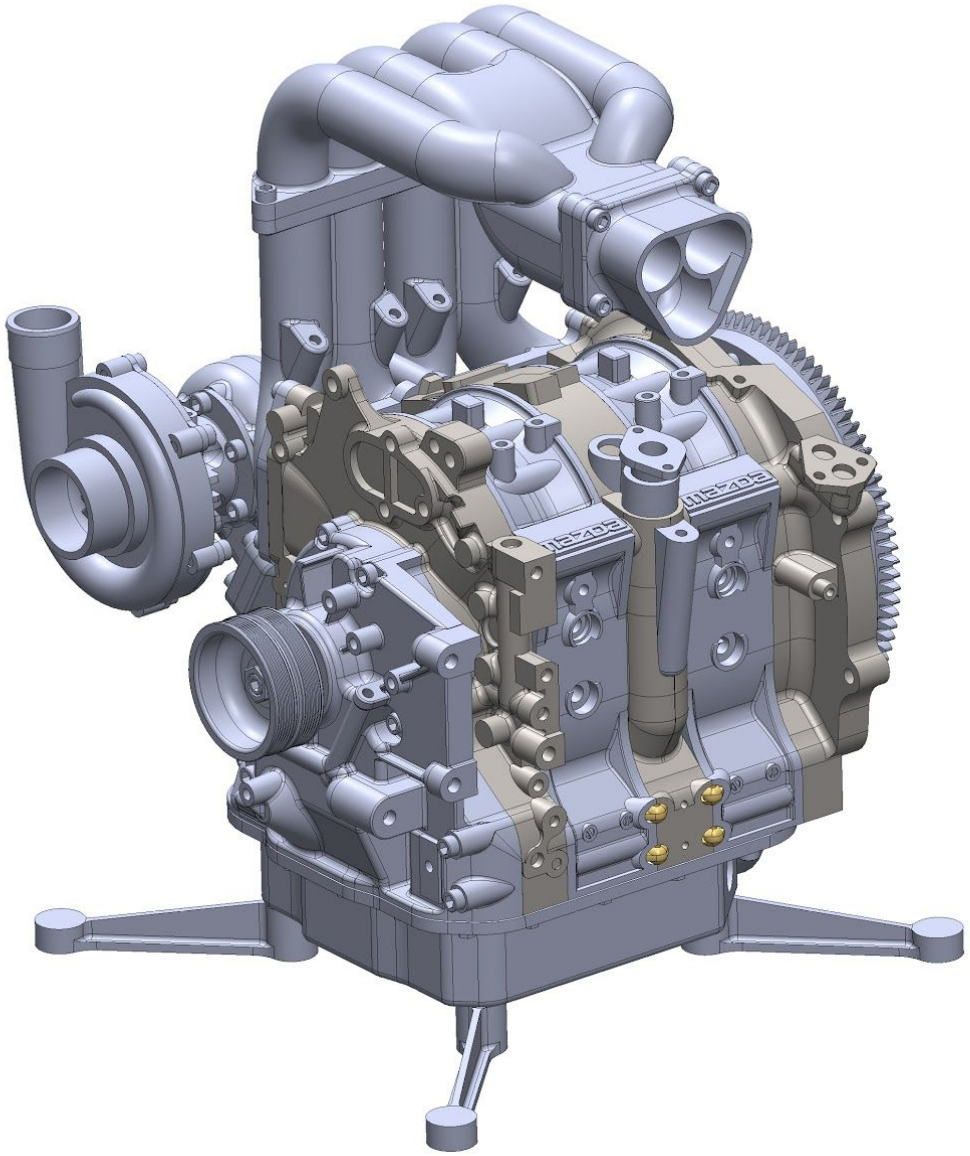
Mazda 13B Rotary Engine
Assembly Instructions



Recommended tools and supplies

Assortment of drill bits. Small metric or numbered assortment.
Pin vise for drill bits
M3 Tap
Hacksaw or dremel with cut off wheel
Super Glue - Thin and Medium Gap Filling. This kit on amazon has all the viscosities of super glue plus accelerator and debonder.
2P 10 Adhesive Kit
Small file set
Sand Paper
Allen keys. 1.5, 2, and 2.5mm. Best to have ball end
Soldering Iron for electronics
Wire stripper for small gauge wires
Micro USB cable for programing arduinos
Silicone grease or similar
Clear packing tape

Print 4mm drill stop.

Time….

Videos that show the entire assembly process can be found on YouTube

Tx Coil Assembly
https://youtu.be/EmVJviE91RQ

Rx Coil Assembly
https://youtu.be/jvaCdXu2P3Q

Smart rotor electronics assembly
https://youtu.be/9vBccUlQD5Y

Threaded insert installation
https://youtu.be/E3Xl8bVdVFM

Visual coolant and magnet installation
https://youtu.be/Tku3EXYJdZk

Eccentric Shaft assembly
https://youtu.be/YOwO540saOs

Front, rear, and center plates assembly
https://youtu.be/44PJikE5U04

Hinge installation
https://youtu.be/maB6_Qe7CoM

Front and rear plate assemblies installation
https://youtu.be/cSrM31eyr3s

Flywheel and pulley installation
https://youtu.be/SMmYmsUQN8I

Intake manifold, exhaust manifold, and turbo assembly
https://youtu.be/N-_aO330CNM

Oil Pan electronics assembly
https://youtu.be/RR1MS9U29gw

Printed Parts List

Part	Qty.	Color I printed	Printing Notes	Finishing Notes
Front Rotor Housing	1	Silver	Support touching build plate	Clean any printing defects from inside rotor housing
Rear Rotor Housing	1	Silver	Support touching build plate	Clean any printing defects from inside rotor housing
Center Plate	1	Black	Support touching build plate	Remove support material
Rear Plate for smart rotor	1	Black	Support touching build plate	Remove support material and brim
Front Plate	1	Black	Support touching build plate	Remove support material
Timing Cover	1	Silver	Support touching build plate	Remove support material
Oil Vent Tube	1	Black	Print with brim	
Oil Filler	1	Black	Print with brim	
Front Fixed Gear	1	Gold		
Rear Fixed Gear	1	Gold		
rotor 1	1	Grey	Support touching build plate	Print two if not using smart rotor, Clean any extra material from gear teeth.
Front Pulley	1	Black	Support touching build plate	Remove support material
Oil Pan - Electric motor mount	1	Black	Can be printed without support, depending on how well your printer is set up.	If using mounting feet, drill out the four holes mark on the surface of the oil pan.
Visual Coolant	1	Apple Green		
Visual Coolant 2	1	Apple Green		
Visual Coolant 3	1	Apple Green		
Visual Coolant 4	1	Apple Green		
Lower Intake Manifold	1	Silver	Print with very large brim and support touching build plate	Remove support material
Upper Intake Manifold	1	Silver	Support touching build plate	Remove support material
Throttle Body	1	Silver		

Turbo Manifold	1	Brown		
Front Shaft	1	Bronze		
Output Shaft	1	Bronze		
Eccentric Shaft center	2	Bronze		
Eccentric Shaft Lobe 1	2	Bronze		
Eccentric Shaft 1	2	Bronze		
Flywheel - 13B	1	Black or dark grey		
Starter Drive Gear 13b	1	Black		
Idle Gear 13b	1	Black		
Turbo Exhaust Housing	1	Brown		
Bearing Housing	1	Bronze		
Turbo Snail Housing	1	Silver	Support touching build plate	Remove support material
Turbo Snail Housing Plate	1	Grey		
Snail housing clamp	2	Dark Grey		
Compressor Wheel	1	Light Blue	Very thin wall, make sure your settings are right before printing. Use Simplify3D or repetier to verify print path.	
Turbine Wheel	1	Red	Very thin wall, make sure your settings are right before printing. Use Simplify3D or repetier to verify print path.	
Turbo Housing clamp	2	Dark Grey		
Mounting Feet	4	Red		
Smart rotor top	1	Grey		
Smart rotor bottom	1	Grey	Support touching build plate. Make sure your settings are right to print gear teeth. Use Simplify3D or repetier to verify print path.	Remove support material

LED Diffuser lens	6	Clear		
Coil backing plate RX	1	Grey		Final thickness should be 1.6mm
Coil backing plate TX	1	Grey		
Coiling backing plate cover	1	Black	Best to print on smooth surface. Bottom layer is very thin, be careful removing from build plate	
Coil Assembly Jig				
TX Coil Assembly Jig	1			
RX Coil Assembly Jig	1			
Coil Assembly Clamp	1			

Non-Printed Parts

Item	Quantity	Item Location
623zz Bearing	4	Turbo, Idle Gear
6700zz Bearing	4	Rear Fixed Gear (2), Front Fixed Gear (1), Timing Cover (1)
6702zz Bearing	3	Center Eccentric Shaft
6703zz Bearing	4	Front and Rear Eccentric Shaft
M3 x 4mm Set Screw	1	Starter Drive Gear
M3 8mm Set Screw	7	Center Eccentric shaft (3), Front Rotor Housing (4)
M3 x 3mm SHCS	5	Intake Manifold (3), Turbo Manifold (2)
M3 x 5mm SHCS	20	Rear Plate (9), TX Coil (6), Starter Gear Drive (2), Smart Rotor
M3 x 8mm SHCS	60	Intake Manifold (13), Turbo Manifold (2), Oil Pan (4), Turbo (16), Front Fixed Gear (6), Rear Fixed Gear (6), Timing Cover (3), Flywheel (1), Front Pulley (1), Oil Pan (8)
M3 x 20mm SHCS	15	Timing Cover (5), Idle Gear (1), Rear Plate (7), Front Eccentric Shaft (1), Rear Eccentric Shaft (1)
M3 x 45mm Threaded Rod	1	Rear eccentric shaft
M3 x 70mm Threaded Rod	1	Front eccentric shaft
M3 x 55mm Threaded Rod	1	Turbo Shaft
M3 x 3mm Threaded Insert	70	See insert and magnet page
M3 Nut	5	Starter Gear Drive (1),
3mm washer	7	Oil Pan (4), Turbo (2), Idle Gear (1)
4mm x 2mm disc magnet	41	See insert and magnet page
Barrel Hinge	4	
500 rpm geared motor	1	
Speed controller	1	

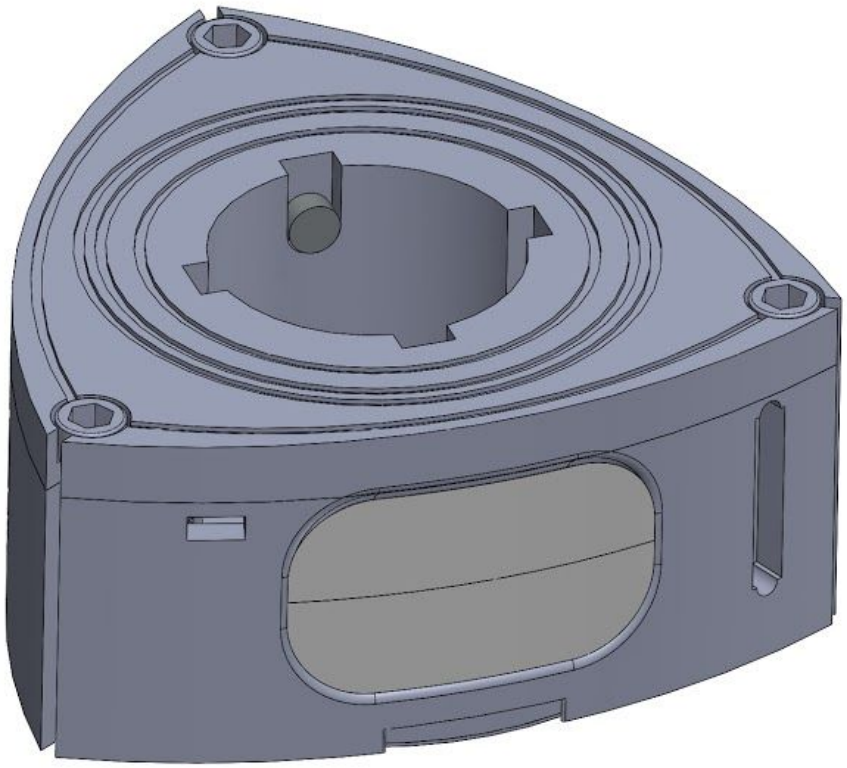
DC Female Power Jack	1	
12v 1a Power Supply	1	
Arduino Attiny85	2	
Mosfet Module	1	
100uf 25v Capacitor	2	
10k Resistor	1	
470k Resistor	1	
Diode	4	
0.082uf MPF Capacitor	2	
Plastic Reed Switch	1	
Toggle Switch SPDT	1	
26 AWG Silicone Hook Up Wire (Red, Black, Blue)	1	
30 AWG Magnet Wire	1	
18 AWG Red/Black Wire (ft)	2	
Addressable LED	3	

Insert and Magnet Locations

Brass Insert Locations		
Part	Location	Total # of Inserts
Lower Intake Manifold	Upper Manifold Mounting Surface	5
Upper Intake Manifold	Throttle Body Mounting Surface	4
Turbo Manifold	Turbo Mounting Surface	4
Oil Pan	Idler Gear Mount	1
Rear Plate	Transmission Mounting holes (if using engine stand), Fixed Gear Mounting Holes, Oil Pan Mounting Holes, Intake Manifold Mount	14
Rear Housing	Exhaust/Intake Mounting surface, Rear Plate Mounting Surface Oil Pan Mounting Surface	13
Front Plate	Fixed Gear Mounting Holes, Timing Cover Mounting Surface	14
Mounting Feet		4
Smart Rotor		3
Eccentric Shaft Assembly		
Eccentric Shaft 1	Two inserts in each	4
Output Shaft		2
Front Shaft		1
4x2mm Magnet Locations		
Center Plate	Front and Back Mounting Surfaces	12
Rear Rotor Housing	Center Plate Mounting Surface, Upper Spark Plug Hole	7
Front Rotor Housing	Center Plate Mounting Surface	6

Eccentric Shaft Assembly		
Eccentric Shaft 1	Two magnets in each	4
Eccentric Shaft Center	Two magnets in each	4
Rotor	Four in each rotor	8

Mazda 13B Smart Rotor Assembly



Notice: Please familiarize yourself with the assembly procedure before attempting. If you are unsure of your ability to assemble and solder an electronic circuit or program an Arduino, please seek out somebody that can assist you.
These circuits are designed by an amature (me), so they might be troublesome or results may vary between different assemblies. These circuits have been tested for days at a time and have proven to be stable. But the wireless power circuit inherently produces heat as a by product and could produce significant heat if not properly assembled and tested. Never leave this circuit powered while unattended.

Hardware			Printed Parts	
Part	Qty.		Part	Qty.
Arduino Attiny85	2		Smart rotor top	1
Mosfet Module	1		Smart rotor bottom	1
100uf 25v Capacitor	2		LED Diffuser lens	6
10k Resistor	1		Coil backing plate RX	1
470k Resistor	1		Coil backing plate TX	1
Diode	4		Coil backing plate cover	1
0.082uf MPF Capacitor	2			
Plastic Reed Switch	1		Coil Assembly Jig	
Toggle Switch SPDT	1		TX Coil Assembly Jig	1
26 AWG Silicone Hook Up Wire (Red, Black, Blue)	1		RX Coil Assembly Jig	1
30 AWG Magnet Wire	1		Coil Assembly Clamp	1
18 AWG Red/Black Wire (ft)	2			
Addressable LED	3			

Wire cut length and location

All lengths include ends stripped 1/16"		
Color	Length (inches)	Location
Red	2	Arduino to LED1 (5v +)
Red	1.35	LED1 to Switch
Red	0.9	Switch to LED2
Red	1.6	LED2 to LED3 (5v +)
Red	2.5	100uf Caps (Vin) to Diode Bridge (Vin)
Red	2.8	Reed switch to Arduino (5V +)
Black	2	Arduino to LED1 (GND)
Black	1.6	LED1 to LED2 (GND)
Black	1.6	LED2 to LED3 (GND)
Black	1.75	LED3 to 100uf Caps (GND)
Black	1.5	100uf Caps (GND) to Diode Bridge (GND)
Blue	1.25	Arduino P4 to 470K Resistor
Blue	0.5	470K Resistor to LED1
Blue	1.6	LED1 to LED2
Blue	1.6	LED2 to LED3
Blue	2.8	Reed switch to Arduino P1

Programing Arduinos

Both arduinos will need to be programmed. Make sure you have the most current code downloaded. You will need to download the Arduino IDE and had and install the drivers for the ATTINY85 Arduino boards. A complete tutorial on how to do this can be found here.
http://digistump.com/wiki/digispark/tutorials/connecting

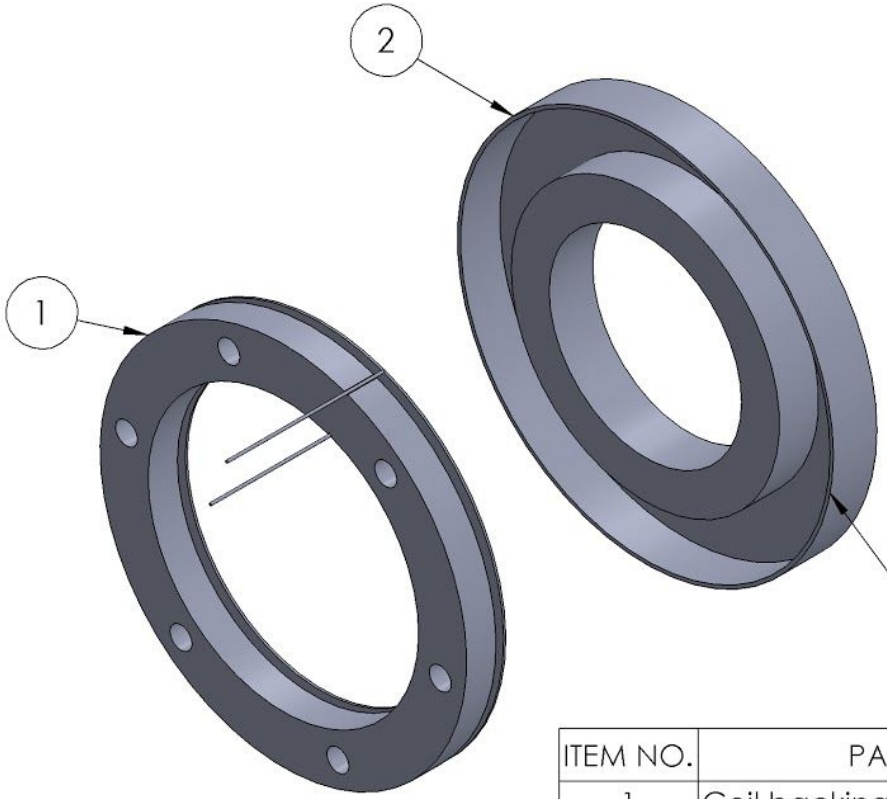
Upload the sample test code from the the tutorial to make sure the board is functioning properly.

Winding Rx and Tx coils

The winding of the Rx and Tx coils if probably the hardest part of this model. Go slow and make sure the magnet wire is properly inplace before glueing.

