# Version History

10/26/2025 Created.

# Goal

The fine alignment of the laser to the individual pads proved very difficult to do to within < 0.1mm. There were too many tolerance issues. This process focuses on just cleaning the outer and inner circumferences which are the hardest to clean.

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# Process Steps

## Define the Paths to Clean

A dedicated program is used to generate G Code for cleaning of the masking resin off the Carousel part. This program focuses on cleaning the outer circumference and inner circumferences of the pads.

The size of the Carousel requires there be two cleaning steps, one for the top sectionof the Carousel and one for the bottom section. There can be overlap in the cleaning step if desired.

The fine alignment of the laser to the Carousel is done using the outer and inner grooves in areas between the masked pads. This avoids the resin from making the alignment difficult to see. Aligning the laser at low target power makes the glare off the aluminum less and aligning to the groove makes the laser change in intensity easier to spot.

Seven reference points are used to provide some averaging of the alignment errors. An analysis is done knowing the expected diameter of each outer and inner circle which will flag points with too much error and these can be remeasured.

When aligned the laser is turned on and run in full arcs from the starting to ending angles for each cleaning offset from the outer and inner groove. The laser is not shut off between pads as it will not damage the aluminum and this avoids needing precision rotational alignment of the laser to Carousel.

So two major simplifications:

* Using the outer and inner grooves to do the alignment which do not have masking in them and their small width provide finer alignement.
* Keeping the laser on for the fully arc, not trying to precisely fine each pad.

### Geometry Definition Tab

A screenshot of a computer

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This view shows the initial screen. The data entry is done on the left side and the plot is shown on the right. The outer and inner diameters come from the CAD drawing. The offsets show the spacing from the center of the grooves.

The plot on the right shows both the top and bottom cleaning passes and the reference points. The check boxes at the top allow either the top, the bottom of both to be displayed. See below. For each view, the reference points that will be used for fine alignment are shown.

It is suggested to use 7 points, however, only 3 are strictly required. The angles picked should target locations that are free of resin to make alignment to the groove center earier. The exact X-Y location of these points is not critical, what matters is the laser must be aligned to the center of the groove as precisely as possible.

Note the pad offsets provide the ability to clean inwards or outwards. For example for the outer circumference you could have offsets of 0.1, 0.18, 0.26, which will clean outwards. However, you could also program 0.26, 0.18, 0.1 to have the laser start outside the pad and move inward towards the pad.

A screenshot of a graph

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Zooming in on the plot shows the grooves as solid lines and the cleaning paths as dotted lines:

A graph with numbers and lines

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### G-Code Tab

The G-code tab shows the preamble, cleaning passes and postscript g-code that will be used. You can modify the code if needed.

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### Laser Control Tab

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# Geometry of a Pad and the Cleaning Paths

## Geometry of the pad to the center of the grooves

The geometry of the pad comes from the outer and inner diameter of the circumference grooves at 17.643” and 16.837” from page 5 detail P of the dimension drawing. These translate to outer and inner radius in mm of 224.0661mm and 213.8299mm.

The sides come from the lines that intersect these arcs. The lines are defined on page 6 detail M, as the lines parallel to the X axis but offset +/-0.300” or +/-7.62mm.

A diagram of a piece of metal

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To move the cleaning to the outer edges of the center of the grooves, the points need to be adjusted, outwards. The amount for the circumference grooves appears to be about 0.06mm.

Details P and N show the edge of the arc grooves from the center is 0.004” \* tan(30) = 0.0023” or 0.059 mm. A very small amount.

A blueprint of a circular object with lines and numbers

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