Machining the Rotor

Stock Needed: AL 6061 4”x4”x1”

Tolerances: Exterior rotor shape is as designed and no additional material should be removed or left behind.

1. Rotor thickness is designed at .906” however this is a max specification and should be .902” - .9055” due to expansion during operation. This may require multiple facing operations due to varying stock thickness and roughness.
2. Bearing fit is the most crucial tolerance of the rotor. As designed in the CAD file (rotor) bearing fit is too tight. After many trials, the diameter of the bearing cavity should be oversized a total of .0008” meaning -.0004” axial offset in “stock to leave” during machining.
3. The ring gear thickness is bigger than advertised and should be checked with a micrometer to set the ring gear bore depth. This offset should also be applied to the bearing bore depth to ensure no interference between the bearing and ring gear.

Operations:

Operation 1

Tools used:

1. **⅜ flat endmill**
2. **90 deg chamfer**
3. **.106” tap size drill**

(one side is faced, half of the exterior form is machined, interior features created: ring gear bore, bearing bore, holes for ring gear, and through-hole out the bottom)

1. Face two of the 4”x1” faces to create parallel surfaces to grip in CNC vice.
2. Fixture in mill ensuring a minimum of .5” of the stock is above the vise.
3. Set work offsets using the rectangular block program.
4. During CAM setup ensure the above tolerances are accounted for.

Operation 2

Tools Used:

1. **90 deg chamfer**
2. **.114” drill**

(Ring gear hole making): Do not remove the workpiece after the first operation if you intend to drill ring gear holes.

1. Insert ring gear into the workpiece and seat firmly with a hammer.
2. No work offsets need to be completed.
3. CAM program utilizes similar drilling operations from the first operation.

Operation 3

Tools used:

1. **⅜ flat endmill**

(2nd half of the exterior form is machined and 2nd side is faced) during this step rotor thickness is set and requires careful setup and measurement of the workpiece after operation 1:

1. Utilize soft grips to fixture workpiece.
2. Ensure correct fixturing by using a manual probe attached to the spindle.
3. Run the probe along the machined surface facing you and adjust for runout with a hammer.
4. Set (XY) work offsets using the bore created in operation 1.
5. Set Z work offset using the top unfaced side.
6. Measure rotor thickness after the operation and before removing If necessary face again. It is recommended to use the same work offsets and edit the program only to gain these small tolerances.

Operation 4:

Tools used:

1. **1/16 flat endmill**

(Apex seal slots)

1. Utilize soft grips to fixture rotor with one point facing up.
2. Ensure correct fixturing visually.
3. Set Z work Offset using the probe carefully aligned with tip of the rotor.
4. Set Y work offset using the probe with the “y web” program.
5. X work offset is set manually by jogging the endmill into position and carefully aligning.

When satisfied, record x active offset, navigate to g54 x work offset, enter “-” followed by active offset, and push “enter”. This should set X work offset according to the endmill position.

Repeat 3 times

Operation 5:

Tools used:

1. **⅛ Ball-End Mill**

(Combustion Cavity)

1. Utilize soft grips to fixture rotor with the side facing up.
2. Ensure correct fixturing visually.
3. Set X work Offset off with the probe off of one edge of the apex seal slot
4. Set Y work offset using the probe with the “y web” program.
5. Set Z work offset manually with the end mill.

Repeat 3 times **(note that only the x work offset needs to be reset for each operation. Y axis can be reset but will have minimal effect. The Z axis should not be changed to ensure equal depths of the combustion cavity.)**