Coil Assembly Jig	
TX Coil Assembly Jig	1
RX Coil Assembly Jig	1
Coil Assembly Clamp	1
Coil backing plate RX	1
Coil backing plate TX	1
M3 x 8mm SHCS	12
M3 x 20mm SHCS	4
M3 Hex Nut	4

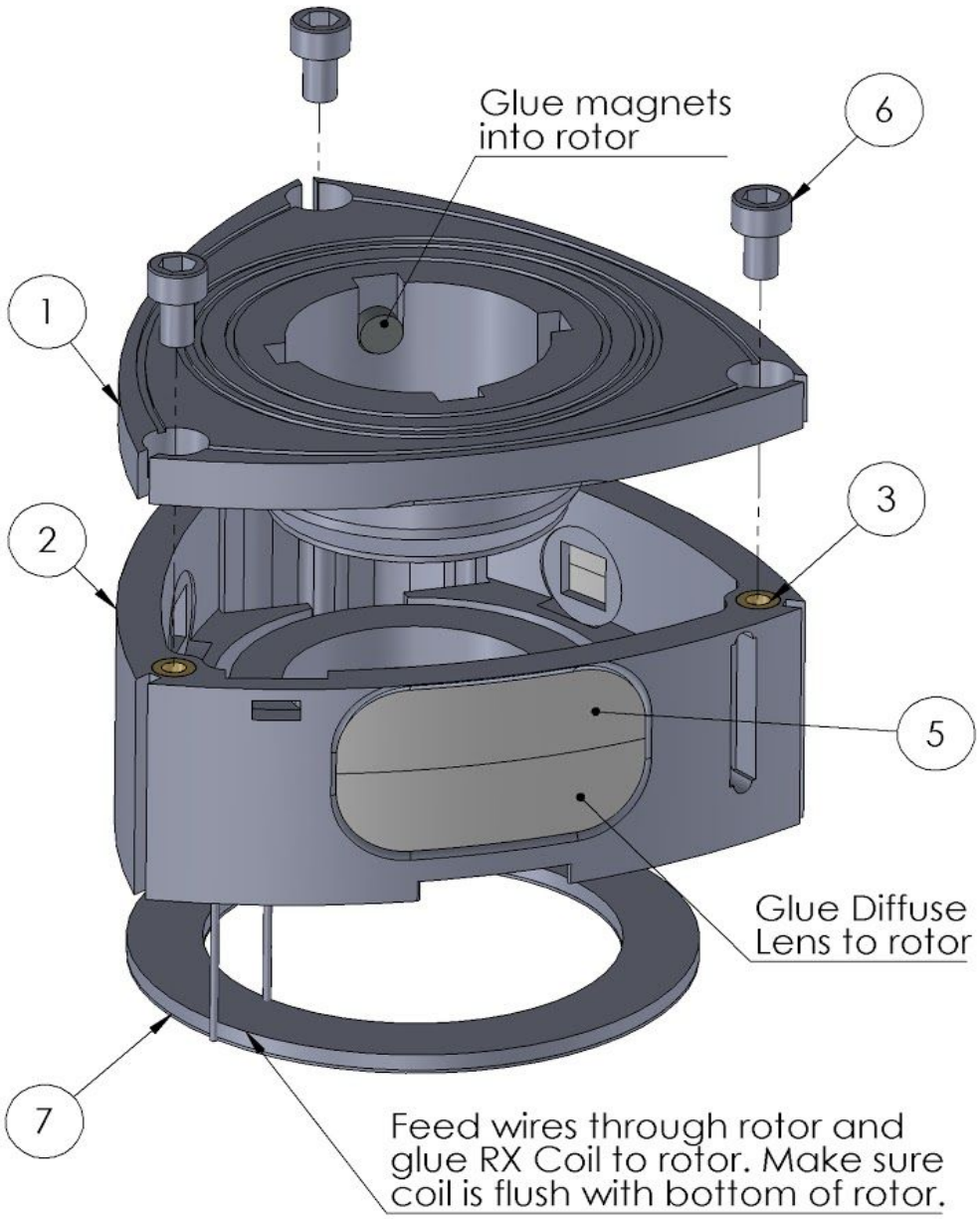
TX Coil Assembly (if using)

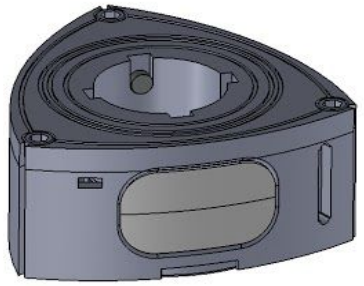


Place Coil backing plate cover on flat surface and glue TX Coil assembly together.

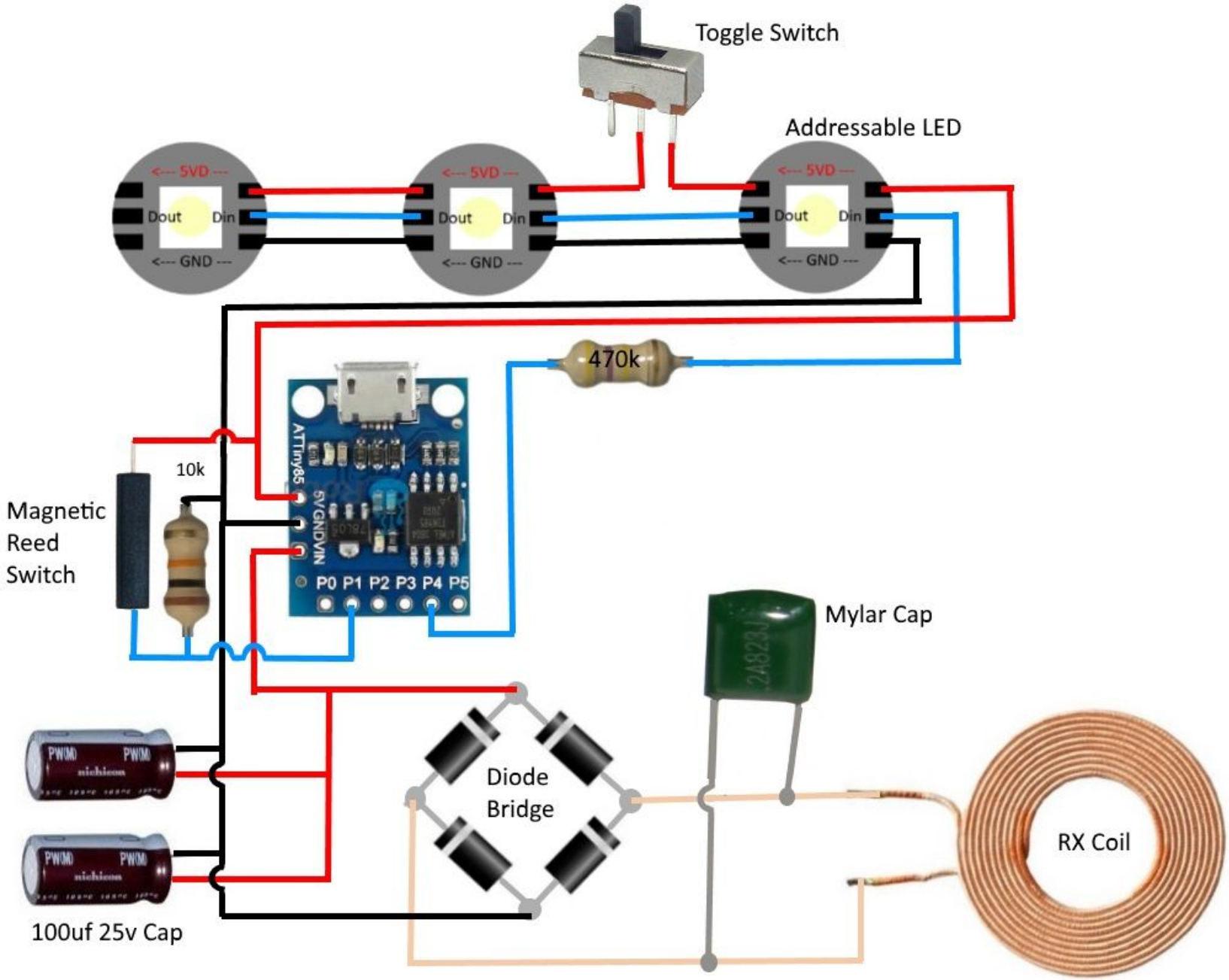
ITEM NO.	PART NUMBER	QTY.
1	Coil backing plate with TX Coil	1
2	Coiling backing plate cover	1

Smart Rotor Assembly

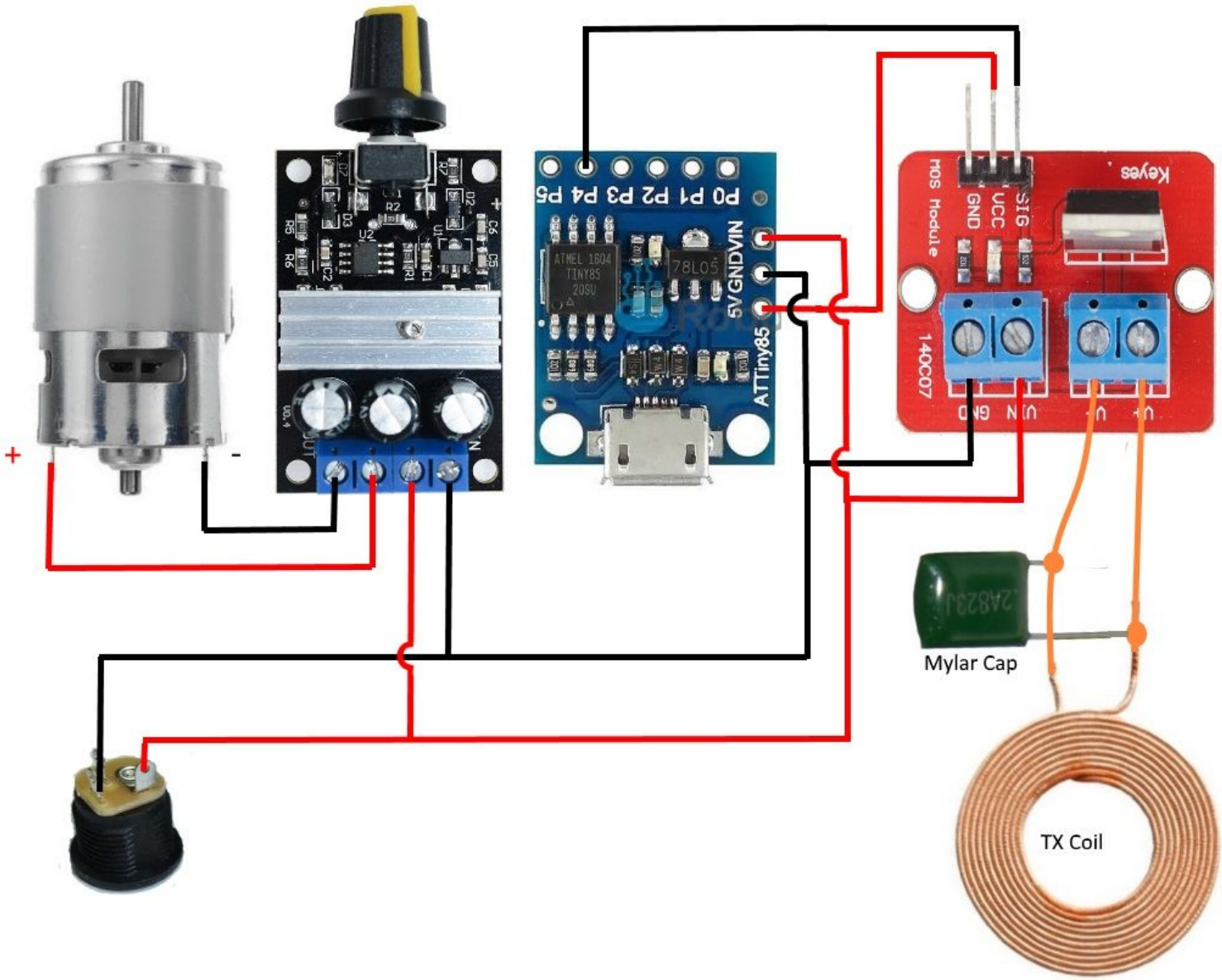




ITEM NO.	PART NUMBER	QTY.
1	Smart rotor top	1
2	Smart rotor bottom	1
3	M3 x 3mm Threaded Insert	3
4	4mm x 2mm disc magnet	4
5	LED Diffuse lens	6
6	M3 x 5mm SHCS	3
7	RX Coil	1

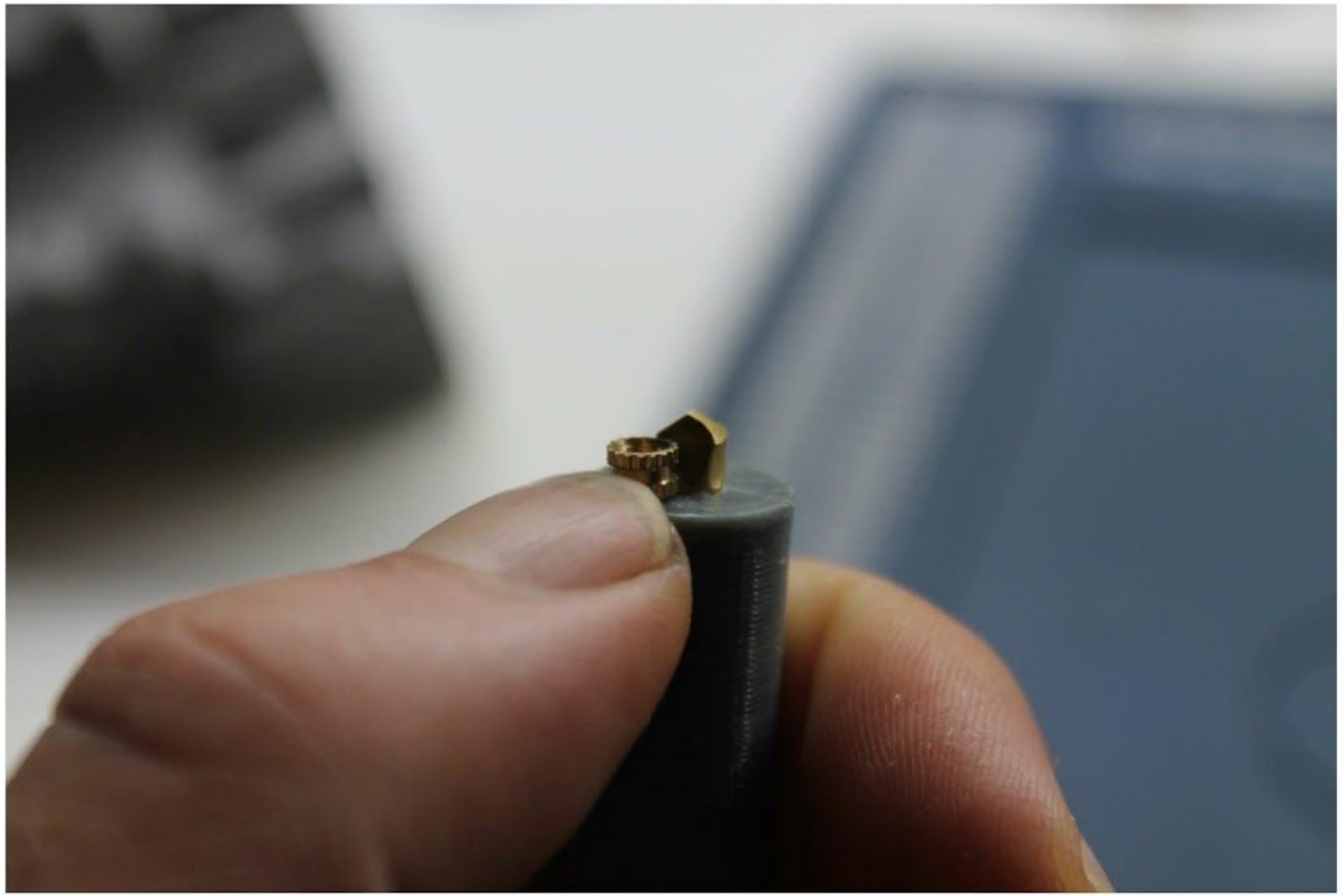

Toggle Switch
Addressable LED
<--- 5VD ---
Dout
Din
<--- GND ---
470k
10k
Magnetic
Reed
Switch
ATTiny85
5V GND VIN
P0 P1 P2 P3 P4 P5
Mylar Cap
Diode
Bridge
RX Coil
100uf 25v Cap

Oil pan electronics schematic

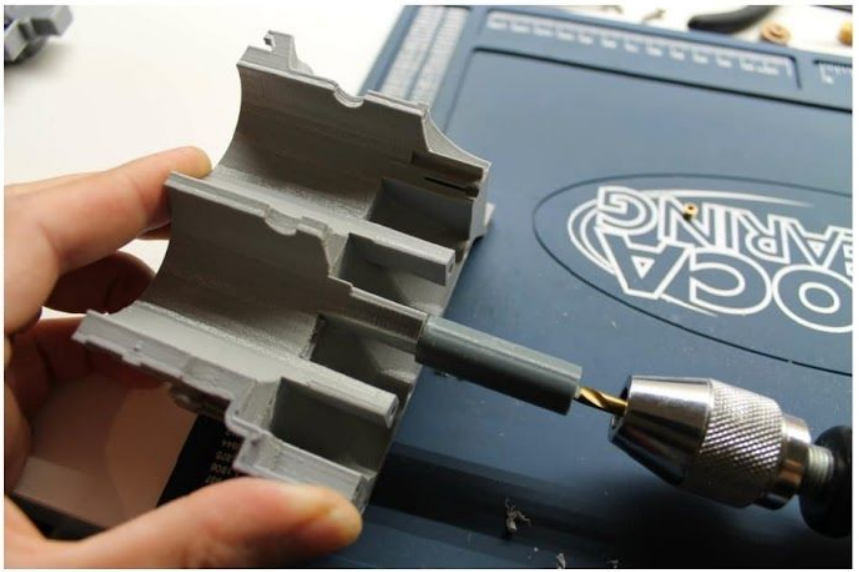


How to install threaded inserts

Using a #20 drill bit or similar, set depth stop to slightly deeper than insert.

