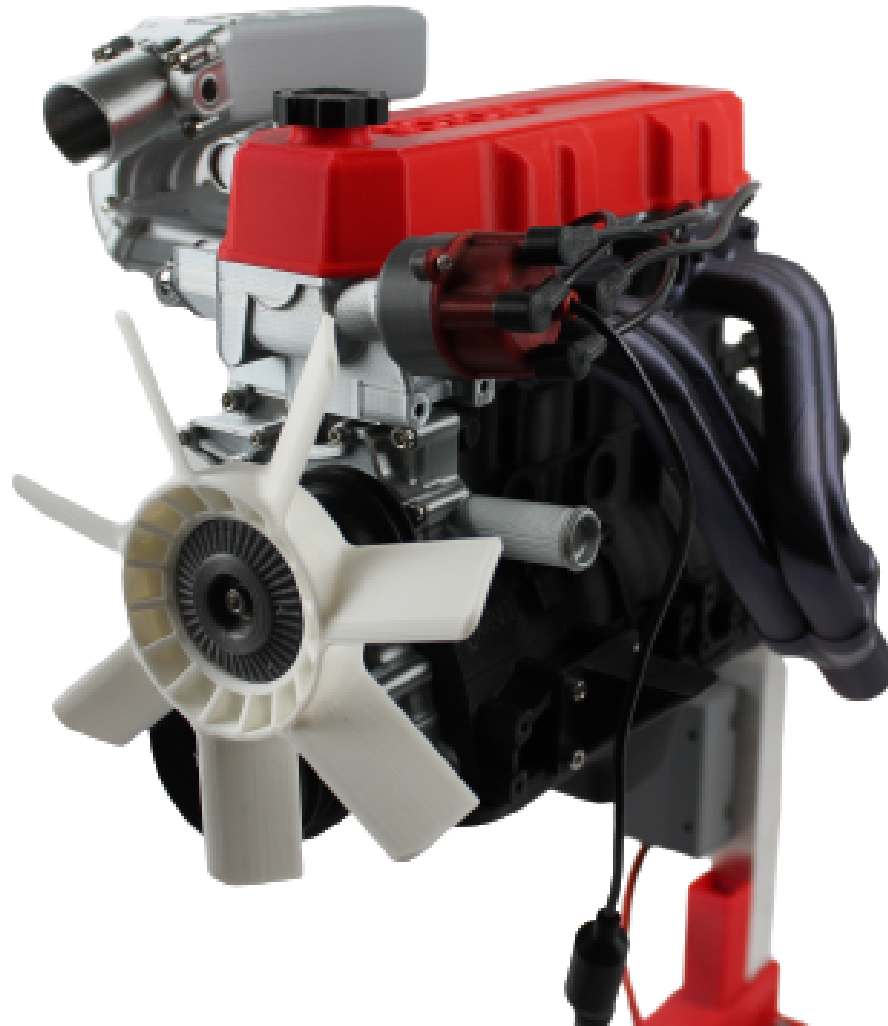


Toyota 22RE 4 Cylinder

Engine Assembly Instructions



Recommended tool and materials

Small metric allen key set

Assorted drill bits

Hand drill

Pin vice for drill bits

Rotary tool

Razor blade

Small wood chisel set for cleaning up printed parts

Miniature file set

Assortment of different thickness super glues.

Silicone grease (for installing threaded inserts)

Adjustable temperature heat gun

Soldering Iron

Electrical tape or shrink tubing

Scotch tape

Printed Parts	Quantity	Printing notes	Color I printed in	Finishing notes
Timing Idle gear 1	1	Print high quality (.12mm or less) Print with dense infill (60% or greater)	Light grey	Make sure gear teeth are free from surface defects
Timing Idle gear 2	1	Print high quality (.12mm or less) Print with dense infill (60% or greater)	Light grey	Make sure gear teeth are free from surface defects
Timing Idle gear 3	1	Print high quality (.12mm or less) Print with dense infill (60% or greater)	Light grey	Make sure gear teeth are free from surface defects
22RE Block - Cutaway	1	Regular quality is fine (.2mm), density 20% Print with supports touching build plate (overhang 85 degrees)	Flat black	Remove support material. Smooth cylinder walls with sand paper.
Main cap	5	Print with support touching build plate. Density 50% or greater. Print with brim.	Flat black same as engine block	Remove support material.
Crank 1	3	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crank 2	4	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crank 3	1	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crankshaft spacer .125	1	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crankend	1	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crank gear	1	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crank spacer	1	Print with dense infill (80%)	Metallic/Silk Bronze	Ream/drill out holes to 3mm.
Crank pulley	1	No support needed	Black	Ream/drill out holes to 3mm.
Flywheel	1		Gun Metal Grey	Ream/drill out holes to 3mm.
Connecting rod	4	Print with dense infill (60%). Print with brim.	Metallic/Silk Copper	Ream/drill out holes to 3mm.
Connecting rod cap	4	Print with dense infill (60%). Print with brim.	Metallic/Silk Copper	Ream/drill out holes to 3mm.
Piston	4	Best to print in high quality (.12mm or less)	Gun Metal Grey	Ream/drill out holes to 3mm.
Rear Main	1		Metallic/Silk Silver	Ream/drill out holes to 3mm.
Cylinder Head	1	Print with supports touching build plate (overhang 60 degrees)	Metallic/Silk Silver	Remove support material. Clean up valve seat surface.
Intake valve	4	Print with fine resolution (.12mm or less)	Sky blue	
Exhaust valve	4	Print with fine resolution (.12mm or less)	Red	
Spring retainer	8	Print with supports touching build plate (overhang 85 degrees)	Black	Remove support material
Fuel pump block off plate	1		Silver	
Cam bearing cap	3	Print with supports touching build plate (overhang 60 degrees) Print with brim if needed.	Metallic/Silk Silver	Remove support material
Cam Gear	1	Print high quality (.12mm or less) Print with dense infill (60% or greater)	Bronze	Make sure gear teeth are free from surface defects
Camshaft1	1	Print with brim Print with dense infill (60% or greater) Print with support material everywhere.	Bronze	Remove support material

Camshaft2	1	Print with brim Print with dense infill (60% or greater) Print with support material everywhere.	Bronze	Remove support material
Head Brace	1	Print with supports touching build plate (overhang 75 degrees) Print with wide brim	Metallic/Silk Copper	Remove support material/brim. Ream/Drill out holes to 3mm.
Rocker Arm	8	Print in fine resolution (.12mm or less) Print with support touching build plate (overhang 70 degrees) Print with dense infill (60%)	Metallic/Silk Bronze	Remove support material/brim. Ream/Drill out holes to 3mm.
Timing cover	1	Print with support touching build plate (overhang 85 degrees)	Metallic/Silk Silver	Remove support material. Ream/Drill holes to 3mm.
Thermostat housing	1		Metallic/Silk Silver	Ream/drill out holes to 3mm.
Intake Manifold Lower	1	Print with brim if needed	Metallic/Silk Silver	
Intake manifold upper - part 1	1		Metallic/Silk Silver	Glue Intake manifold upper parts together
Intake manifold upper - part 2	1		Metallic/Silk Silver	Glue Intake manifold upper parts together
Header	1	Print with support touching build plate (overhang 70 degrees) Print with brim if needed	Silk Black	Remove support material
Throttle body	1		Metallic/Silk Silver	Ream/drill out holes to 3mm.
Fan clutch	1		Silver	
Fan	1	Print with brim if needed. 100% Cooling fan if printing in PLA	White	
Fan pulley	1		Black	
Fanspacer	1		Black	
Starter Motor Mount	1		Silver	
Starter Drive Gear	1	Print high quality (.12mm or less) Print with dense infill (60% or greater)	Black	Make sure gear teeth are free from surface defects
Distributor Base	1	Print with support everywhere. (Overhang 85 degrees)	Gun metal grey	Remove support material
Distributor Cap	1		Red	
Distributor boot - Copy	5	Print with support touching build plate Print with brim.	Black	Remove support material Ream/Drill side hole to 3.5mm
Spark plug boot - Copy	4	Print with brim	Black	Ream/Drill hole to 3mm
Oil pan	1	Possible to print with no support.	Black	
VALVE COVER	1	Possible to print with no support.	Red	
Oil cap	1		Black	
Left motor mount	1		Black	
Right motor mount	1		Black	
Starter Motor Cover	1		Light Gray	
Spark plug wire barrel jack cover	1	Print with brim	Black	

Non-Printed Parts	Quantity	Notes
623zz bearing	19	
608zz bearing	5	
M3 Nut	20	
3mm washer	31	
3mm Fender Washer	8	
M3 x 3mm Threaded Insert	63	
M2 x 5mm SHCS	13	
M3 x 5mm SHCS	14	
M3 x 8mm SHCS	31	
M3 x 10mm SHCS	6	
M3 x 12mm SHCS	8	
M3 x 20mm SHCS	19	
M3 x 25mm SHCS	14	
M3 x 30mm SHCS	1	
M3 x 45mm SHCS cut down to 35mm	8	For valve stems. Cut down to 35mm for valve stem. 35mm from bottom of head to tip of threads
M3 x 50mm SHCS	2	
M3 4mm Set Screw	11	
4mm x 2mm disc magnet	57	
Valve Spring	8	
3mm x 137.5mm	2	For rocker arm rail
M3 x 168mm threaded rod	1	For camshaft
3mm LED	4	
Plastic reed switch	4	
500rpm geared motor	1	
DC PWM Speed controller	1	
DC Female Panel Mount Jack	1	
DC Male Pigtail	1	
12v 1A Power Supply	1	
3mm OD Coaxial wire (two conductors)	10ft	
330 ohm 1/2 watt resistor	1	

