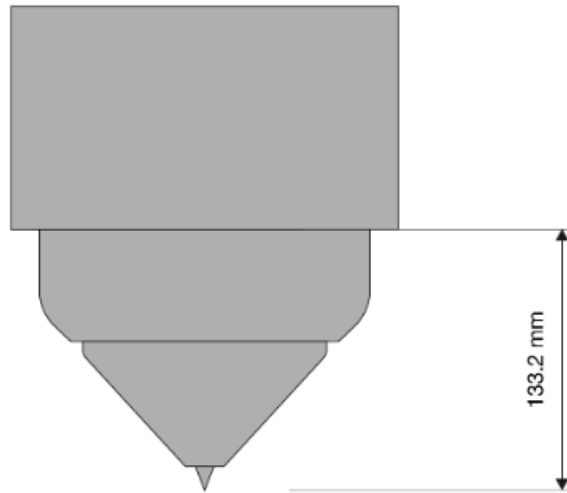
The standard safety distance required when printing at a 90-degree orientation is 150 mm, ensuring that the deposition head will not collide with any surrounding elements along its path. In some cases, a custom workholding solution may be needed to elevate the part beyond this minimum clearance. It is also important to account for the axial distance between the nozzle tip and the outermost edge of the deposition head.

### 4.3.2. Meltio Engine Blue Measurements

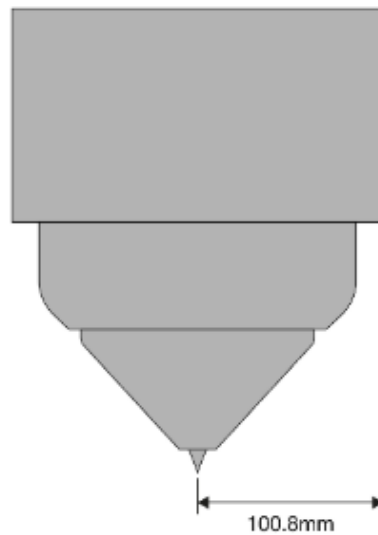


Minimum **Lateral Distance**  
for Head Clearance:  
v3 = 150mm  
**Blue = 180mm**

Another critical parameter to account for is the external angle of the Meltio Engine toolhead.



Minimum Axial Distance  
for Head Clearance: **133.2mm**



Minimum Horizontal Distance  
for Head Clearance: **100.8mm**

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