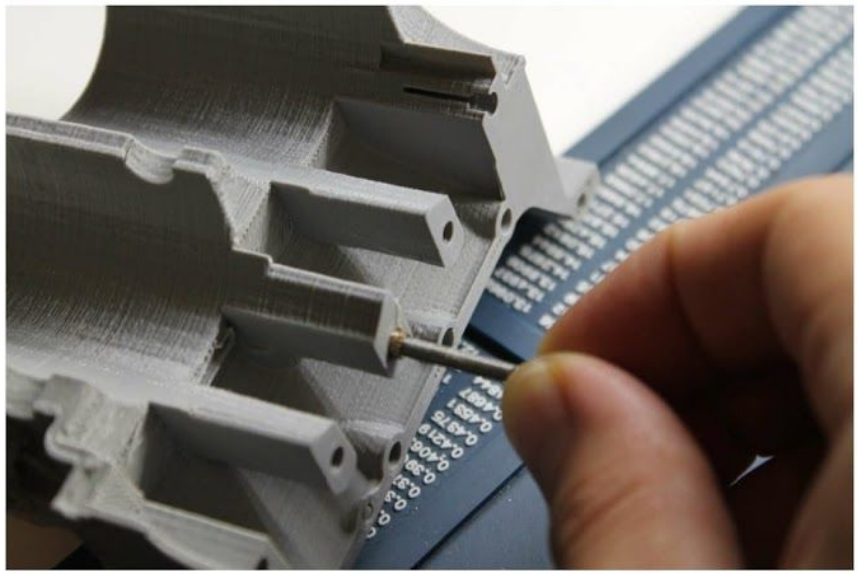


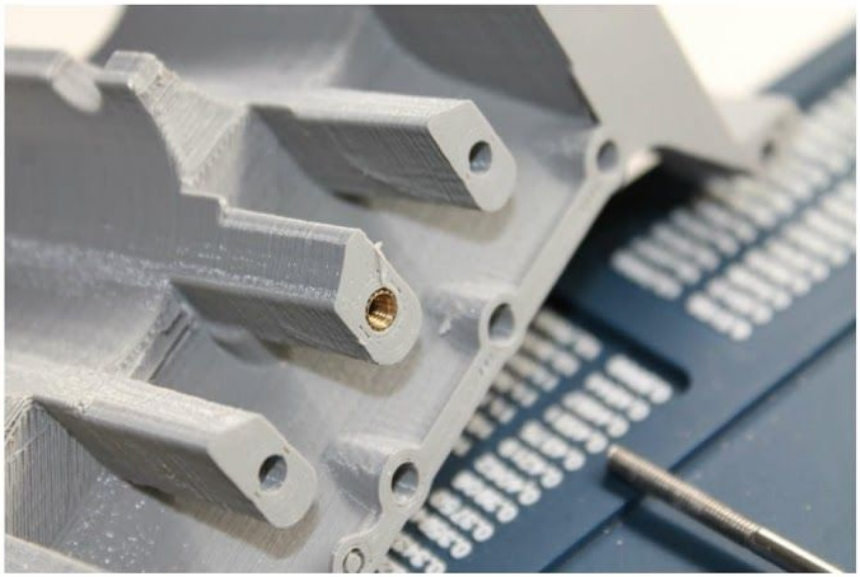
Drill out hole for insert



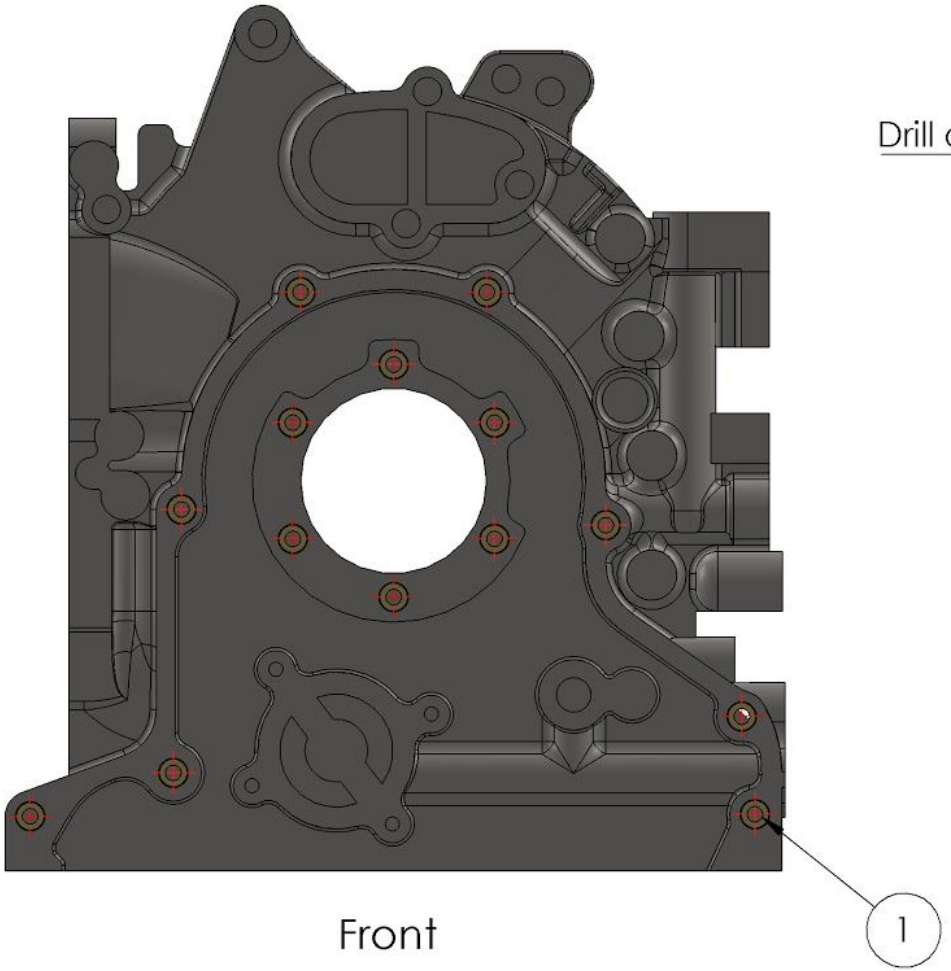
Using an M3 screw as a holder, apply super glue to the outside of the threaded insert. Medium build super glue works best.
Tip: Grease can be applied to the threads of the screw to prevent super gluing the insert to the screw.

Install insert and remove screw. Making sure that insert is aligned with hole.

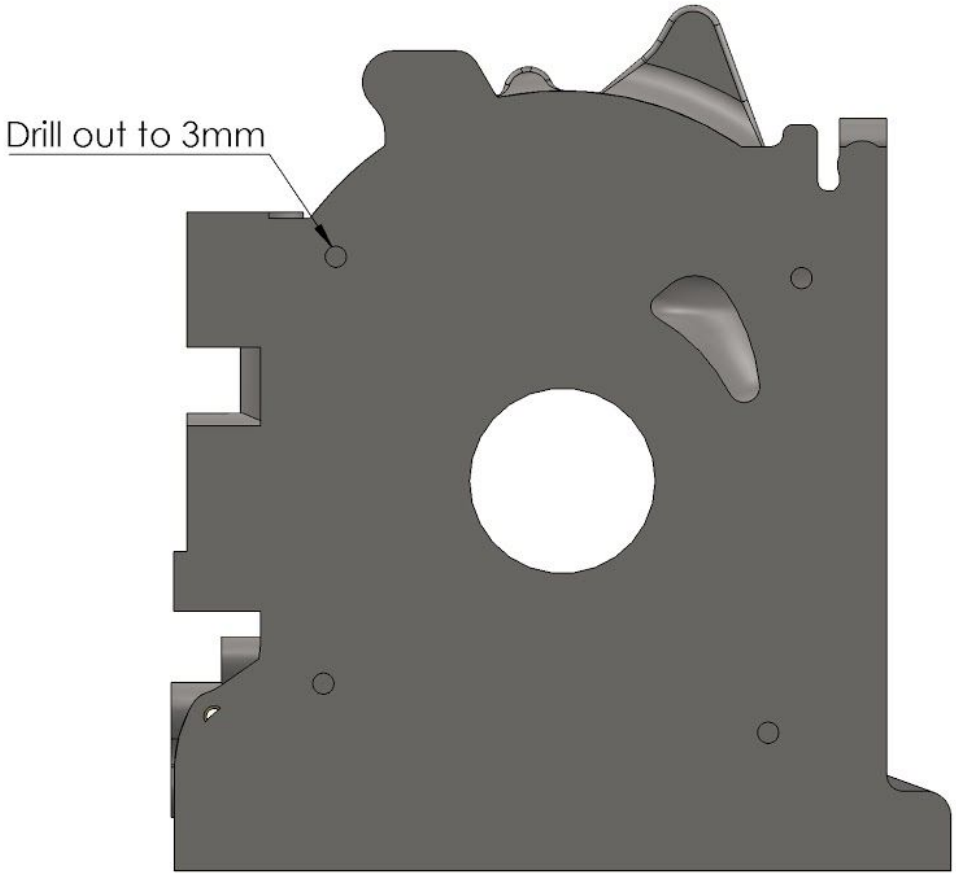




Front Plate Insert Locations



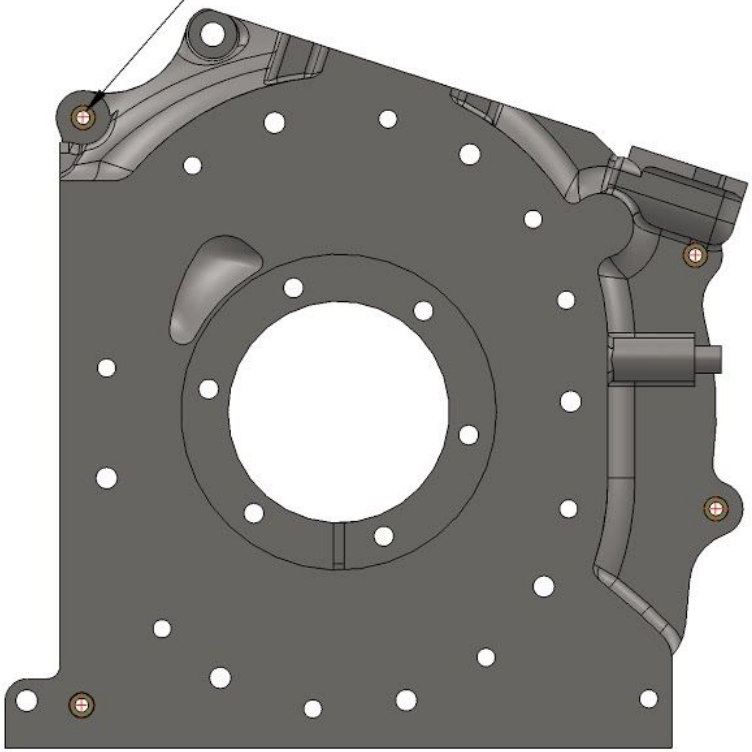
Front



Rear

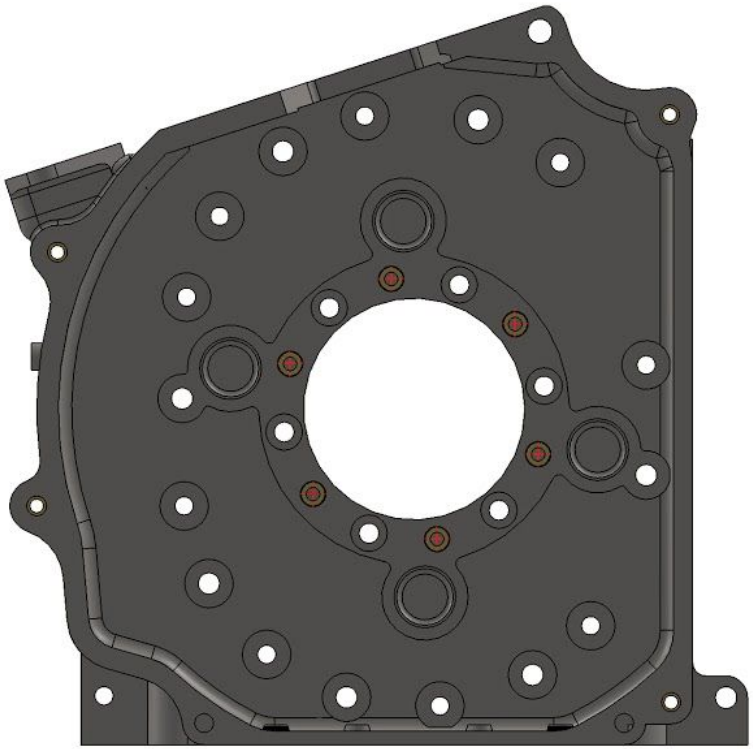
ITEM NO.	PART NUMBER	QTY.
1	M3 x 3mm Threaded Insert	14
2	Front Plate	1

Rear Plate insert locations

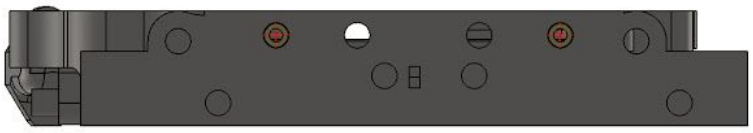


Front

Side



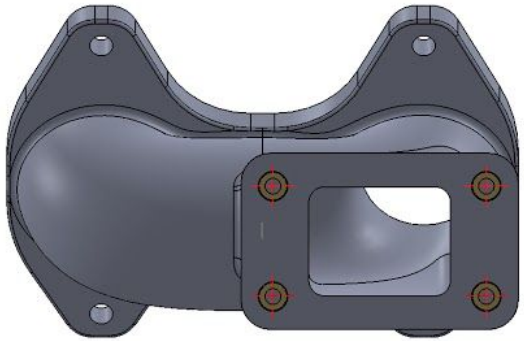
Rear



Bottom

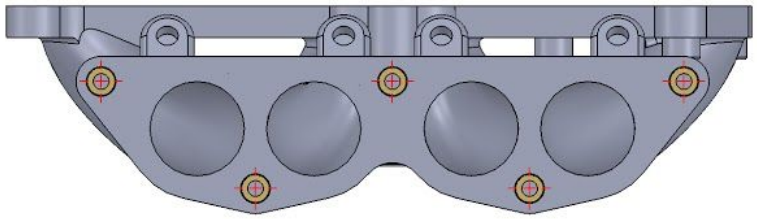
ITEM NO.	PART NUMBER	QTY.
1	Rear Plate	1
2	M3 x 3mm Threaded Insert	14

Turbo Manifold



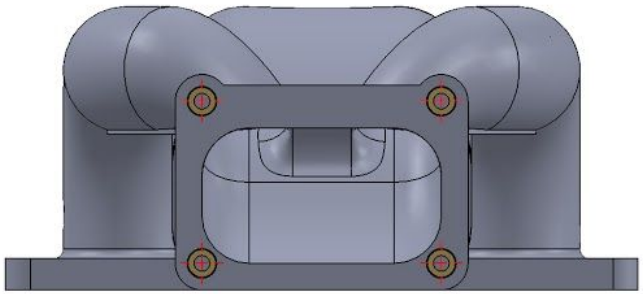
ITEM NO.	PART NUMBER	QTY.
1	Turbo Manifold	1
2	M3 x 3mm Threaded Insert	4

Lower Intake Manifold



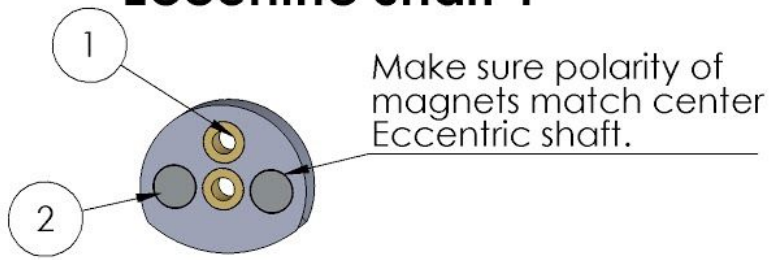
ITEM NO.	PART NUMBER	QTY.
1	Lower Intake Manifold	1
2	M3 x 3mm Threaded Insert	5

Upper Intake Manifold



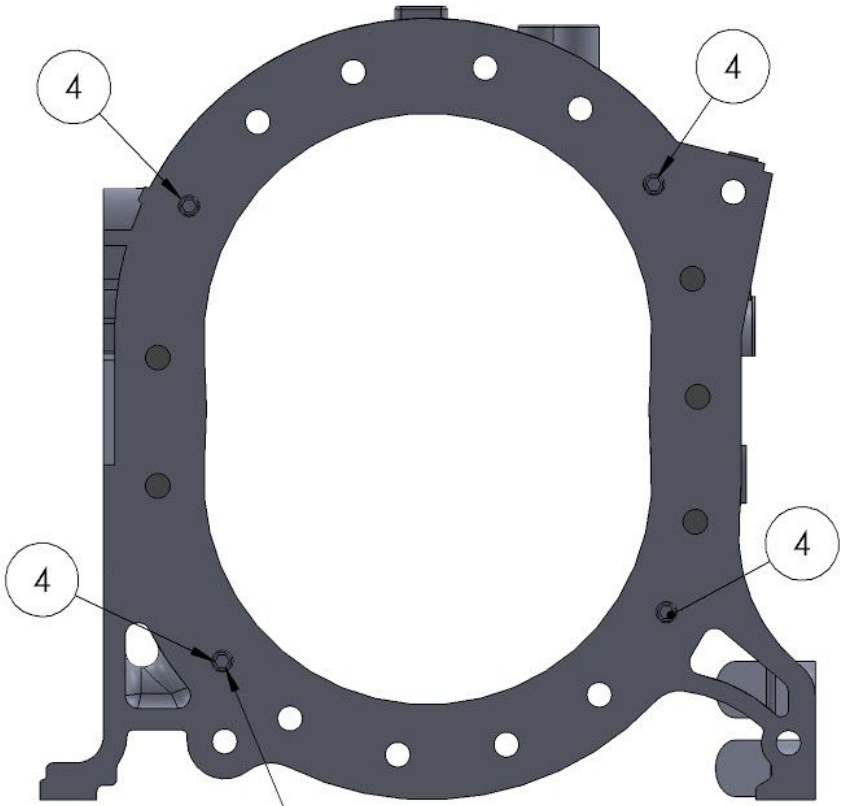
ITEM NO.	PART NUMBER	QTY.
1	M3 x 3mm Threaded Insert	4
2	Upper Intake Manifold	1

Eccentric Shaft 1

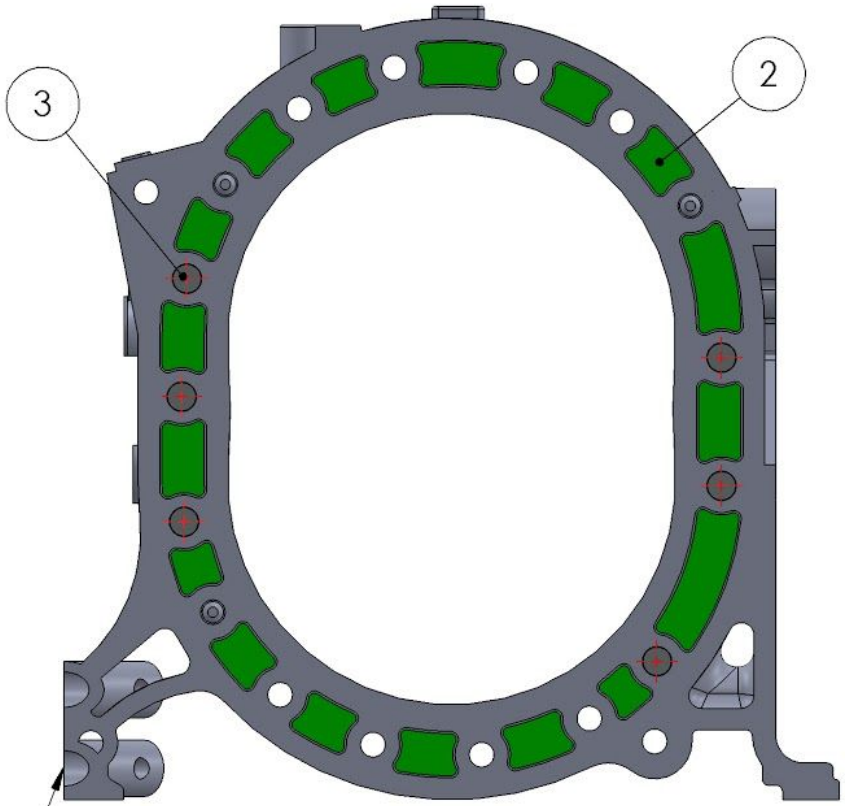


ITEM NO.	PART NUMBER	QTY.
1	M3 x 3mm Threaded Insert	2
2	4mm x 2mm disc magnet	2
3	Eccentric Shaft 1	1

Front Housing Magnet Locations



Front
Install set screws into housing half way.