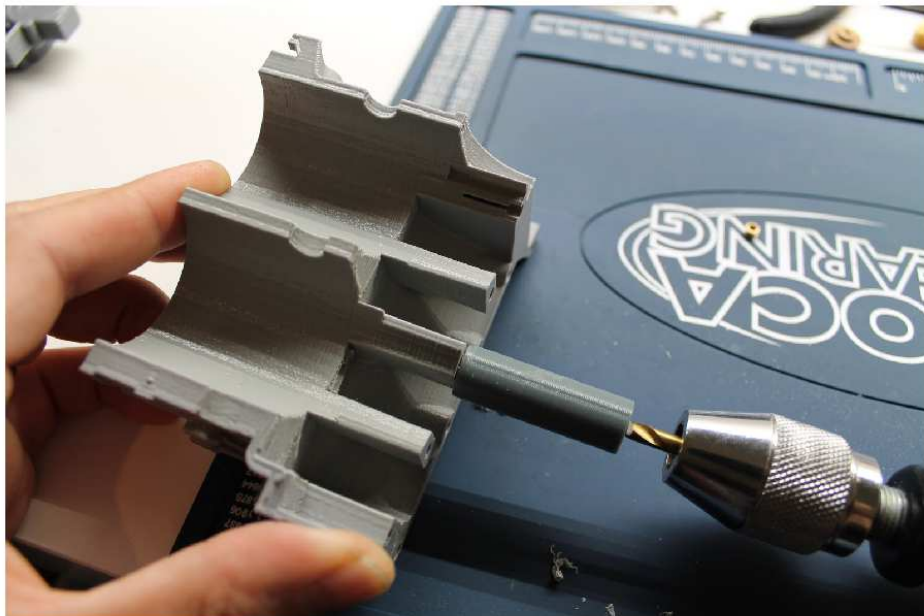
Installing inserts and magnets



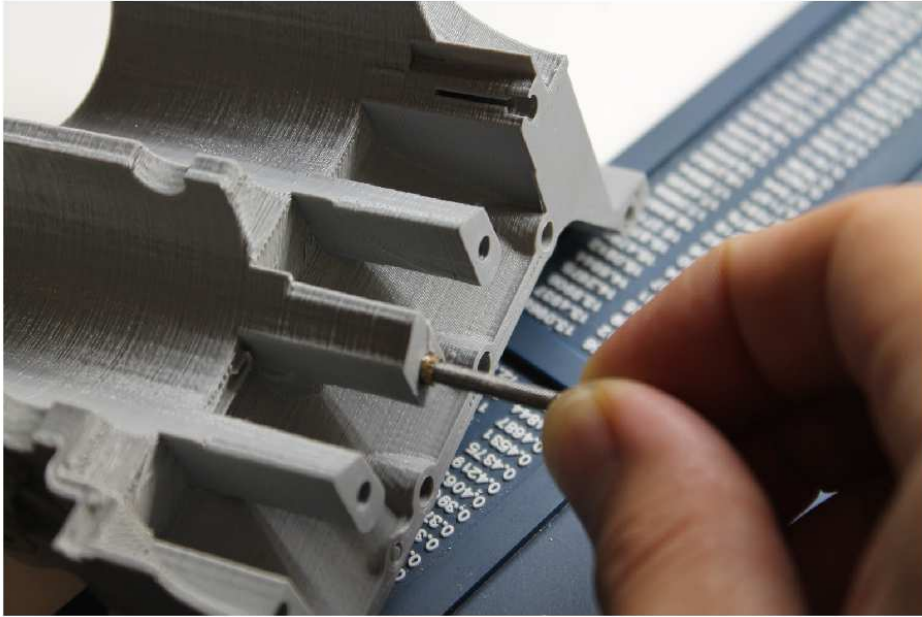
Using a #20 drill bit or similar and a drill stop collar, set the drill bit depth to slightly higher than the threaded insert.



Drill/ream out hole for the threaded insert.



Using an M3 screw, coat the threads with grease and thread insert onto screw. Coat outer surface of threaded insert with super glue.



Insert threaded insert into hole and press firmly.

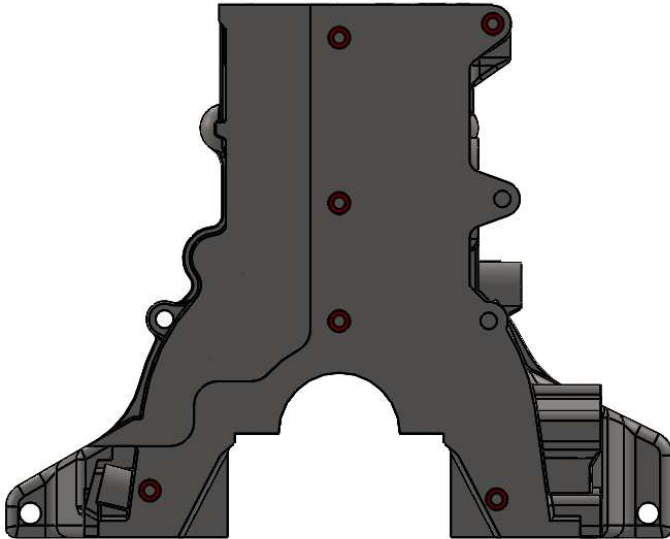


Threaded insert should be flush with surface.

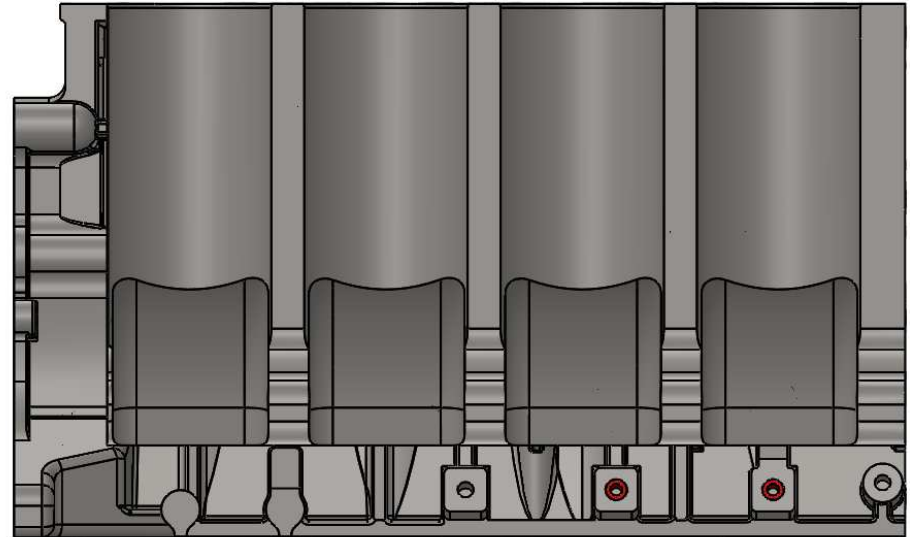
Magnet and Insert Locations

Engine Block

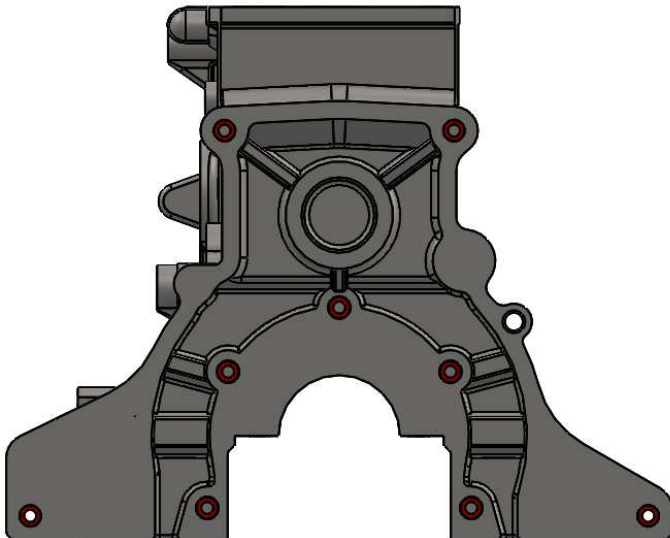
Brass inserts show as red
Magnets shown as green