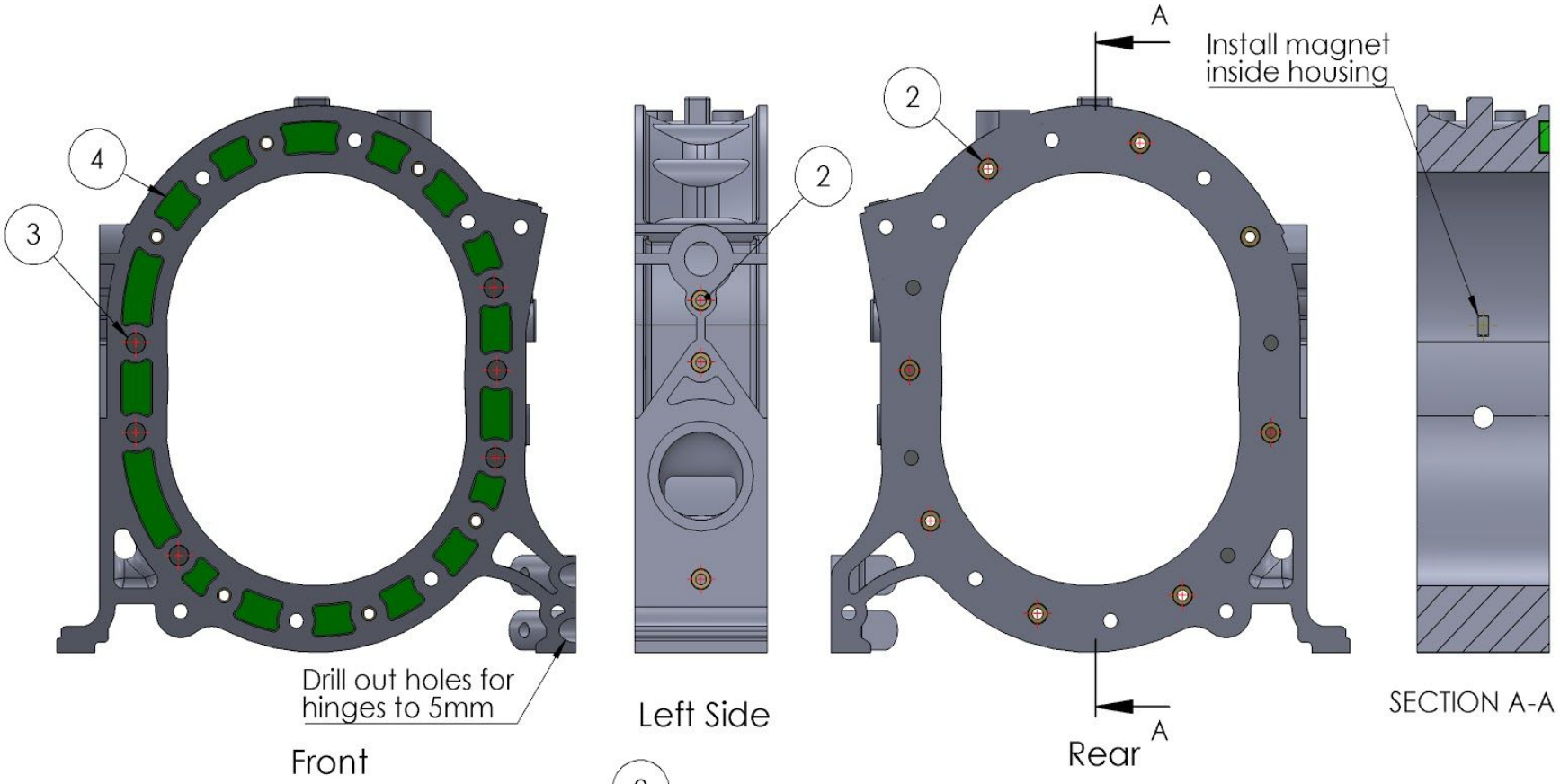


Drill out holes for hinges to 5mm

Rear

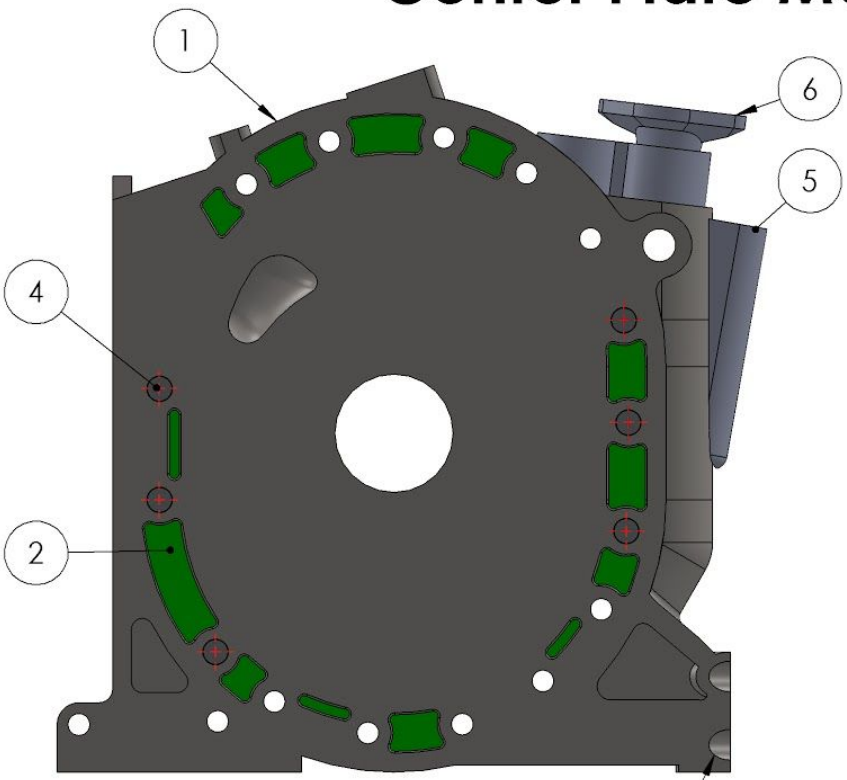
ITEM NO.	PART NUMBER		QTY.
1	Front Rotor Housing		1
2	Visual Coolant 4	Glue to rotor housing	1
3	4mm x 2mm disc magnet		6
4	M3 8mm Set Screw		4

Rear Housing Insert & Magnet Locations

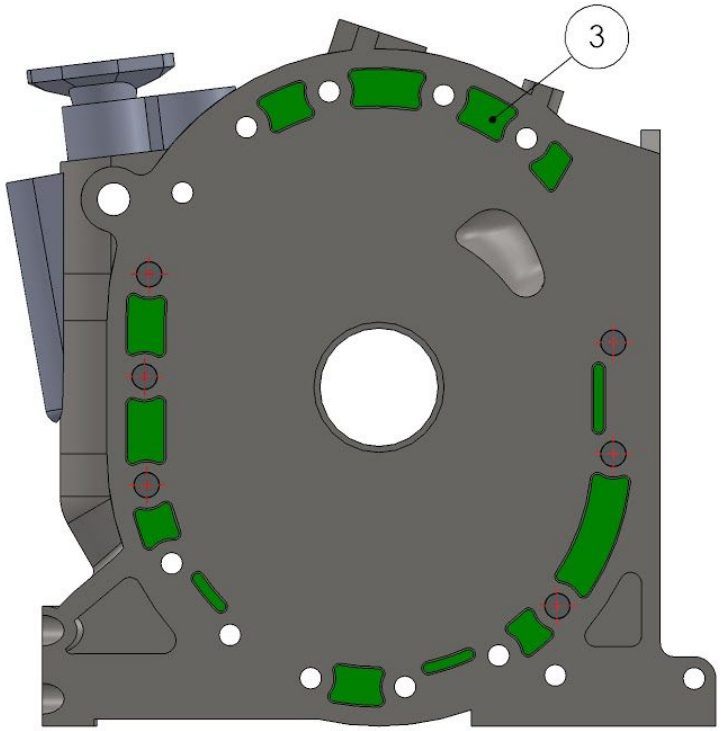


ITEM NO.	PART NUMBER		QTY.
1	Rear Rotor Housing		1
2	M3 x 3mm Threaded Insert		13
3	4mm x 2mm disc magnet		7
4	Visual Coolant	Glue to rotor housing	1

Center Plate Magnet Locations



Front



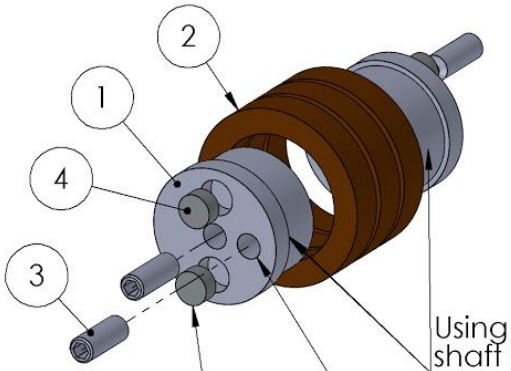
Back

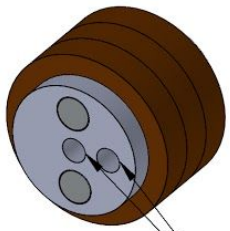
Drill out holes for hinges to 5mm

ITEM NO.	PART NUMBER		QTY.
1	Center Plate		1
2	Visual Coolant 2	Glue to center plate	1
3	Visual Coolant 3	Glue to center plate	1
4	4mm x 2mm disc magnet		12
5	Oil Vent Tube	Glue to center plate	1
6	Oil Filler	Glue to center plate	1

Center Eccentric Shaft Assembly

ITEM NO.	PART NUMBER	QTY.
1	Eccentric Shaft center	2
2	6702zz	3
3	M3 8mm Set Screw	3
4	4mm x 2mm disc magnet	4





Drill out all holes to 3mm after assembly

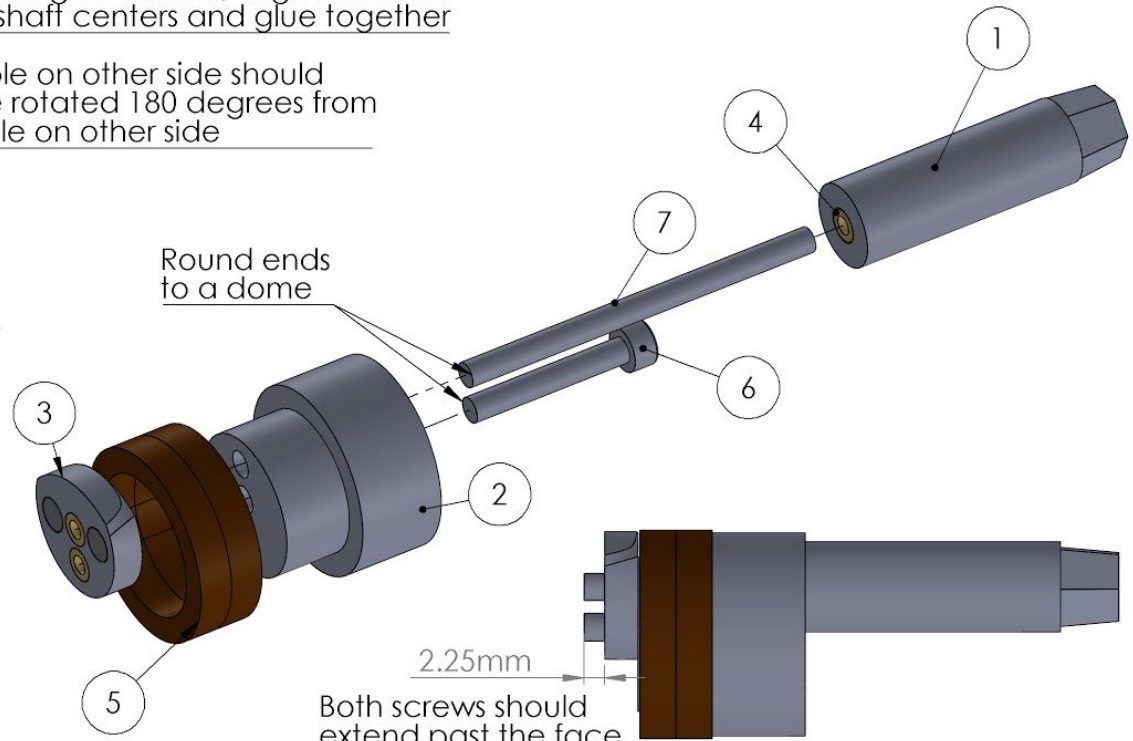
Using set screws, Align Eccentric shaft centers and glue together

Hole on other side should be rotated 180 degrees from hole on other side

Make sure polarity of magnets match front and rear eccentric shafts

Rear Eccentric Shaft Assembly

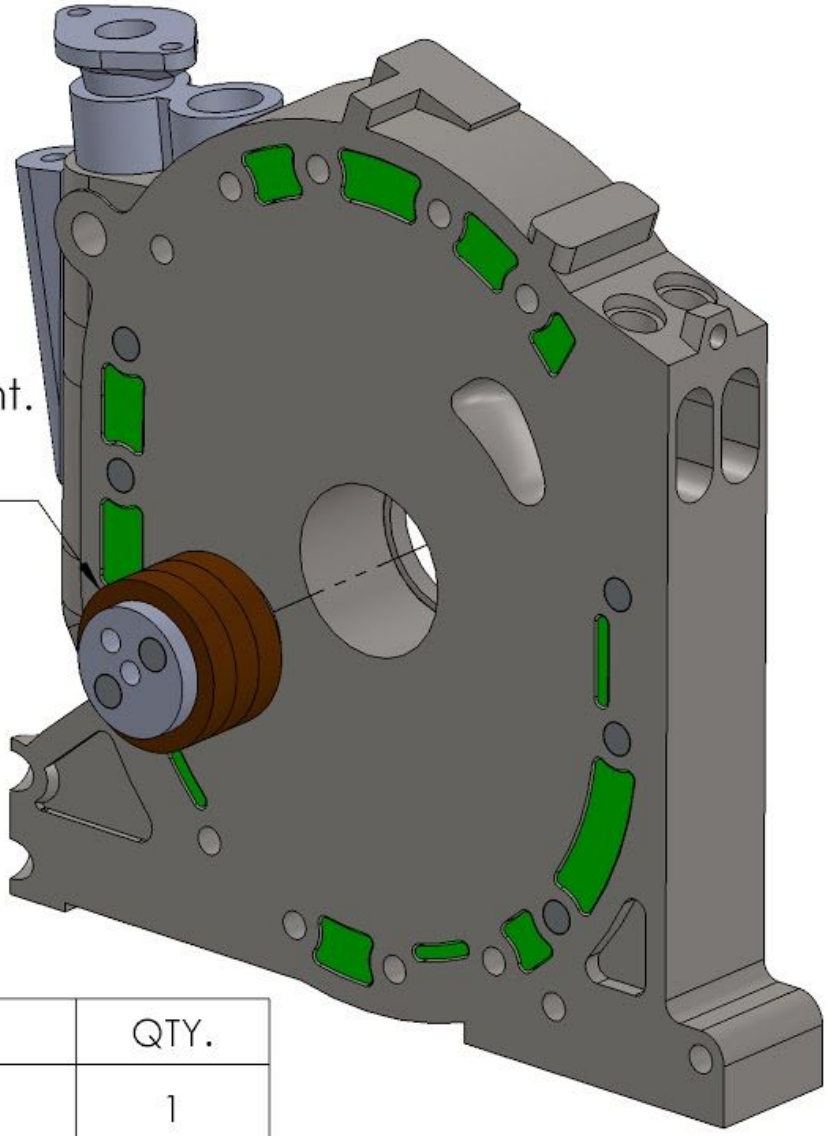
BOM Table		
ITEM NO.	PART NUMBER	QTY.
1	Output Shaft	1
2	Eccentric Shaft Lobe 1	1
3	Eccentric Shaft 1	1
4	M3 x 3mm Threaded Insert	2
5	6703zz	2
6	M3 x 20mm SHCS	1
7	M3 x 45mm Threaded Rod	1



Use Front Shaft and M3 x 70mm threaded rod for front eccentric shaft assembly

Center Plate with Eccentric Shaft Assembly

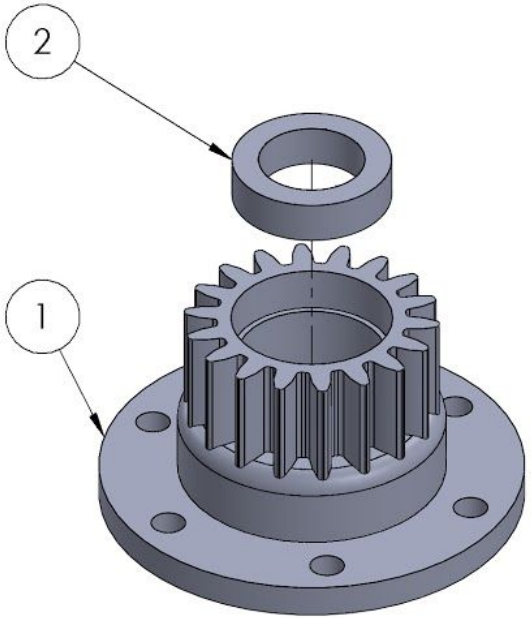
Install Center Eccentric shaft assembly into Center Plate assembly. Should press in tight. If not, use a small amount of glue to hold in place.



ITEM NO.	PART NUMBER	QTY.
1	Center Plate Assembly	1
2	Center Eccentric Shaft Assembly	1

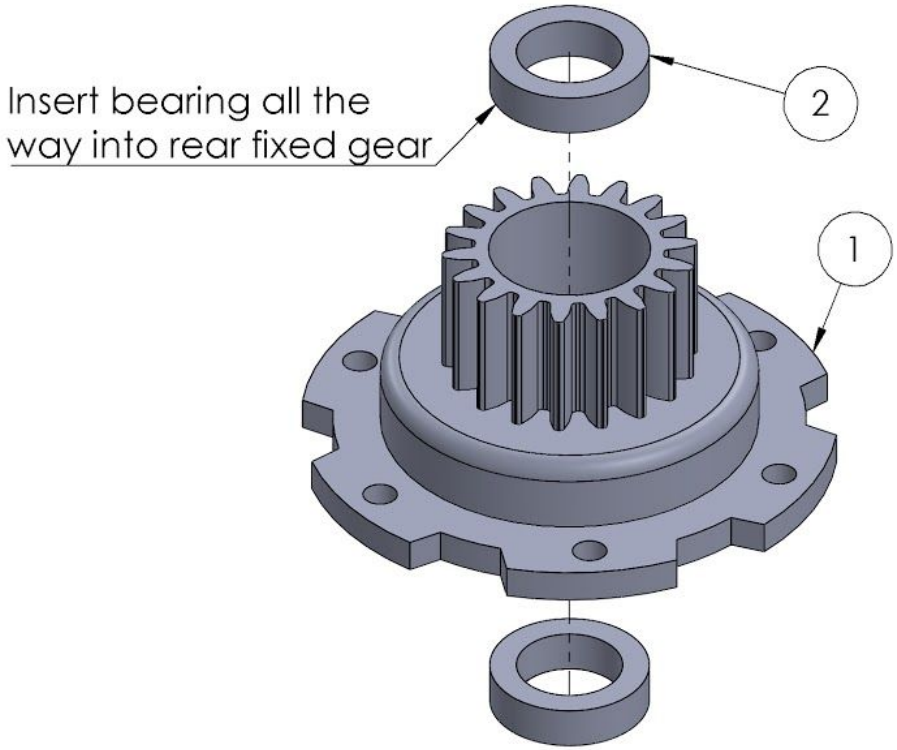
Install Bearings Into Fixed Gears

Front Fixed Gear



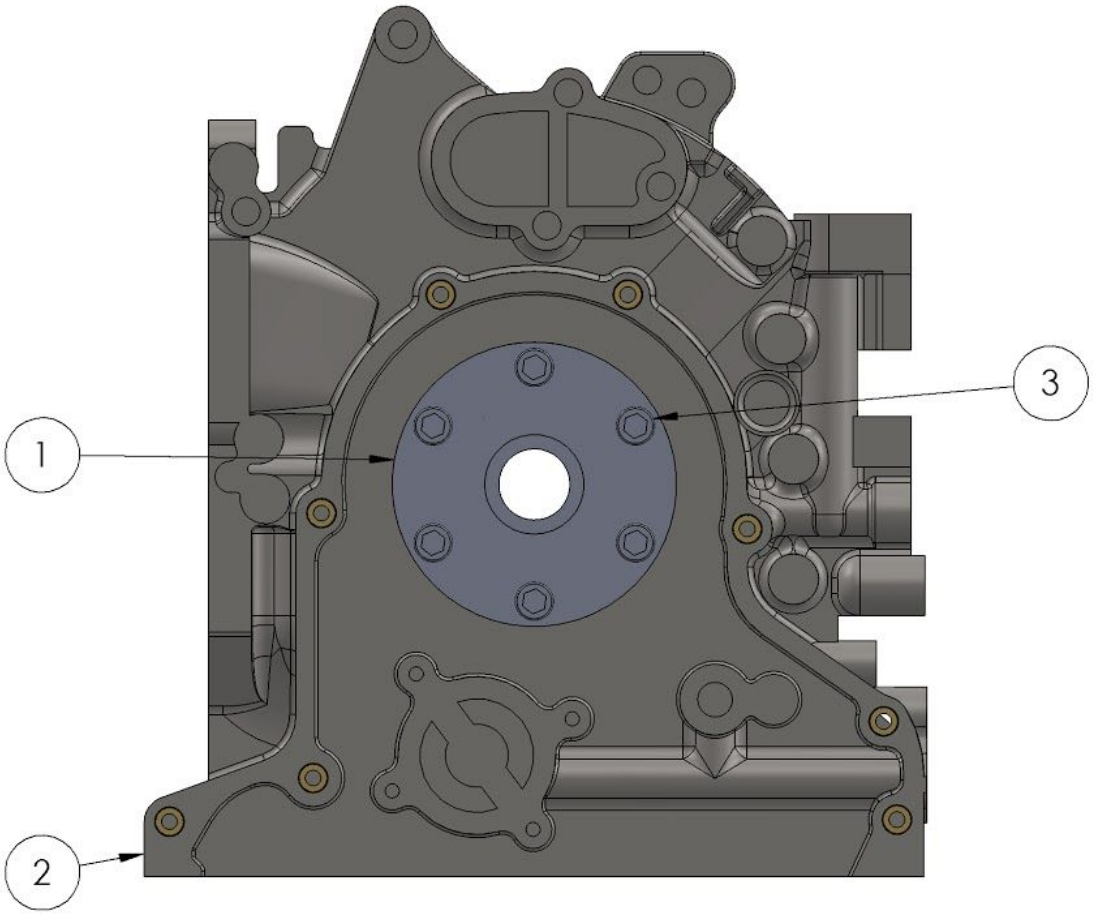
ITEM NO.	PART NUMBER	QTY.
1	Front Fixed Gear	1
2	6700zz Bearing	1

Rear Fixed Gear



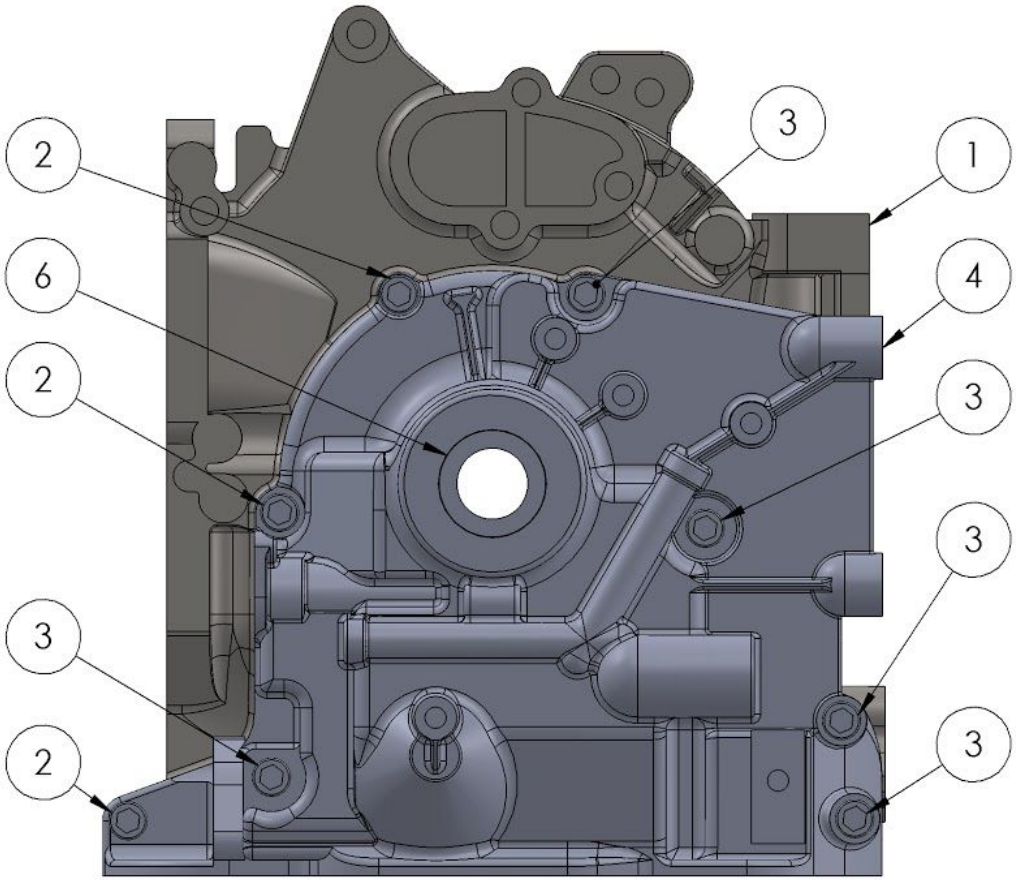
ITEM NO.	PART NUMBER	QTY.
1	Rear Fixed Gear	1
2	6700zz Bearing	2

Front fixed gear installation



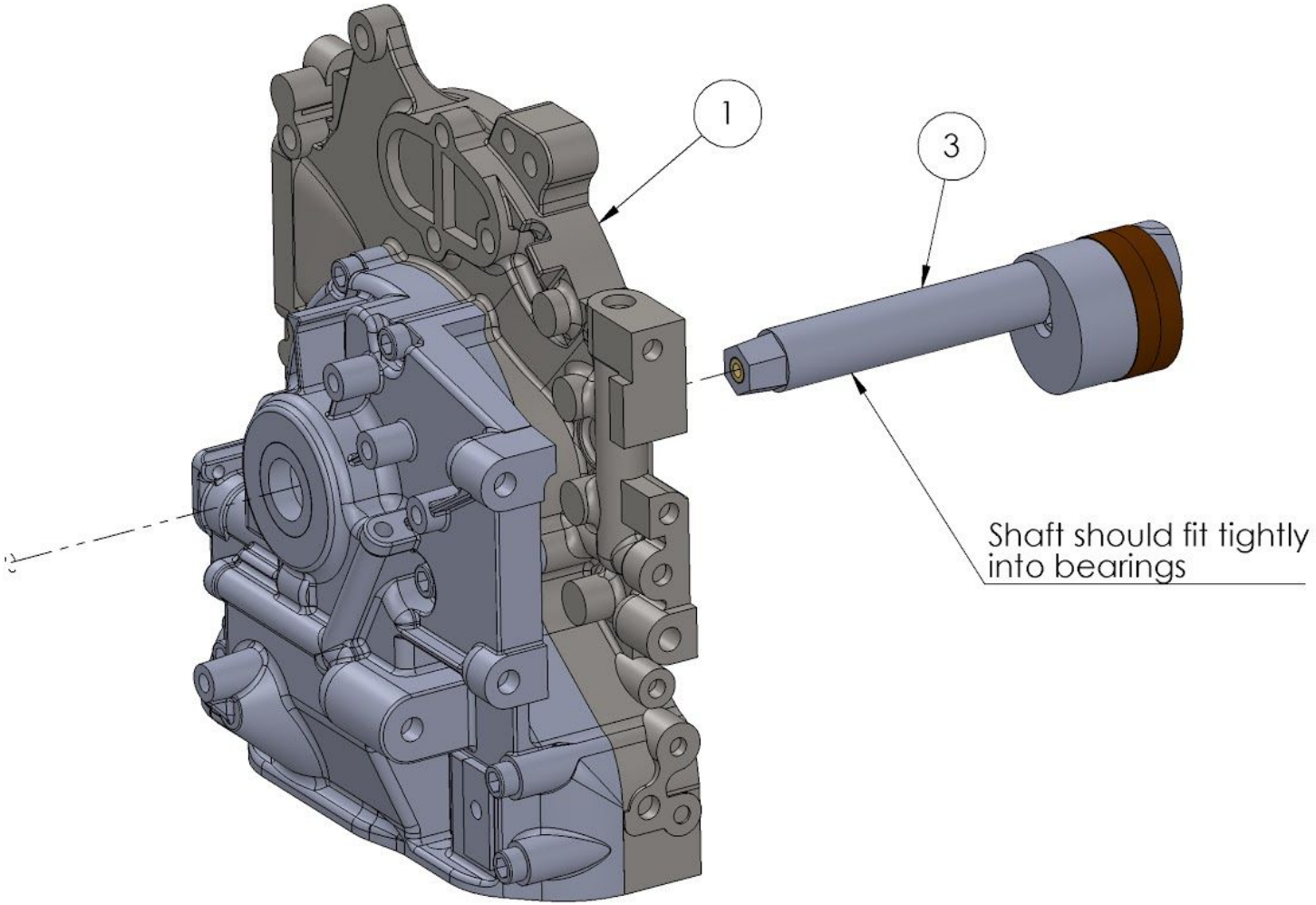
ITEM NO.	PART NUMBER	QTY.
1	Front Fixed Gear Assembly	1
2	Front Plate Insert Assembly	1
3	M3 x 8mm SHCS	6

Front Timing Cover Installation



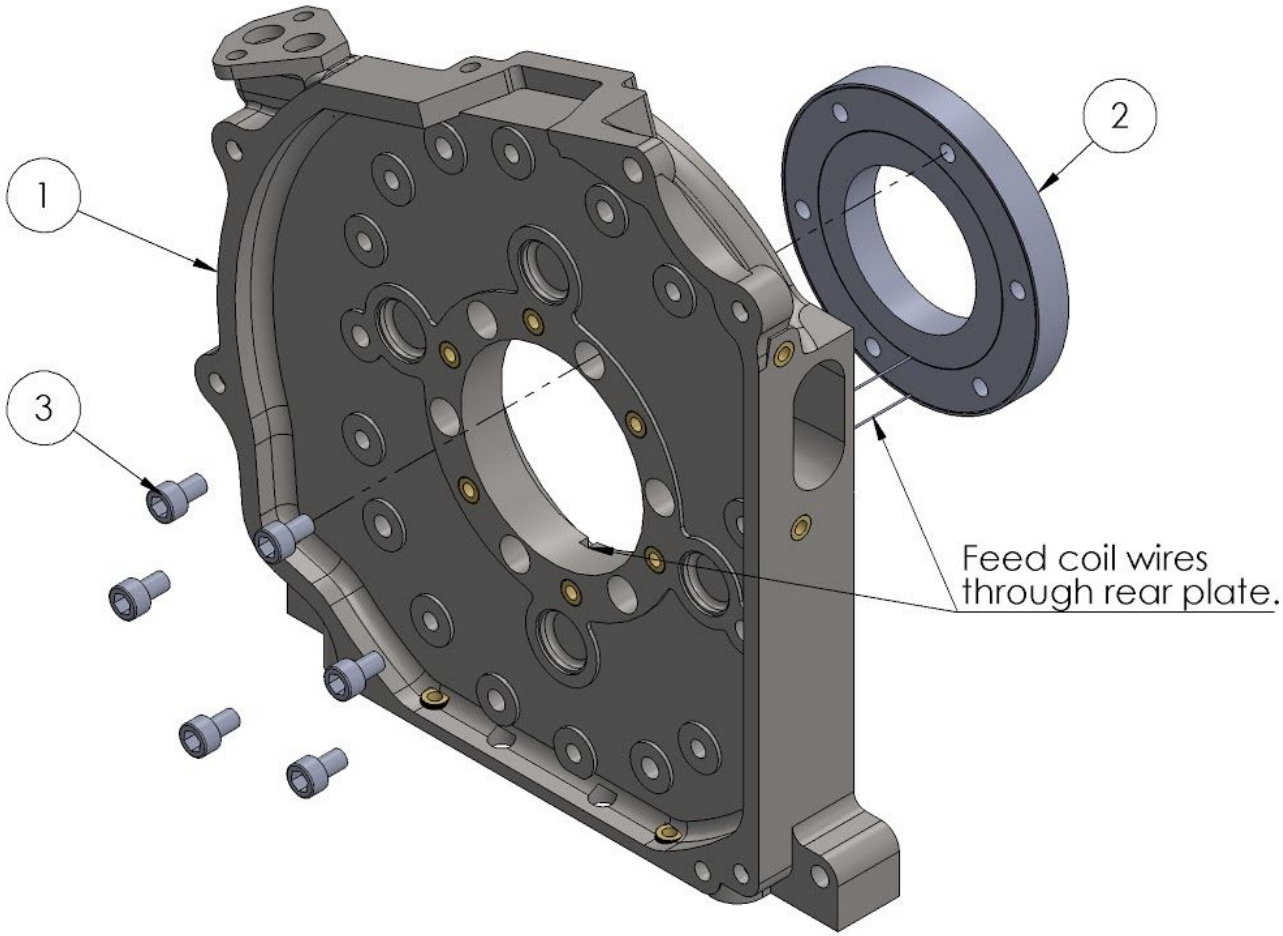
ITEM NO.	PART NUMBER	Timing Cover Installation/QTY.
1	Front Plate Insert Assembly	1
2	M3 x 8mm SHCS	3
3	M3 x 20mm SHCS	5
4	Timing Cover	1
5	6700ZZ Bearing	1

Front Eccentric Shaft Installation



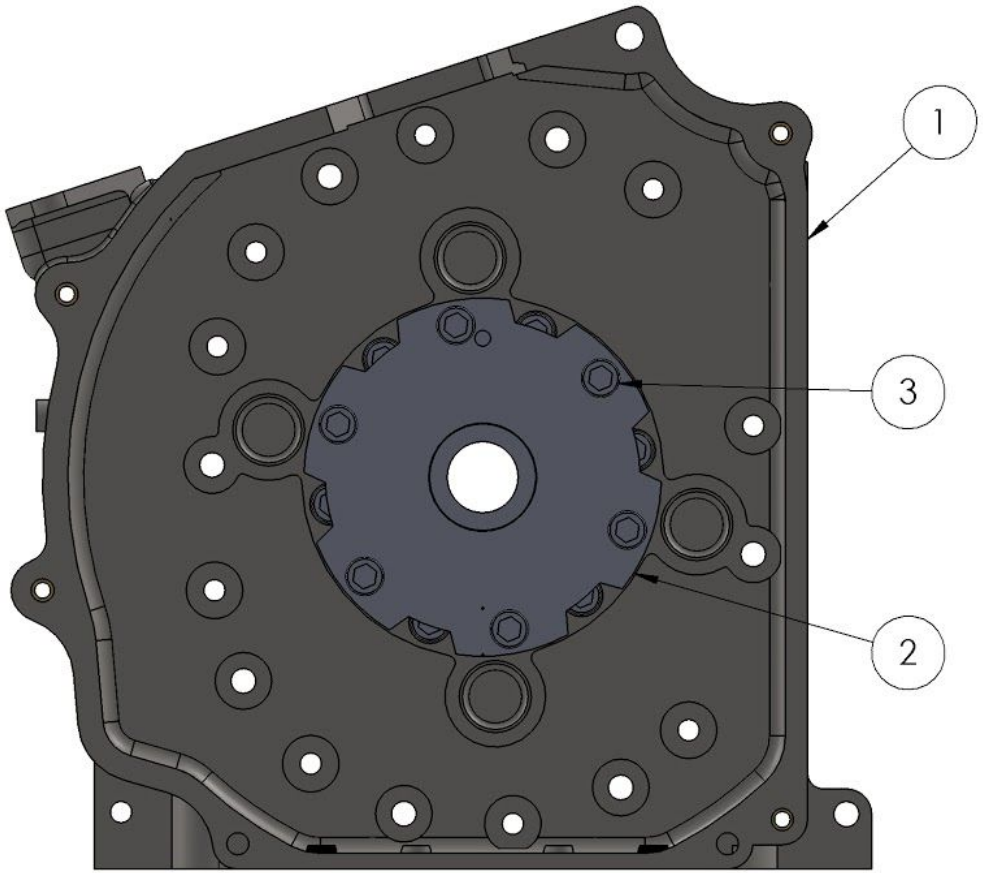
ITEM NO.	PART NUMBER	QTY.
1	Front Plate Insert Assembly	1
3	Front Eccentric Shaft Assembly	1

TX Coil Installation (if using)



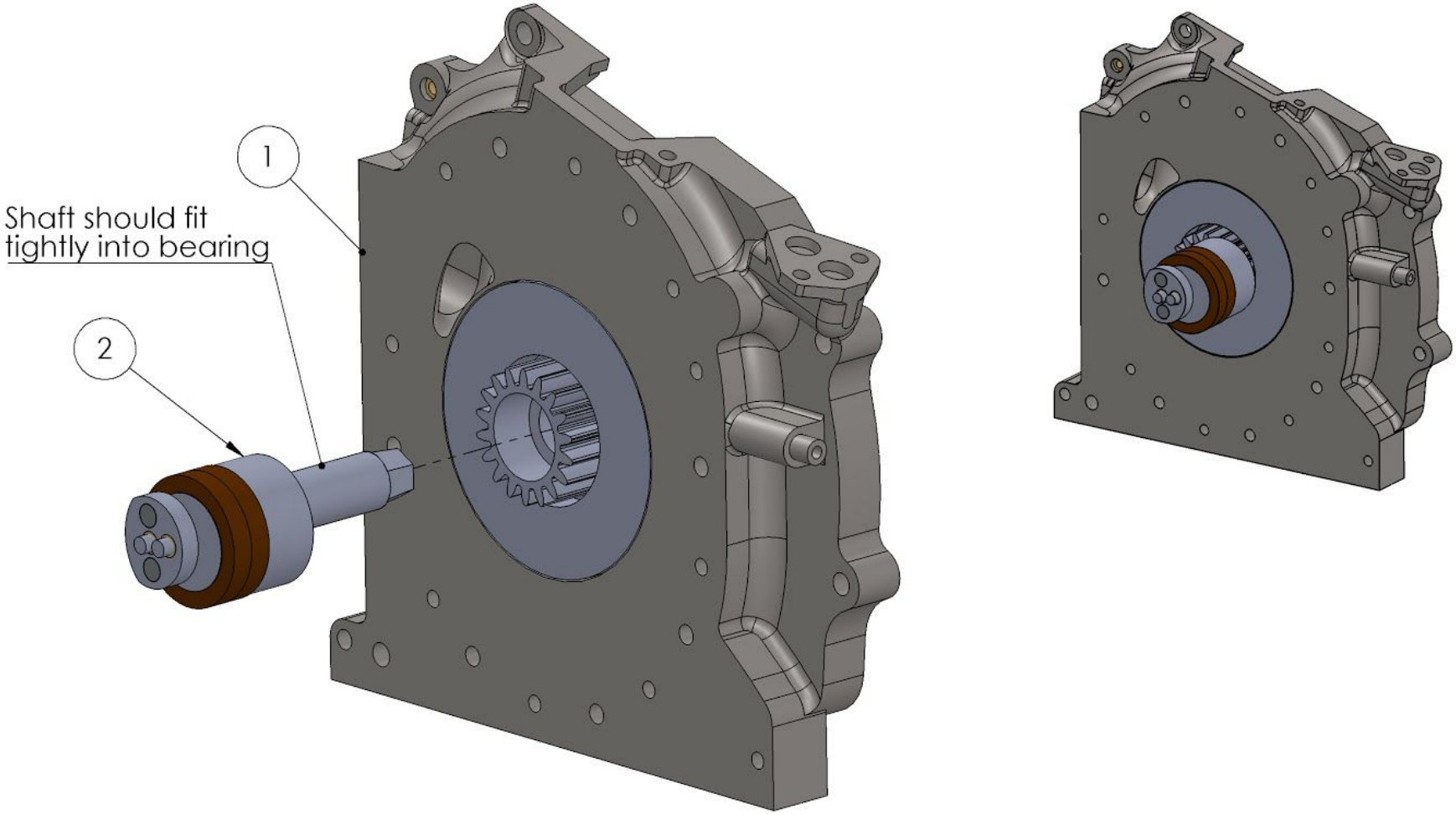
ITEM NO.	PART NUMBER	TX Coil Installation/QTY.
1	Rear Plate Insert Assembly	1
2	Coil Assembly	1
3	M3 x 5mm SHCS	6