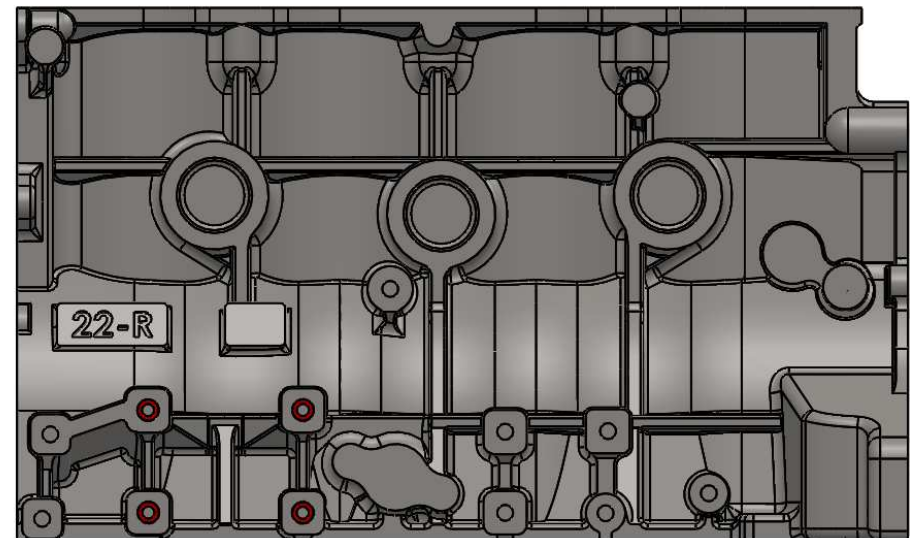
Front



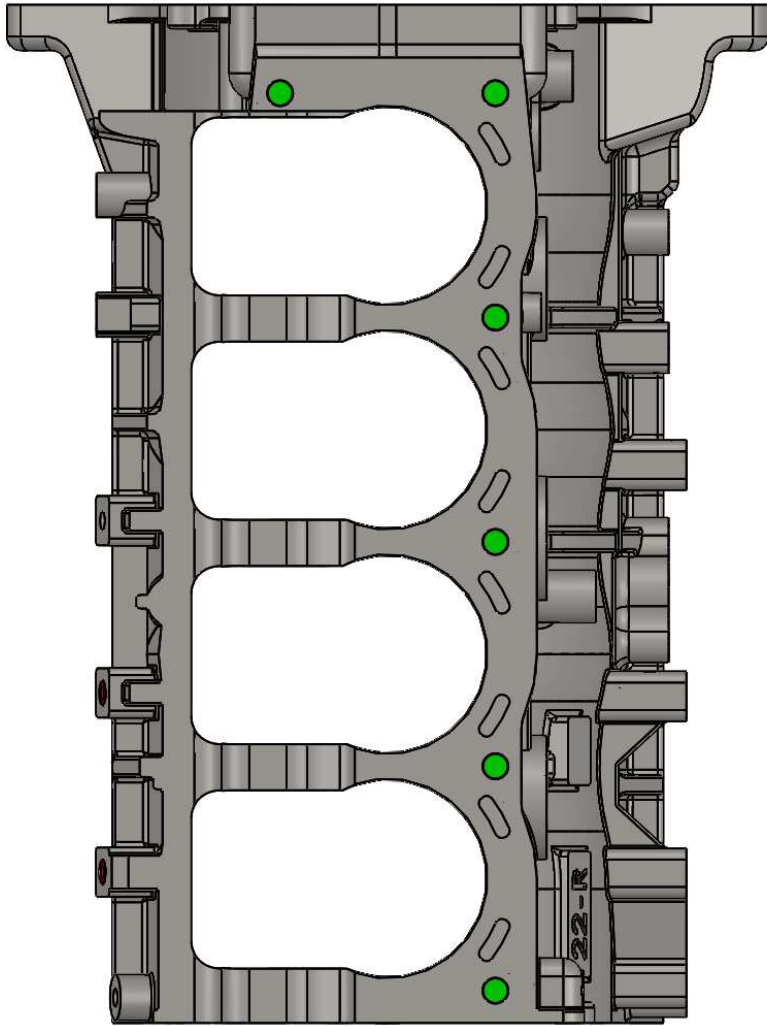
Passenger Side



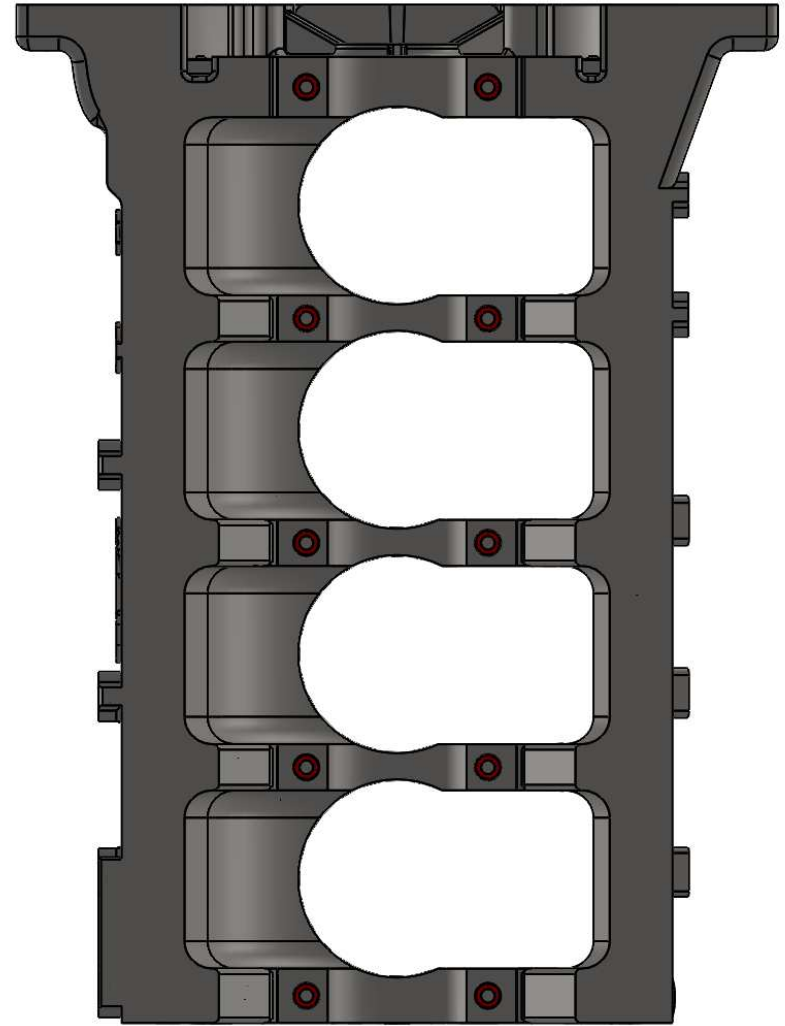
Back



Drivers Side

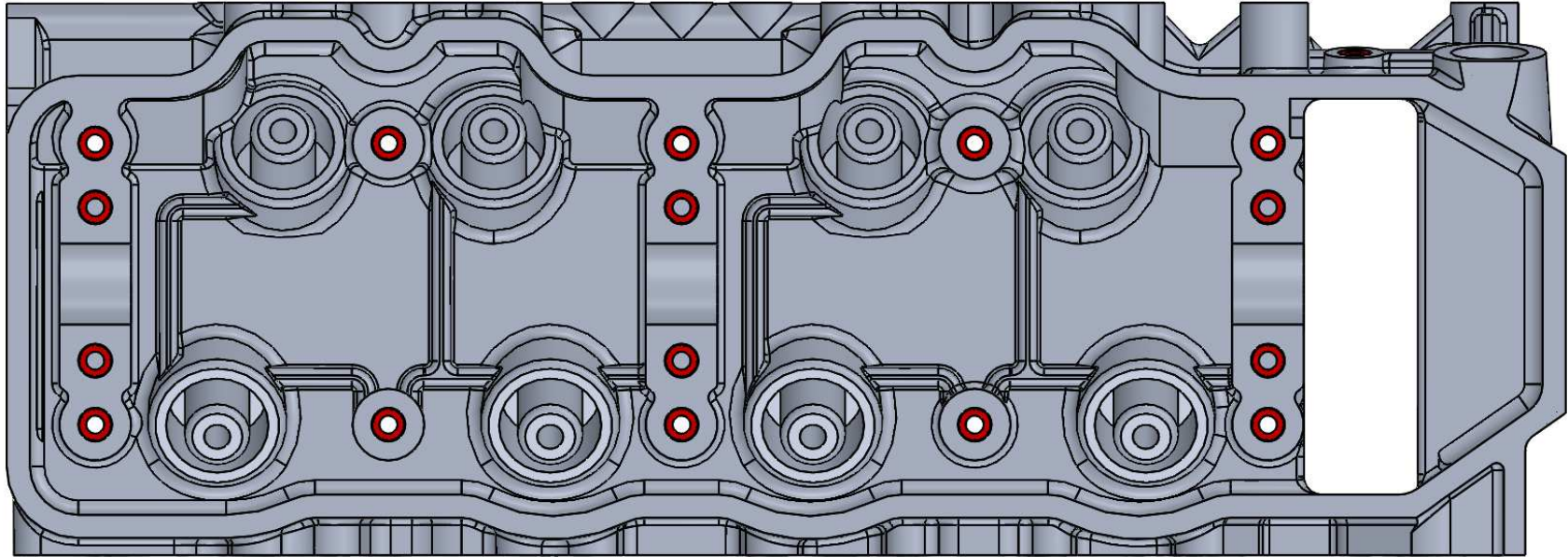


Top

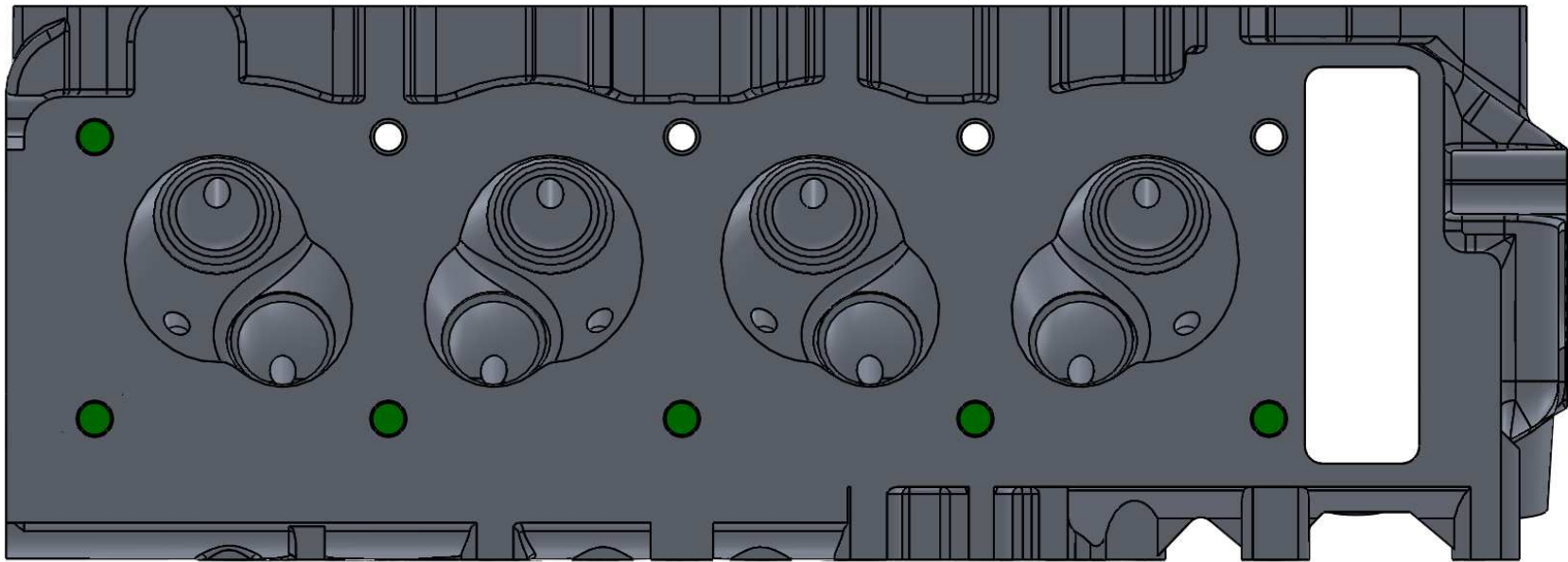


Bottom

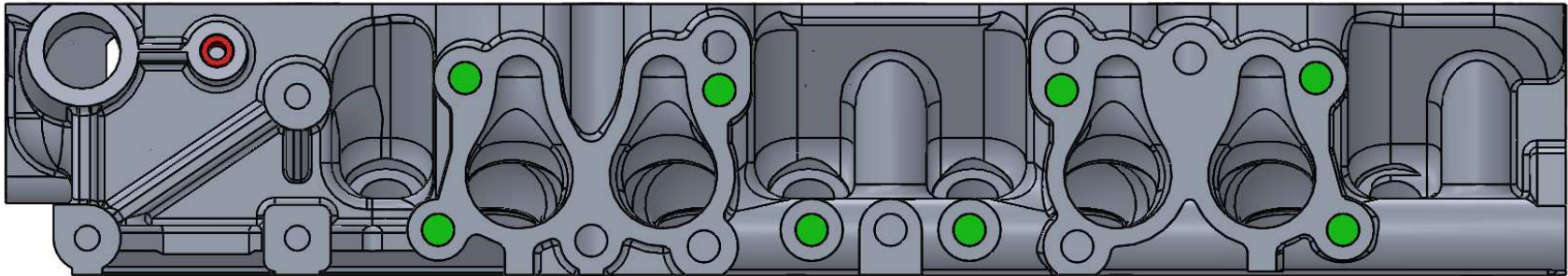
Cylinder Head



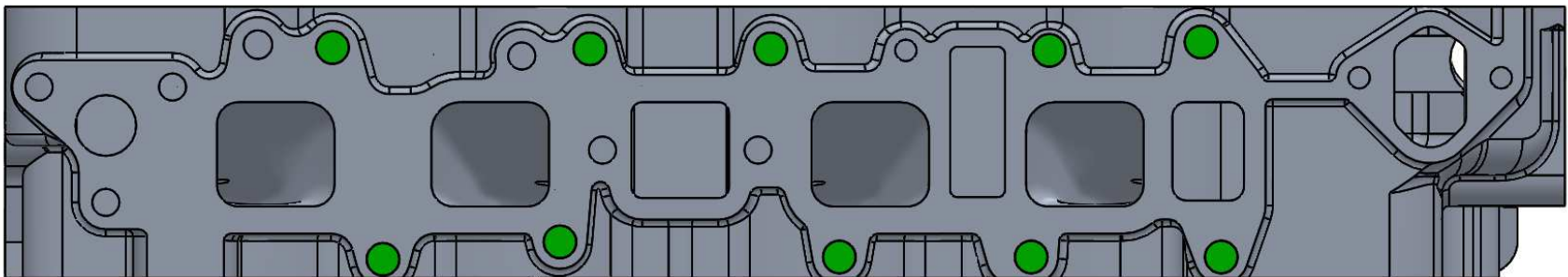
Top



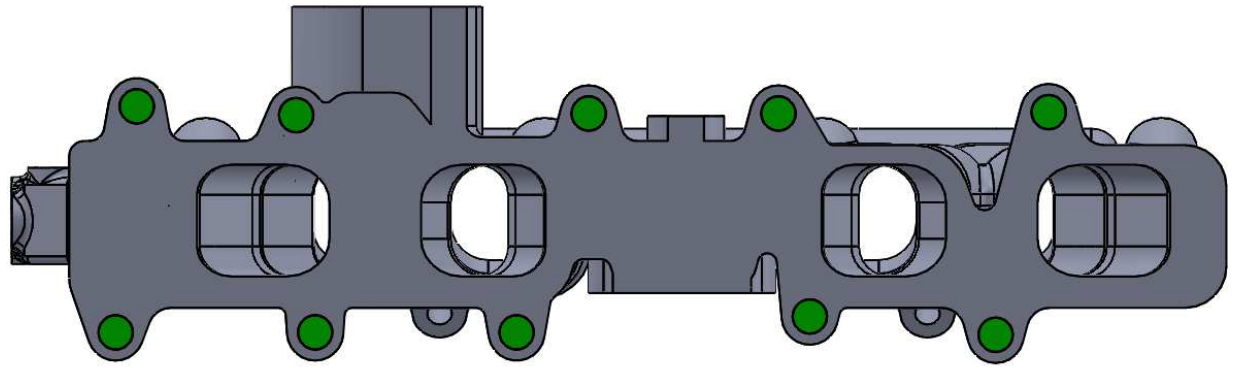
Bottom