Rear Fixed Gear Installation



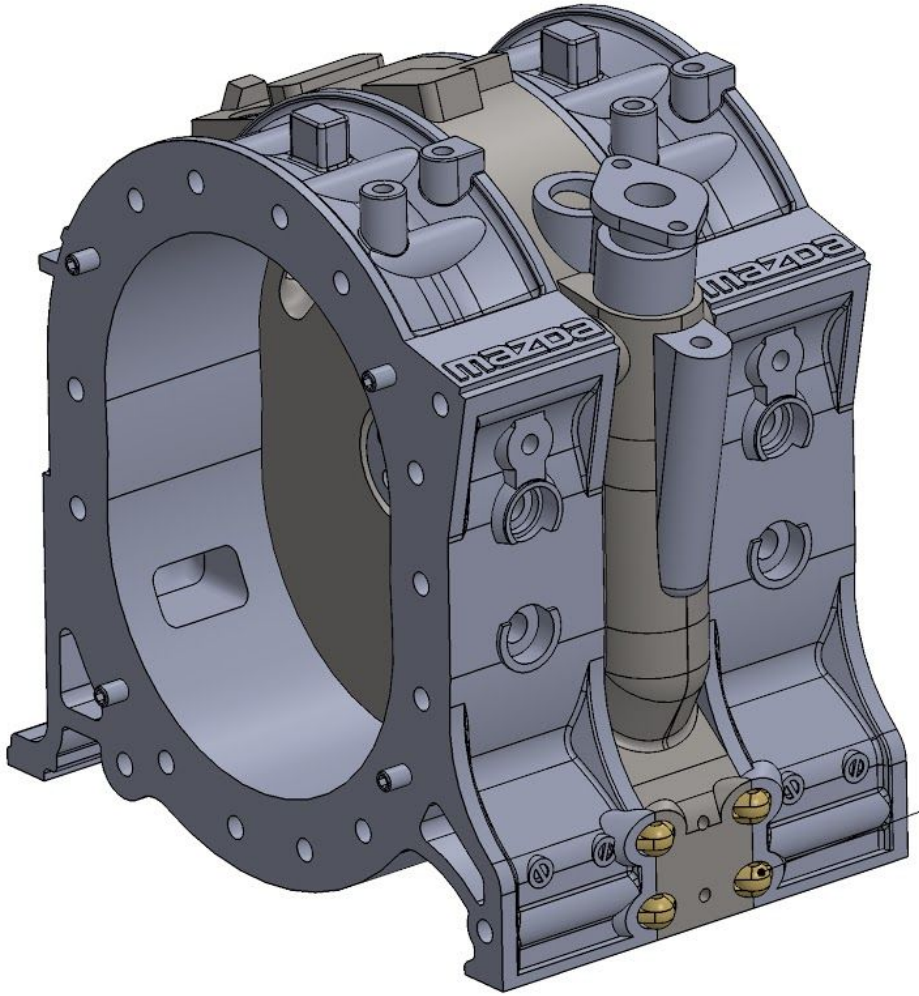
ITEM NO.	PART NUMBER	QTY.
1	Rear Plate Insert Assembly	1
2	Rear Fixed Gear Assembly	1
3	M3 x 8mm SHCS	6

Install Rear Eccentric Shaft assembly Into Rear Plate Assembly



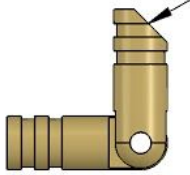
ITEM NO.	PART NUMBER	Shaft installation/QTY.
1	Rear Plate Assembly	1
2	Rear Eccentric Shaft Assembly	1

Hinged Housing Assembly



Chamfer end of each barrel hinge that goes into the center housing

Test fit hinges into housings before gluing into place



Modify Barrel Hinges

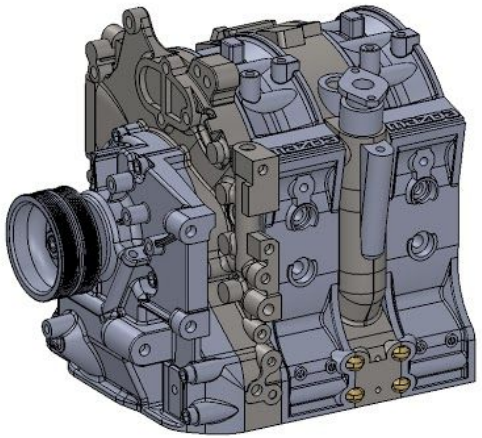
Use grease between the housing assemblies to precent glueing the plastic together. Refer to assembly video for full proceedure.

Install Barrel Hinges into Housings. Make sure housings allign before glueing. Use holes to drop a small amount of extra thin super glue.

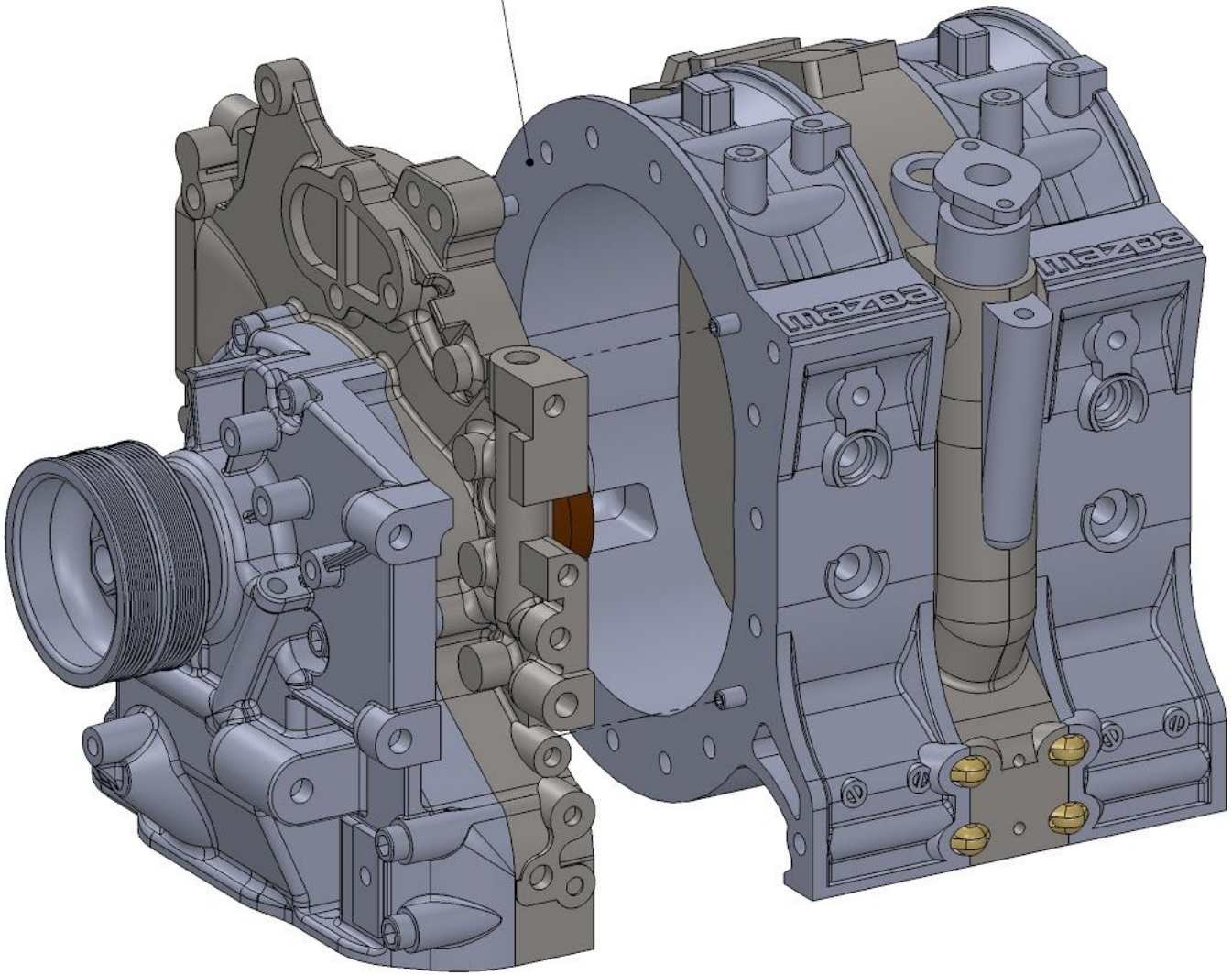
Once hinges are glued in place, leave housing open to prevent the super glue from leaving residue on the plastic parts.

ITEM NO.	PART NUMBER	QTY.
1	Front Housing Assembly	1
2	Rear Housing Assembly	1
3	Barrel Hinge	4
4	Center Plate with Eccentric Shaft Assembly	1

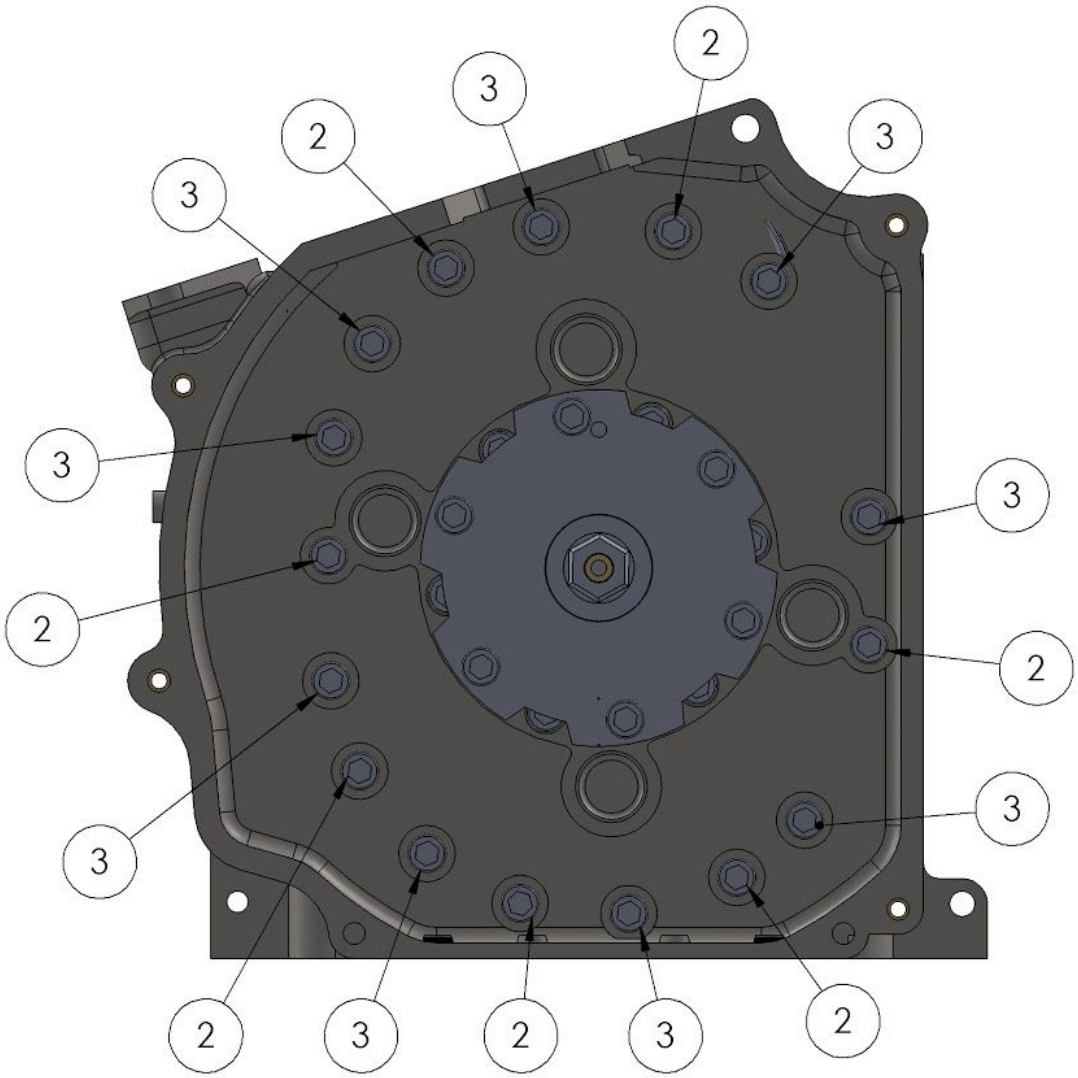
Front Plate Assembly Installation

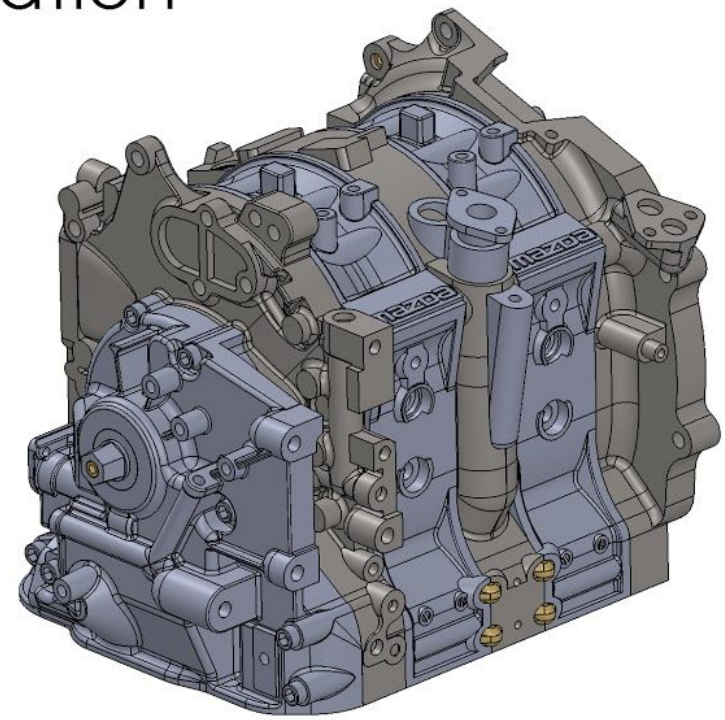


Allign front plate with set screws
and glue to front housing.



Rear Plate Installation



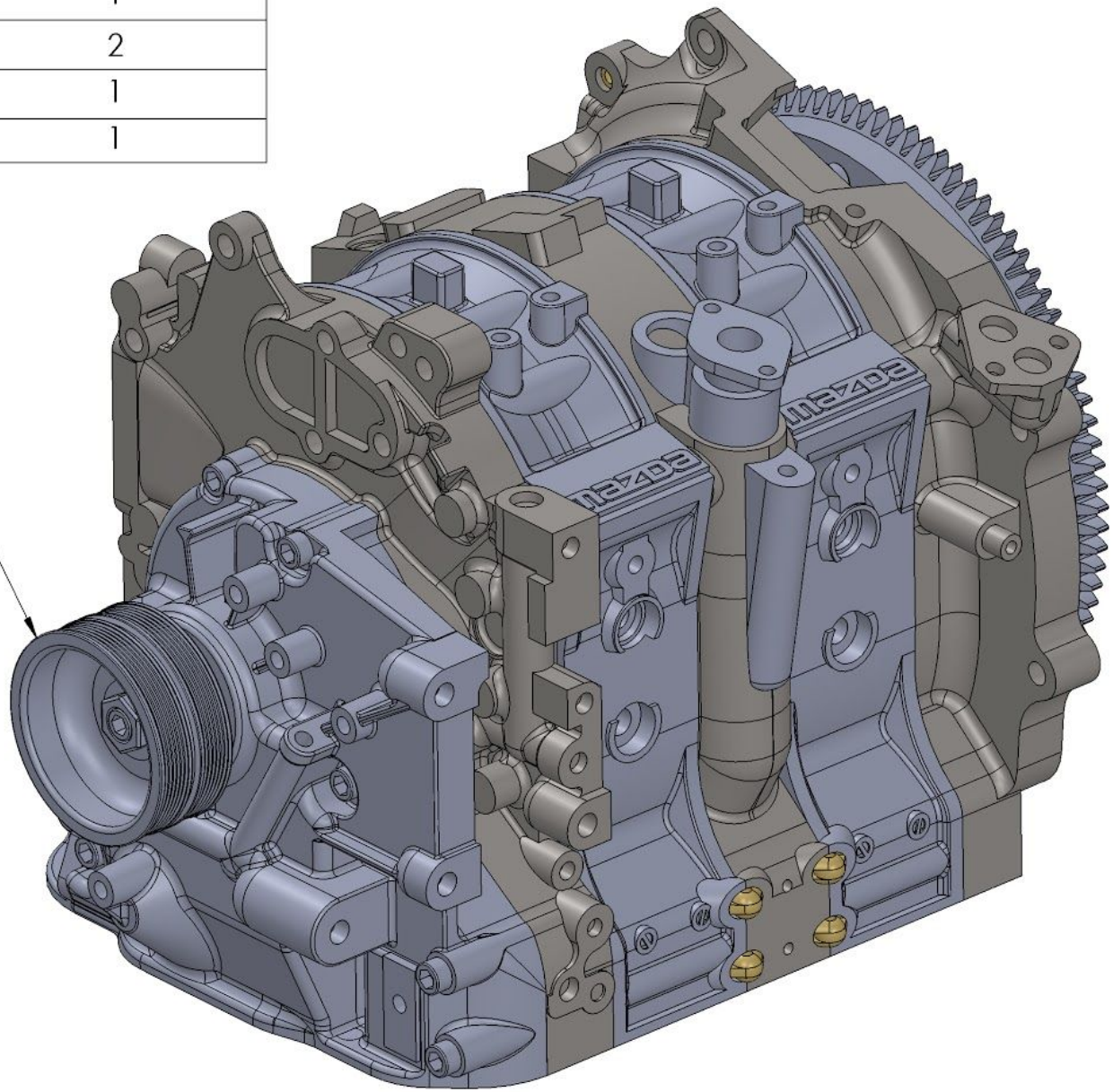


ITEM NO.	PART NUMBER	QTY.
1	Rear Plate Assembly	1
2	M3 x 20mm SHCS	7
3	M3 x 5mm SHCS	9