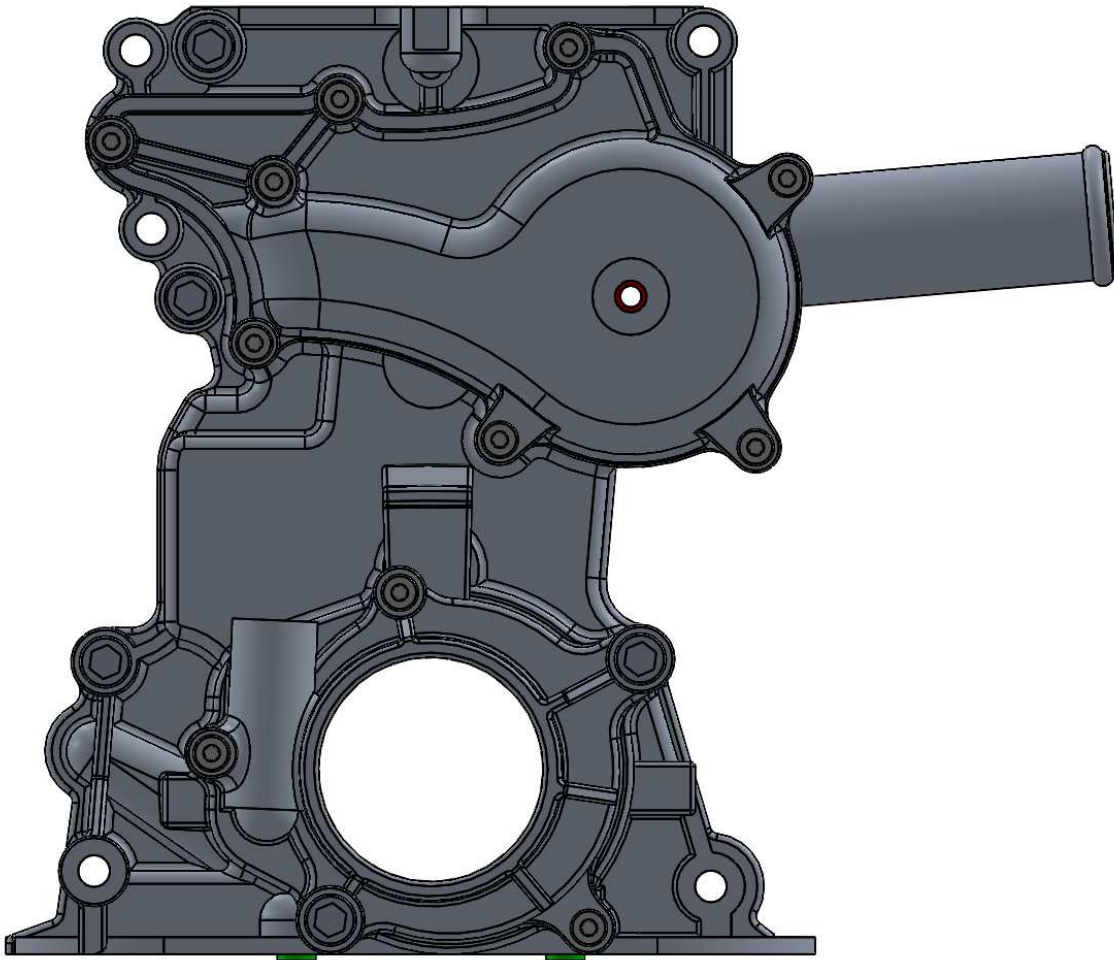
Drivers Side



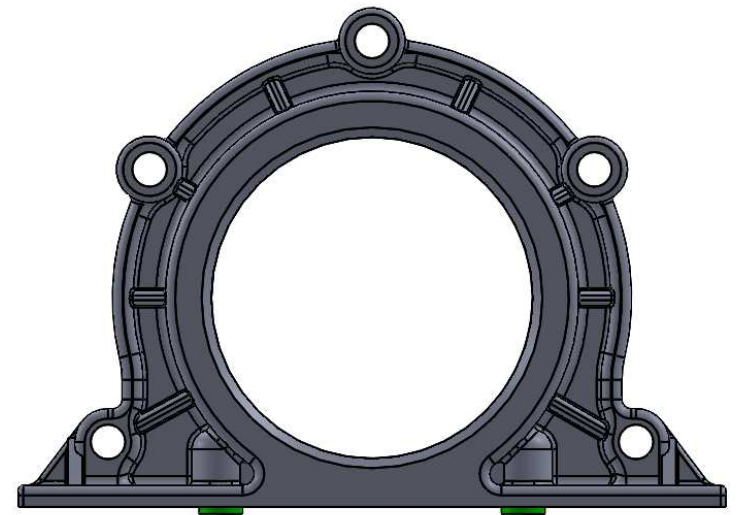
Passenger Side



Lower Intake Manifold

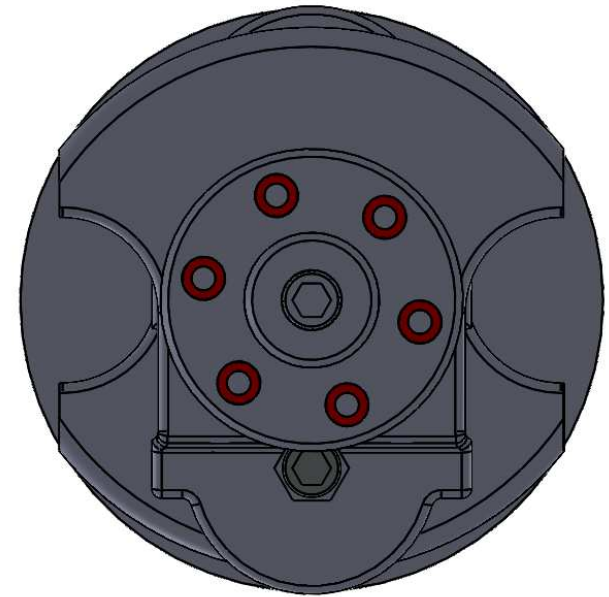
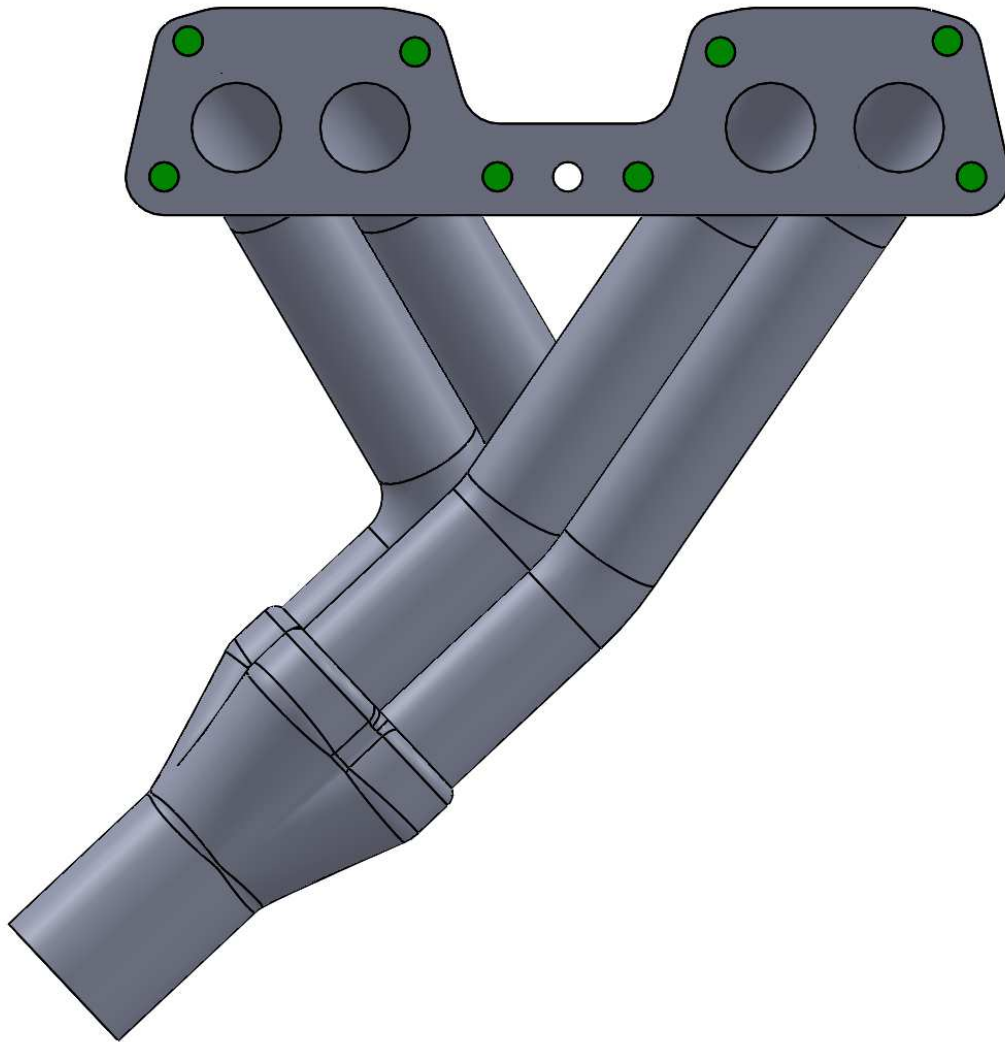


Timing Cover



Rear Main Seal

Exhaust Header

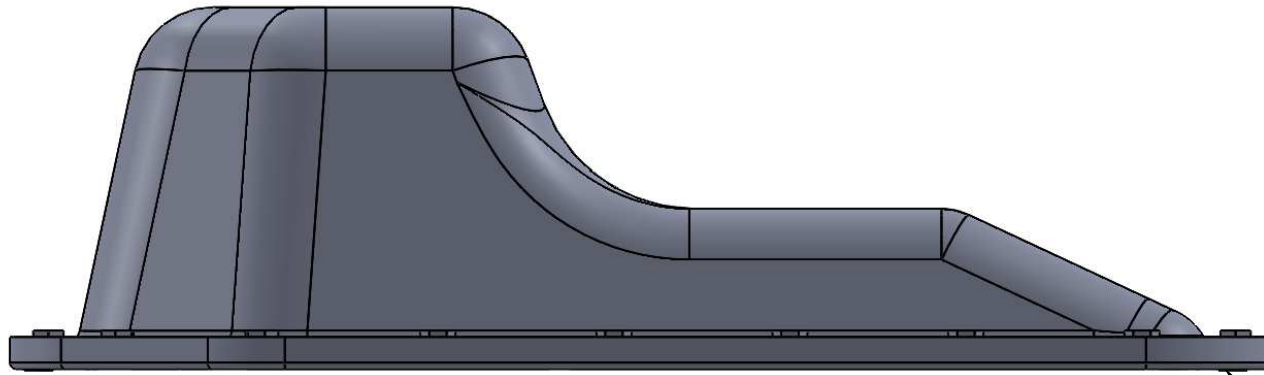


**Crankshaft
Rear Main Flange**

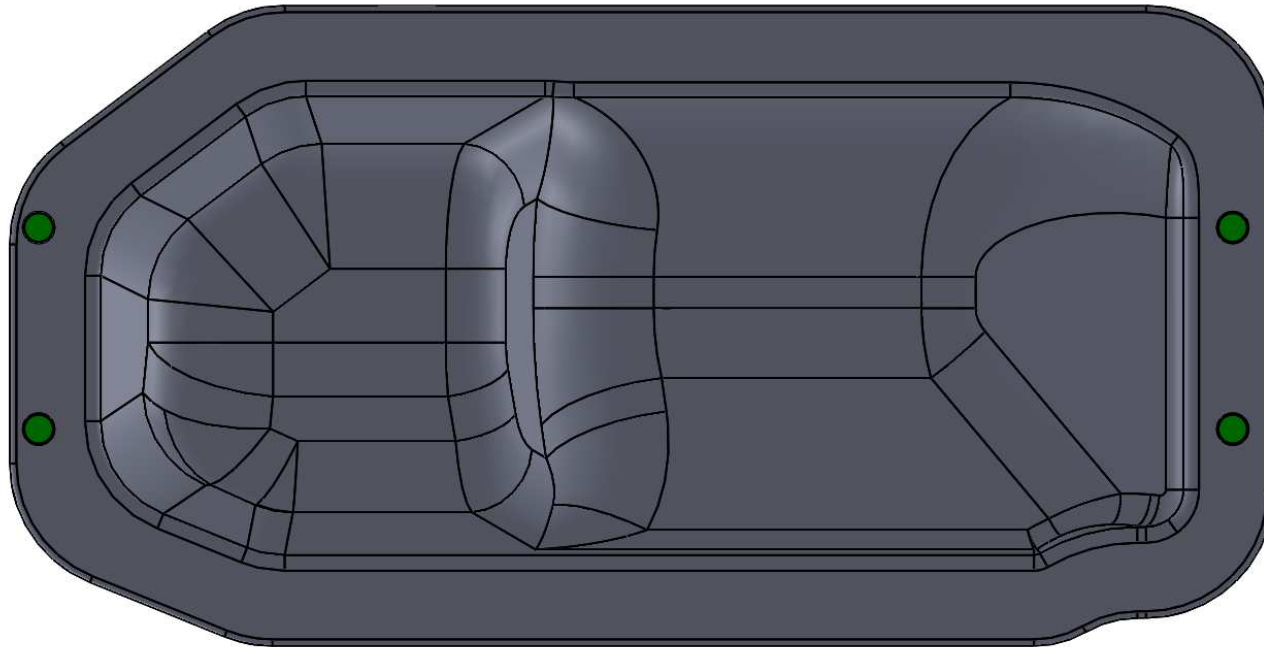


**Connecting Rod
(Bottom)**

Oil Pan

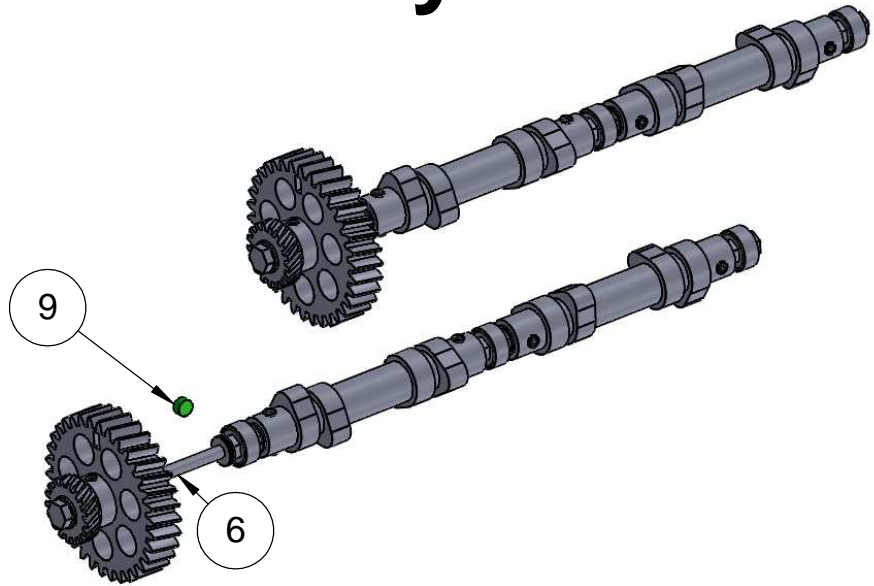


Magnets should be slightly raised from surface.

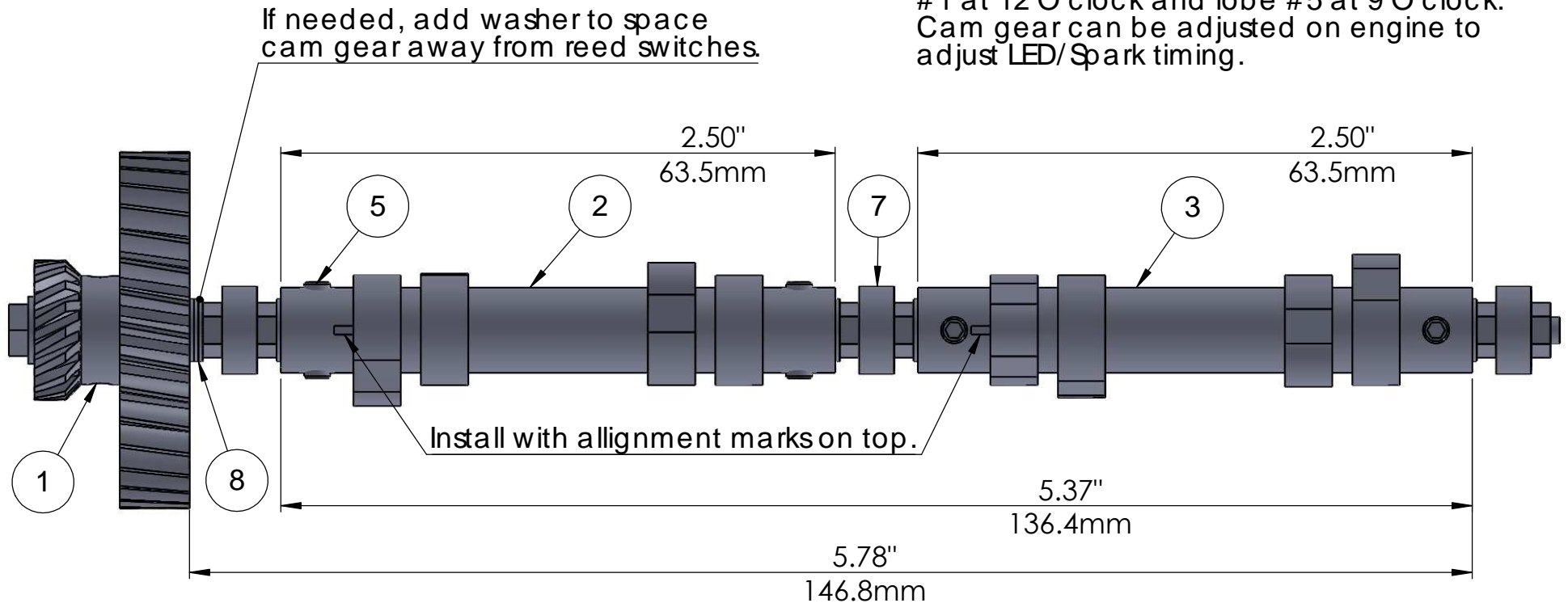


Camshaft Assembly

ITEM NO.	PART	QTY.
1	Cam Gear	1
2	Camshaft1	1
3	Camshaft2	1
4	M3 Nut	6
5	M3 4mm Set Screw	10
6	M3 x 175mm threaded rod	1
7	623zz bearing	3
8	3mm washer	7
9	4mm x 2mm disc magnet	1

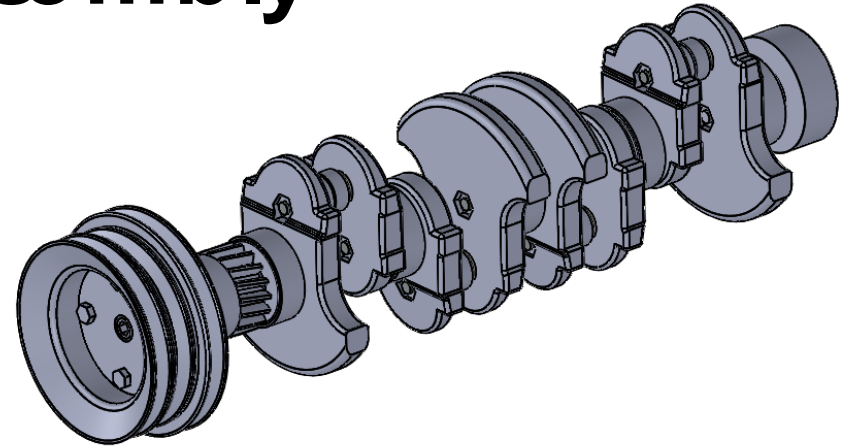
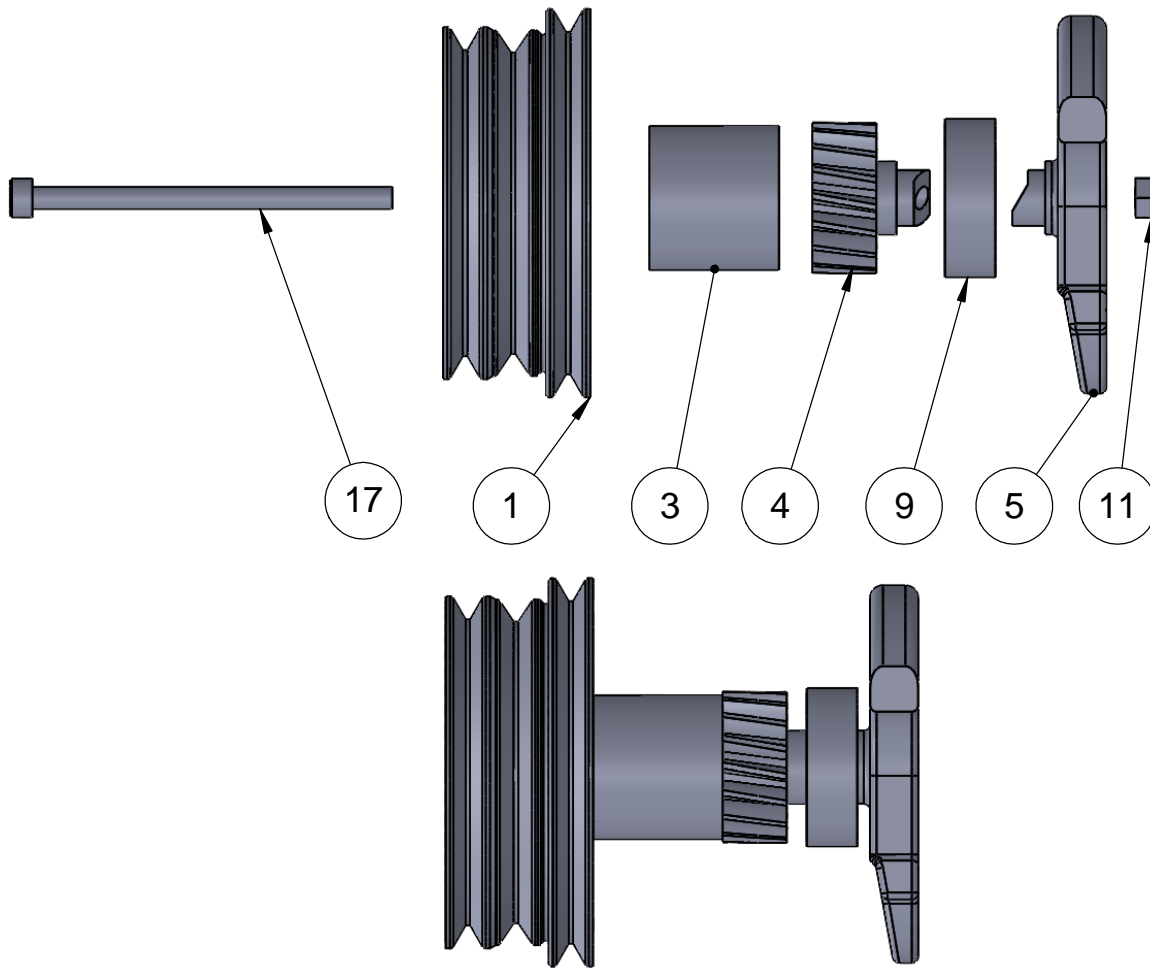


Note: For cam timing, place cam lobe #1 at 12 O'clock and lobe #5 at 9 O'clock. Cam gear can be adjusted on engine to adjust LED/Spark timing.