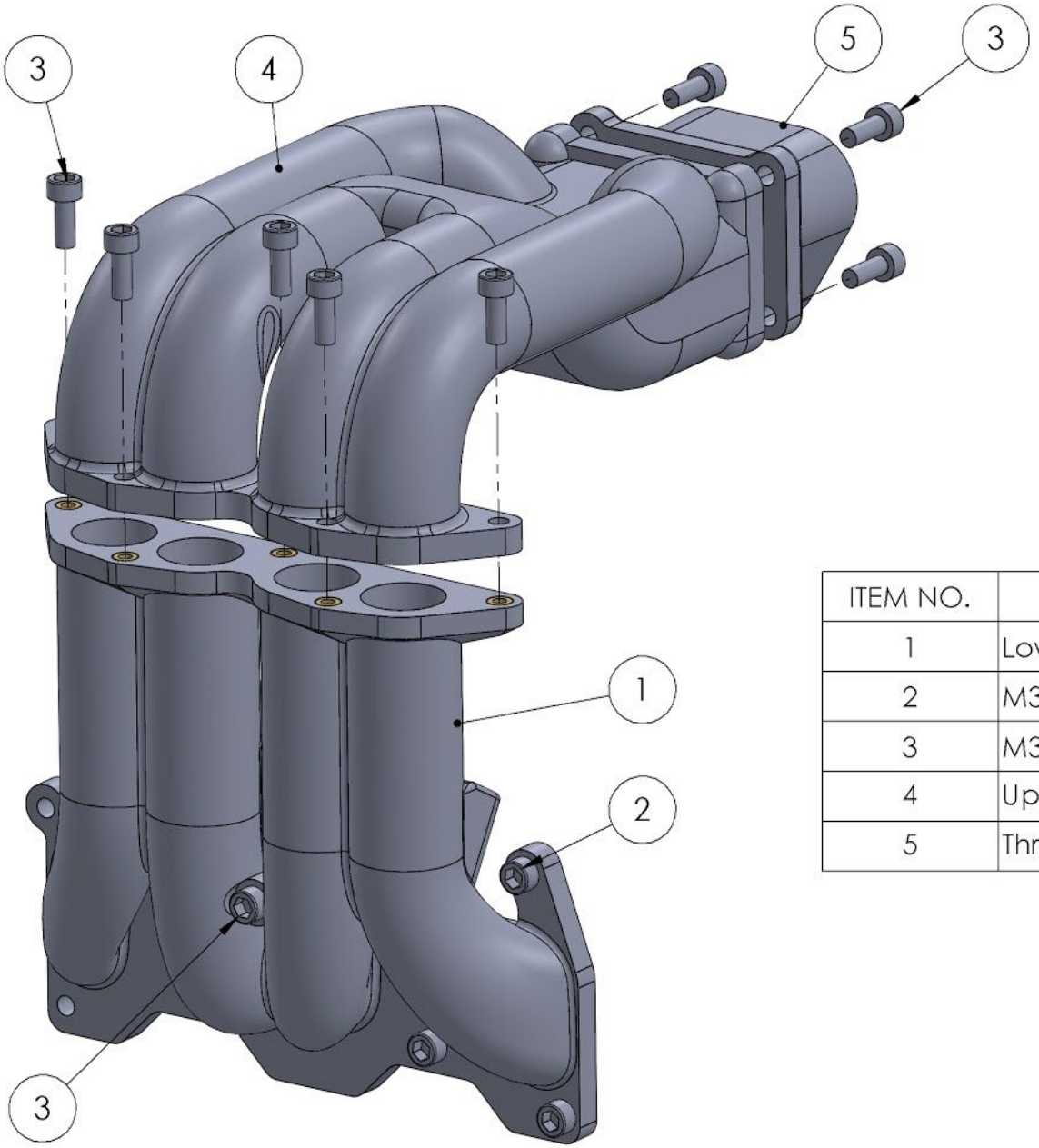
Flywheel and Front Pulley Installation

ITEM NO.	PART NUMBER	QTY.
1	Front Pulley	1
2	M3 x 8mm SHCS	2
3	Flywheel - 13B	1
4	Short Block Assembly	1

Install front pulley and flywheel.
Check for run out and re-index on shaft if needed.



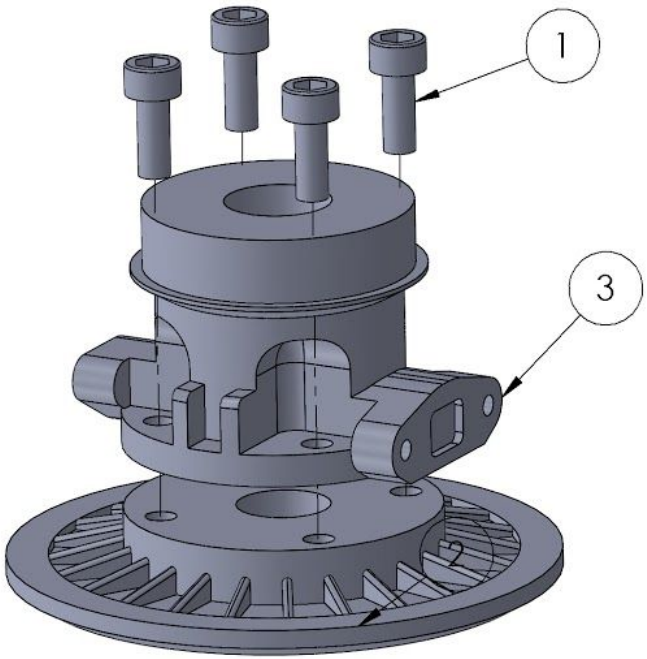
Intake Manifold Assembly



ITEM NO.	PART NUMBER	QTY.
1	Lower Intake Manifold	1
2	M3 x 3mm SHCS	3
3	M3 x 8mm SHCS	10
4	Upper Intake Manifold	1
5	Throttle Body	1

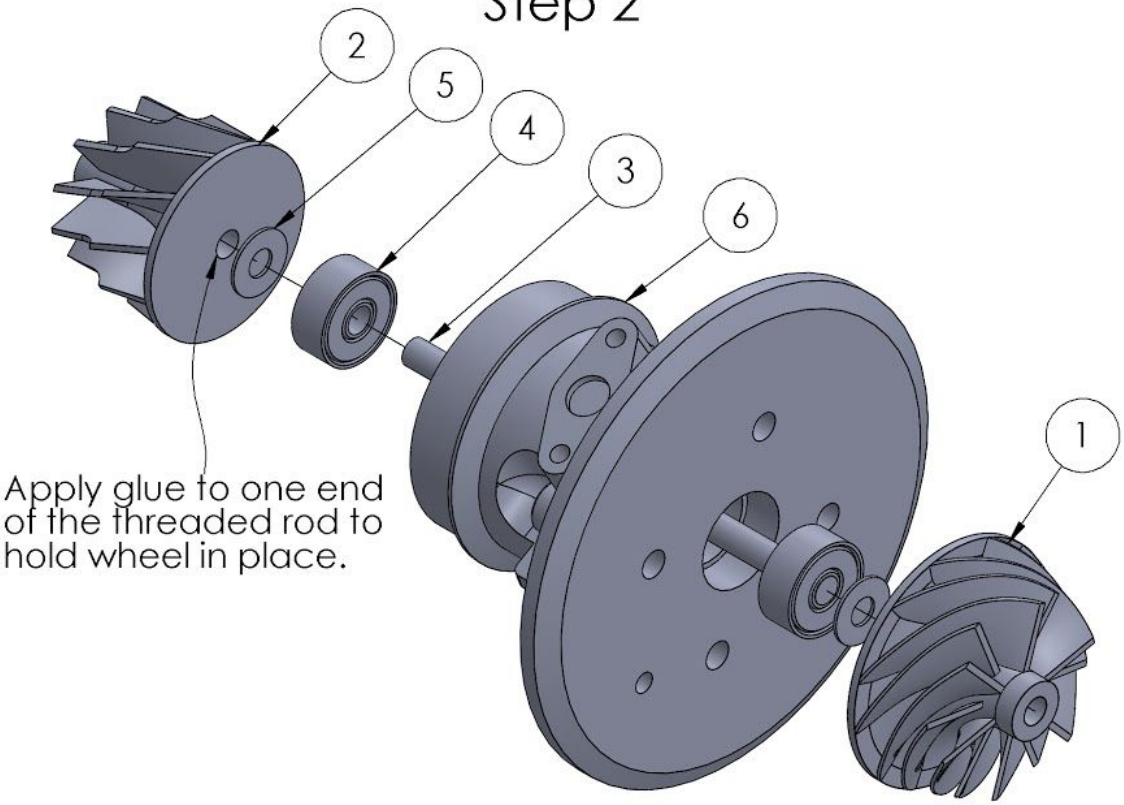
Turbo Assembly

Step 1



ITEM NO.	PART NUMBER	QTY.
1	M3 x 8mm SHCS	4
2	Turbo Snail Housing Plate	1
3	Bearing Housing	1

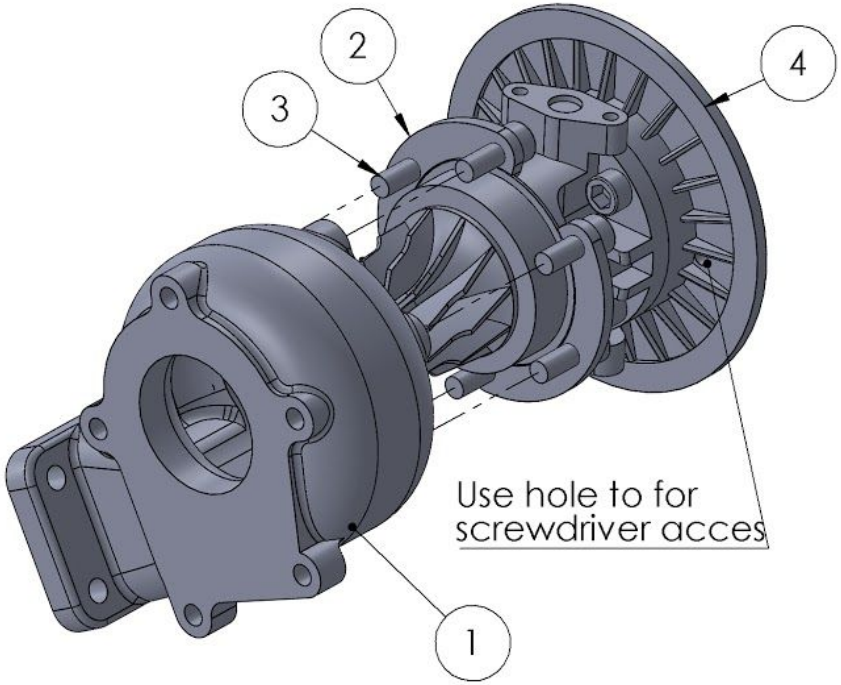
Step 2



ITEM NO.	PART NUMBER	QTY.
1	Compressor Wheel	1
2	Turbine Wheel	1
3	M3 x 55mm Threaded Rod	1
4	623zz bearing	2
5	3mm washer	2
6	Turbo Assembly Step 1	1

Step 3

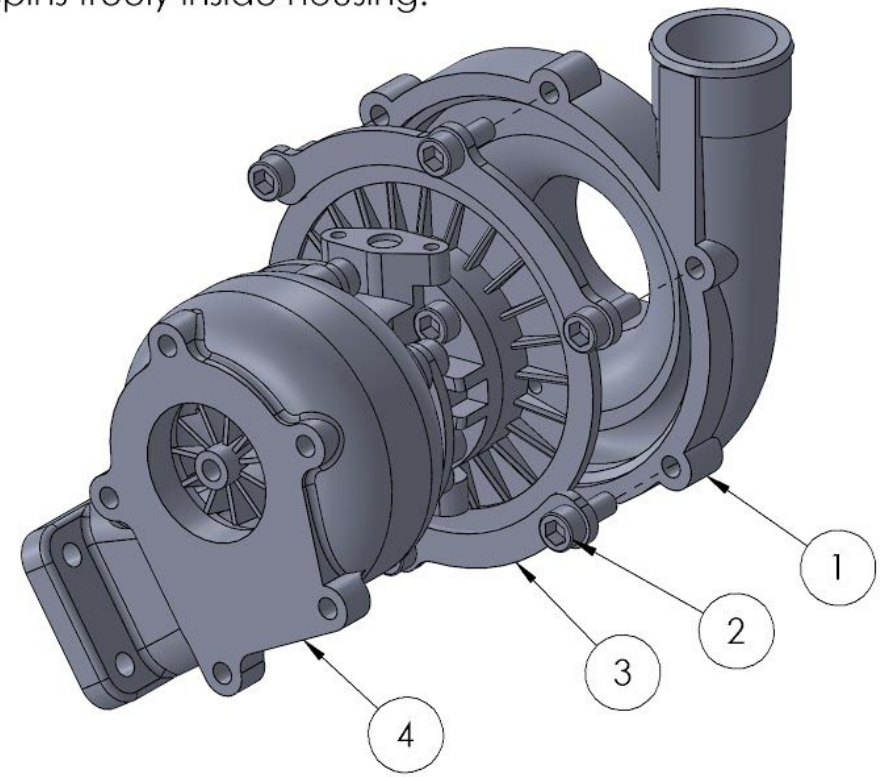
Check that turbine wheel spins freely inside exhuast housing.



ITEM NO.	PART NUMBER	QTY.
1	Turbo Exhuast Housing	1
2	Turbo Housing clamp	2
3	M3 x 8mm SHCS	6
4	Turbo Assembly Step 2	1

Step 4

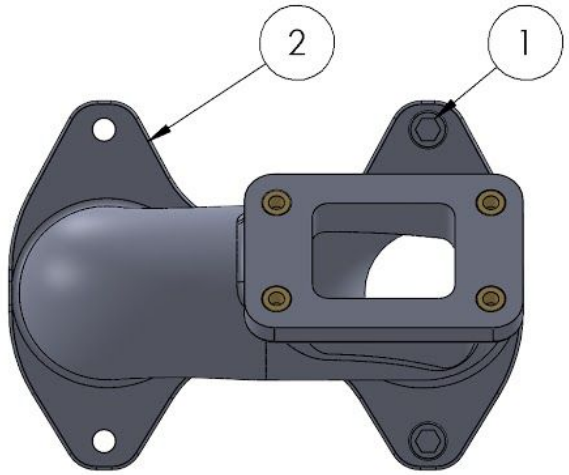
Check that compressor wheel spins freely inside housing.



ITEM NO.	PART NUMBER	QTY.
1	Turbo Snail Housing	1
2	M3 x 8mm SHCS	6
3	Snail housing clamp	2
4	Turbo Assembly Step 3	1

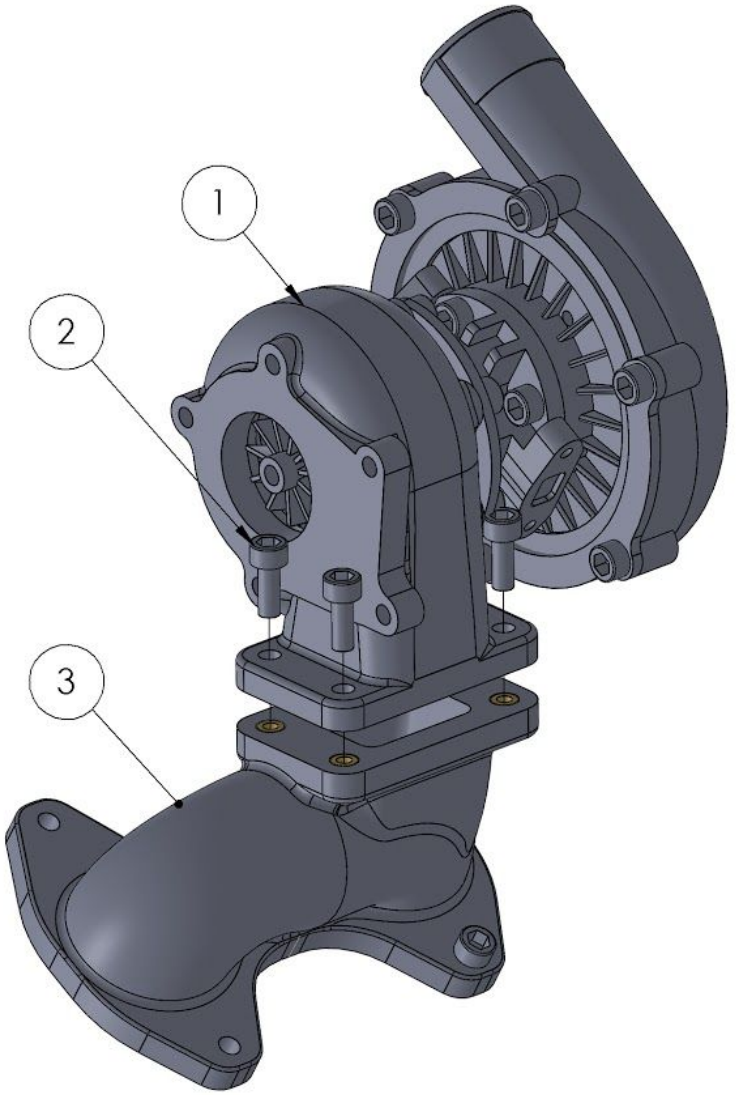
Step 5

Install M3x3mm SHCS into turbo manifold.
Glue if necessary.