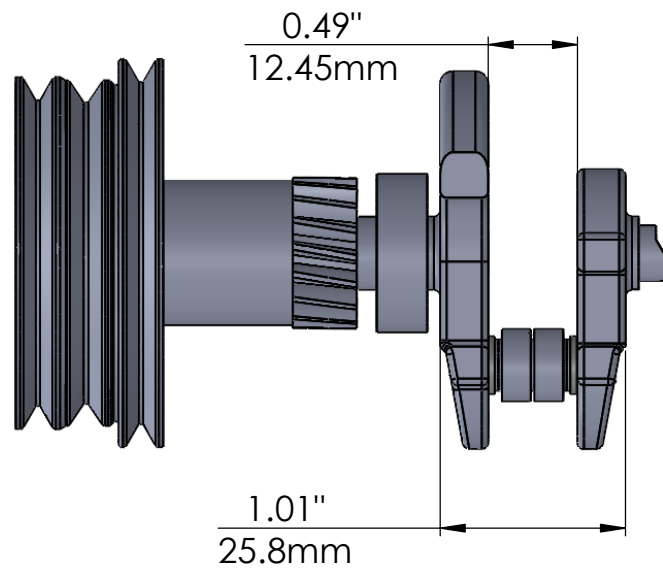
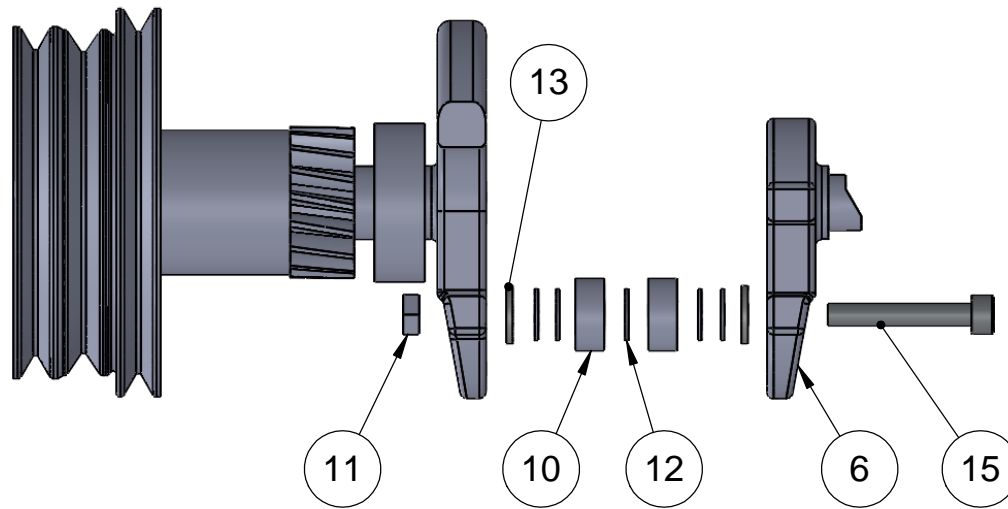
Crankshaft Assembly

Step 1

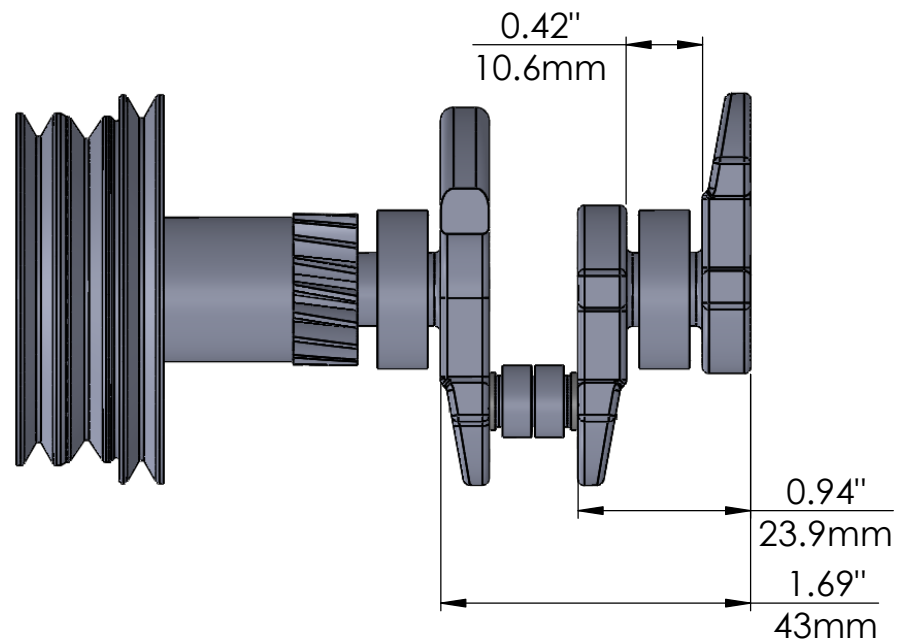
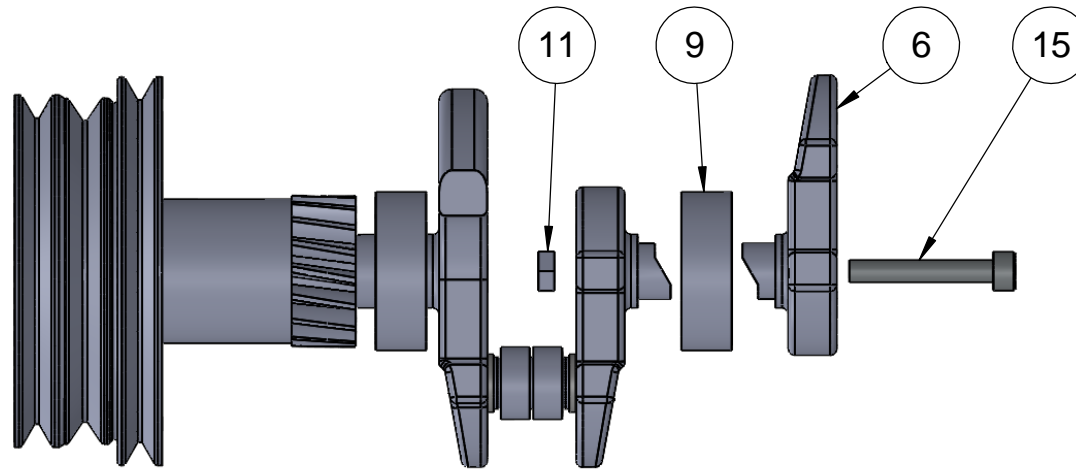


ITEM NO.	PART	QTY.
1	Crank pulley	1
2	Crankend	1
3	Crank spacer	1
4	Crank gear	1
5	Crank 1	3
6	Crank 2	4
7	Crank 3	1
8	Crankshaft spacer .125	1
9	608zz bearing	5
10	623zz bearing	8
11	M3 Nut	9
12	3mm washer	20
13	3mm Fender Washer	8
14	M3 x 3mm Threaded Insert	6
15	M3 x 20mm SHCS	7
16	M3 x 30mm SHCS	1
17	M3 x 50mm SHCS	1

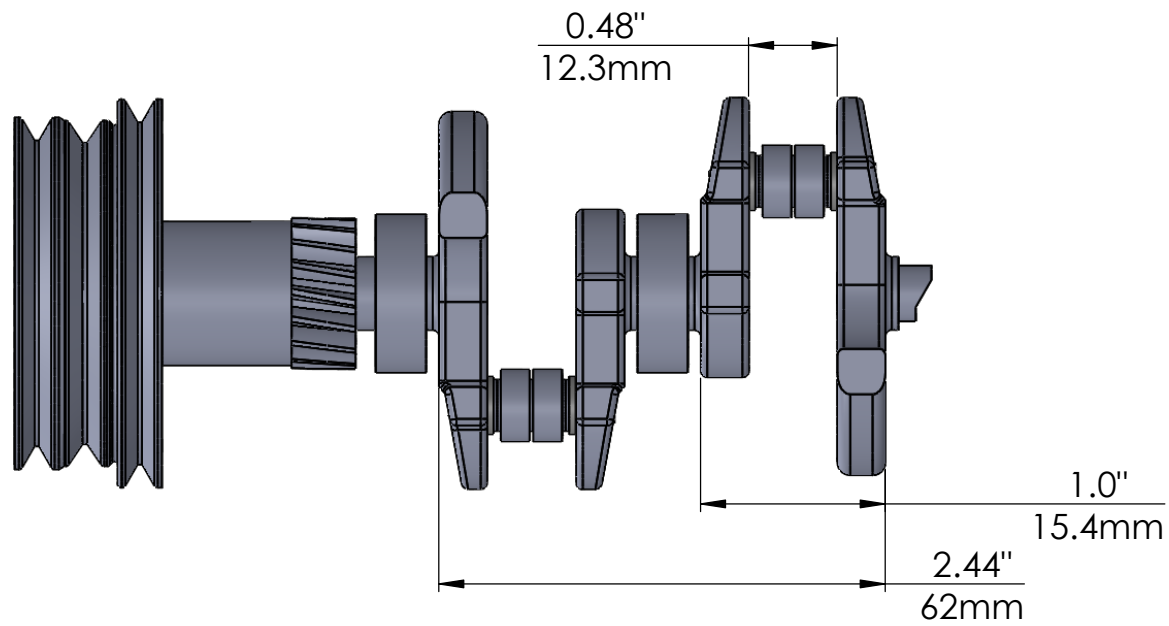
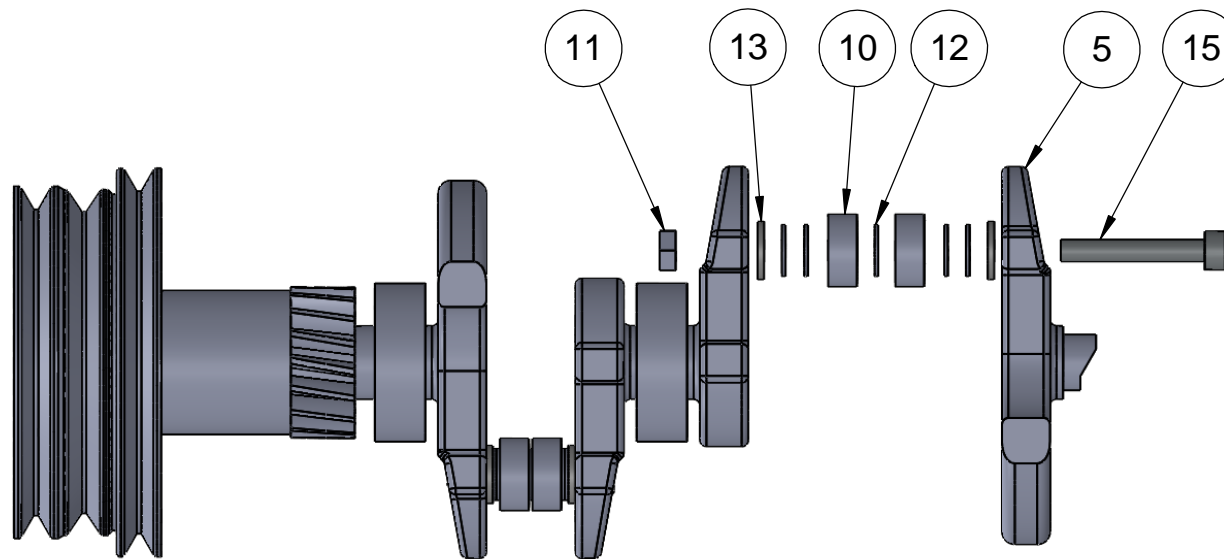
Step 2