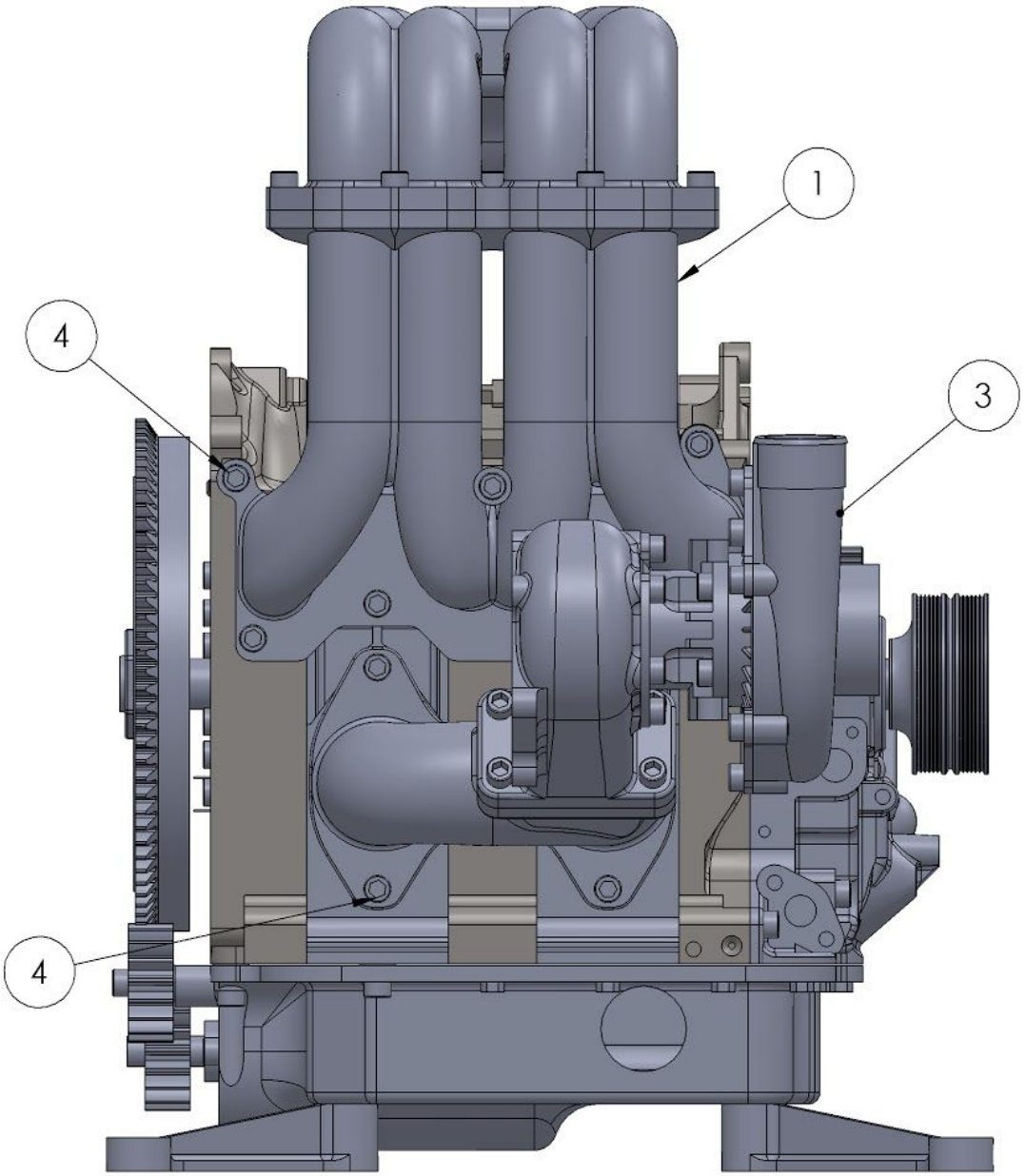
ITEM NO.	PART NUMBER	QTY.
1	M3 x 3mm SHCS	2
2	Turbo Manifold Assembly	1

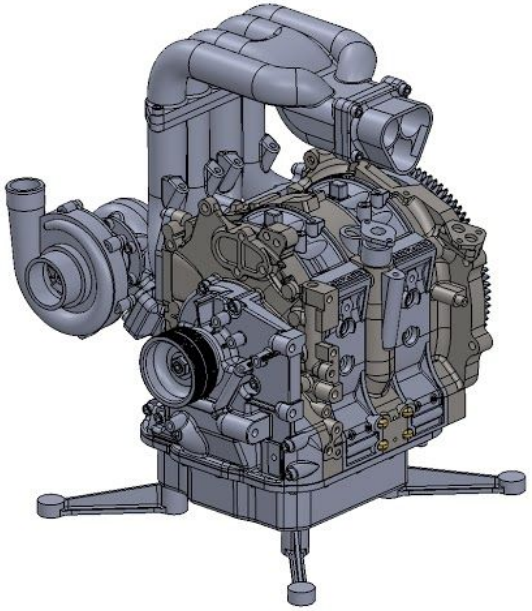
Step 6



ITEM NO.	PART NUMBER	QTY.
1	Turbo Assembly Step 4	1
2	M3 x 8mm SHCS	4
3	Turbo Manifold Assembly	1

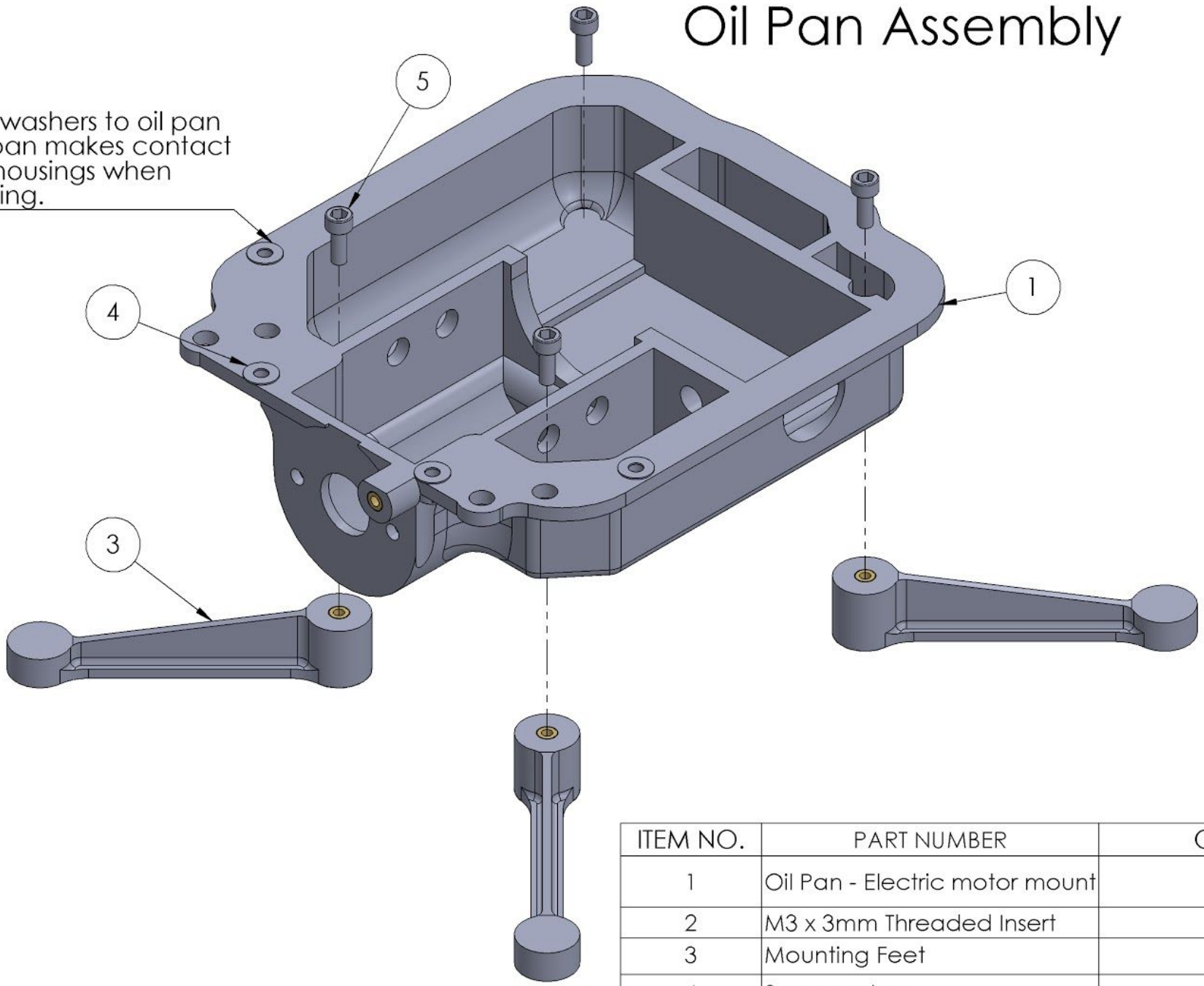
Intake and Turbo Installation





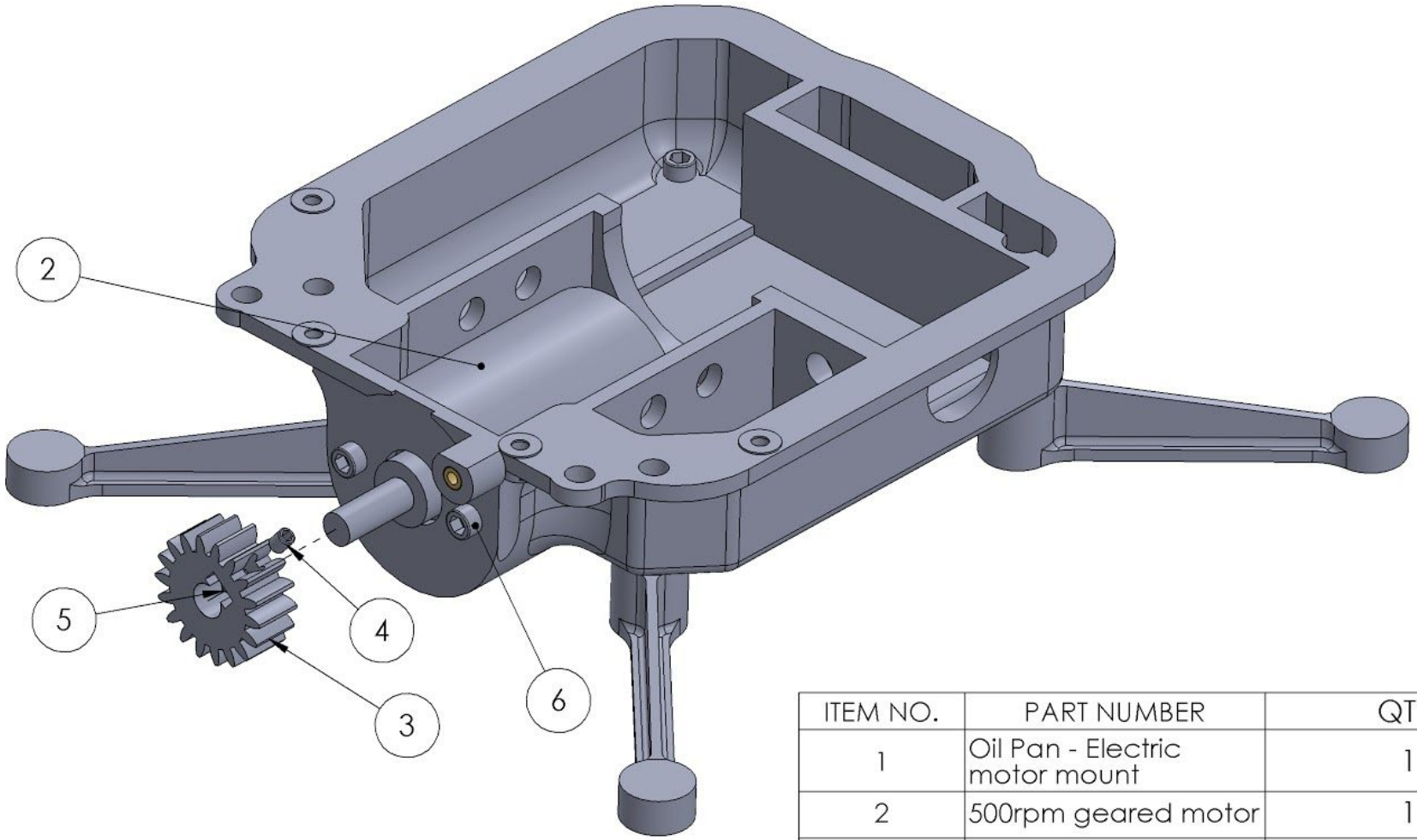
ITEM NO.	PART NUMBER	Default/ QTY.
1	Intake Manifold Assembly	1
2	Hinged Housing Assembly	1
3	Turbo Assem	1
4	M3 x 8mm SHCS	5

Oil Pan Assembly



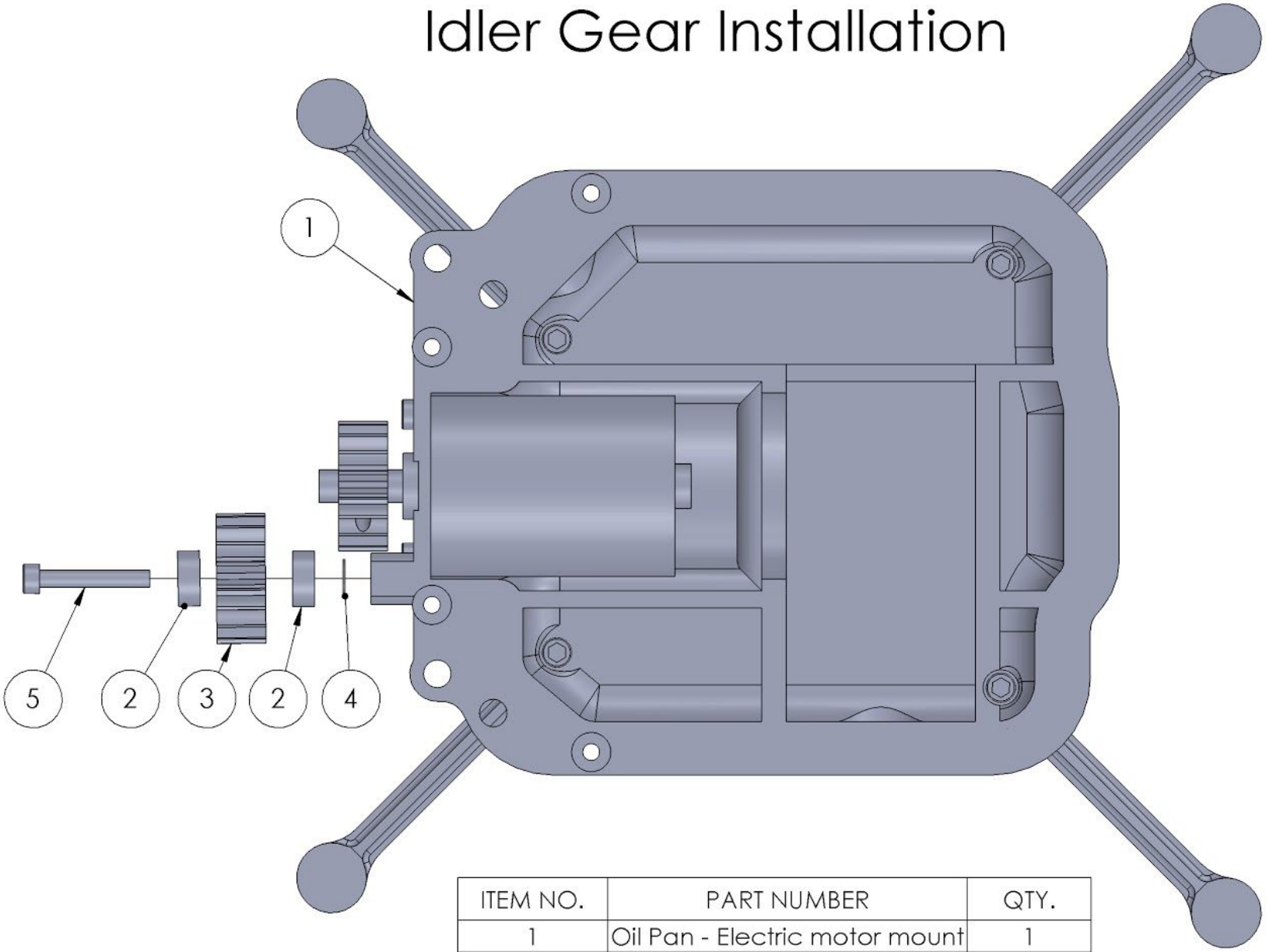
ITEM NO.	PART NUMBER	QTY.
1	Oil Pan - Electric motor mount	1
2	M3 x 3mm Threaded Insert	5
3	Mounting Feet	4
4	3mm washer	4
5	M3 x 8mm SHCS	4

Electric Motor Installation



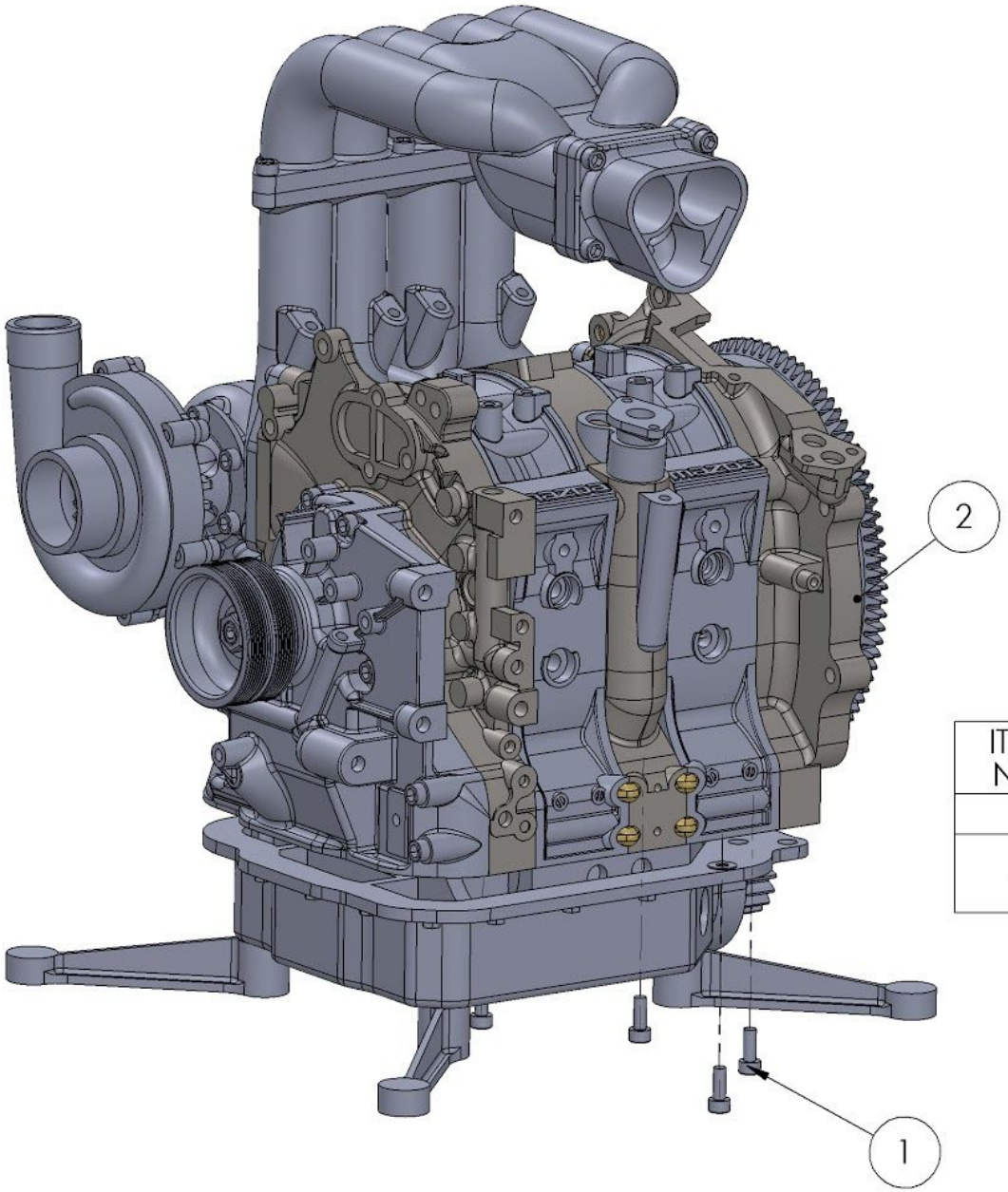
ITEM NO.	PART NUMBER	QTY.
1	Oil Pan - Electric motor mount	1
2	500rpm geared motor	1
3	Starter Drive Gear 13b	1
4	M3 4mm Set Screw	1
5	M3 Nut	1
6	M3 x 5mm SHCS	2

Idler Gear Installation



ITEM NO.	PART NUMBER	QTY.
1	Oil Pan - Electric motor mount	1
2	623zz bearing	2
3	Idle Gear 13b	1
4	3mm washer	5
5	M3 x 20mm SHCS	1

Oil Pan Installation



ITEM NO.	PART NUMBER	QTY.
1	M3 x 8mm SHCS	4
2	Engine Assembly	1