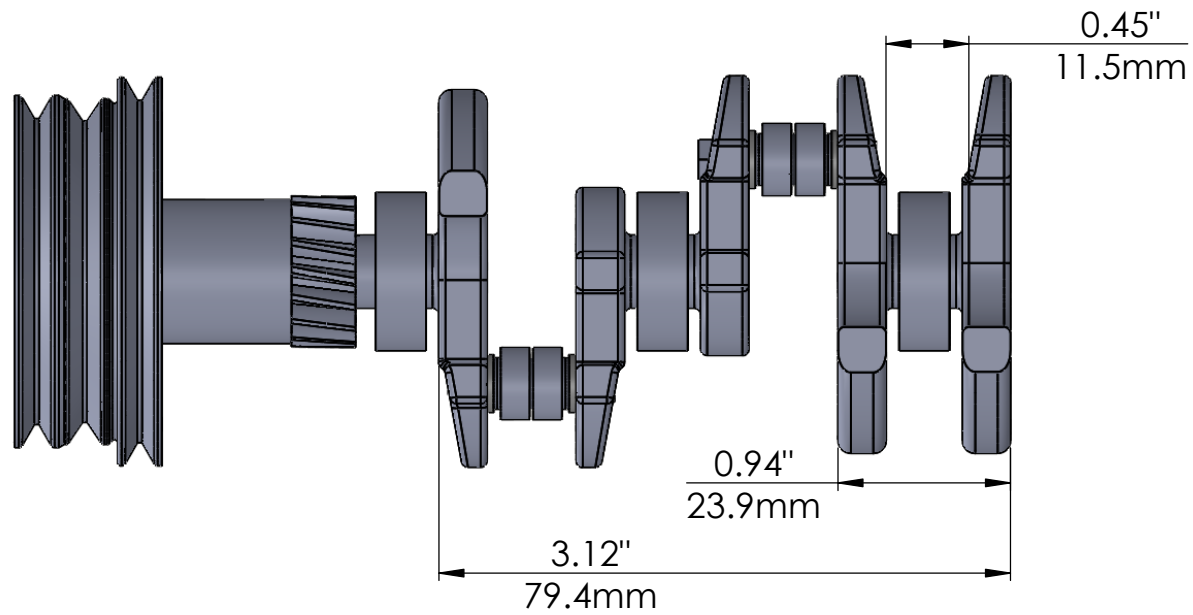
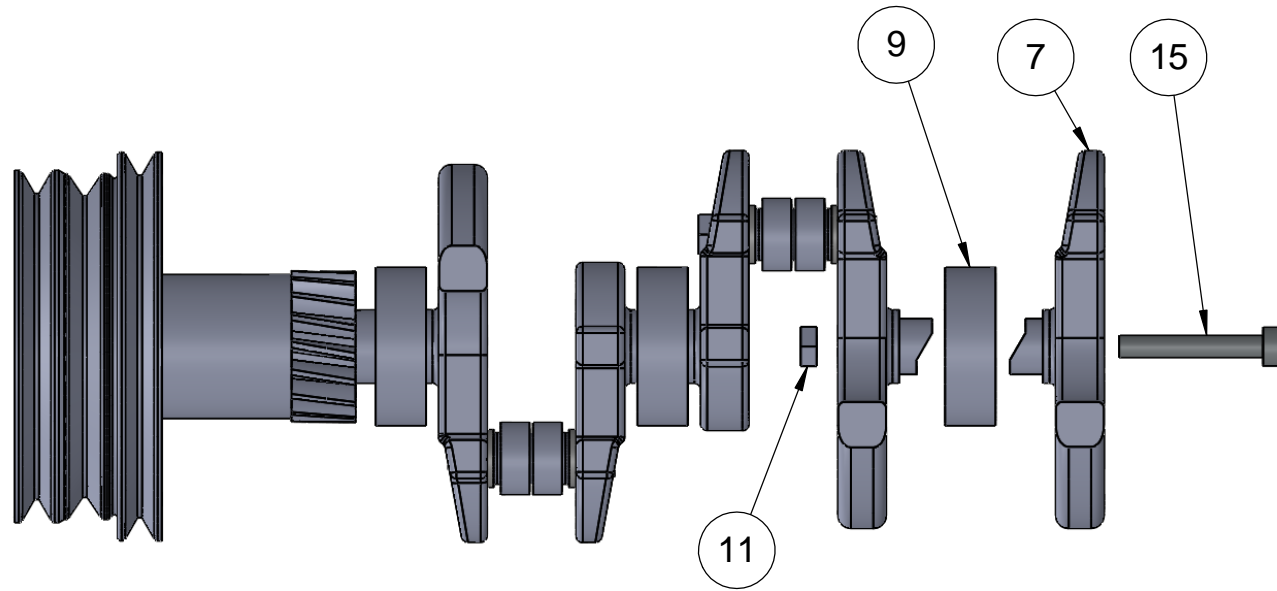
Step 3



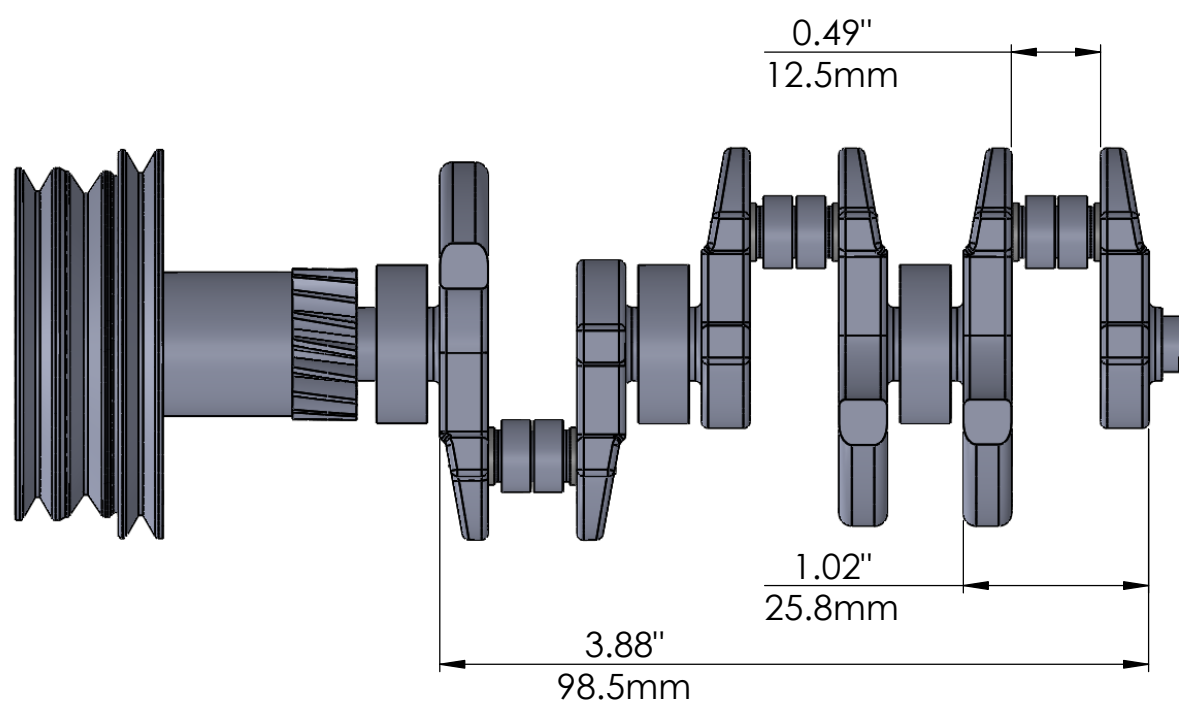
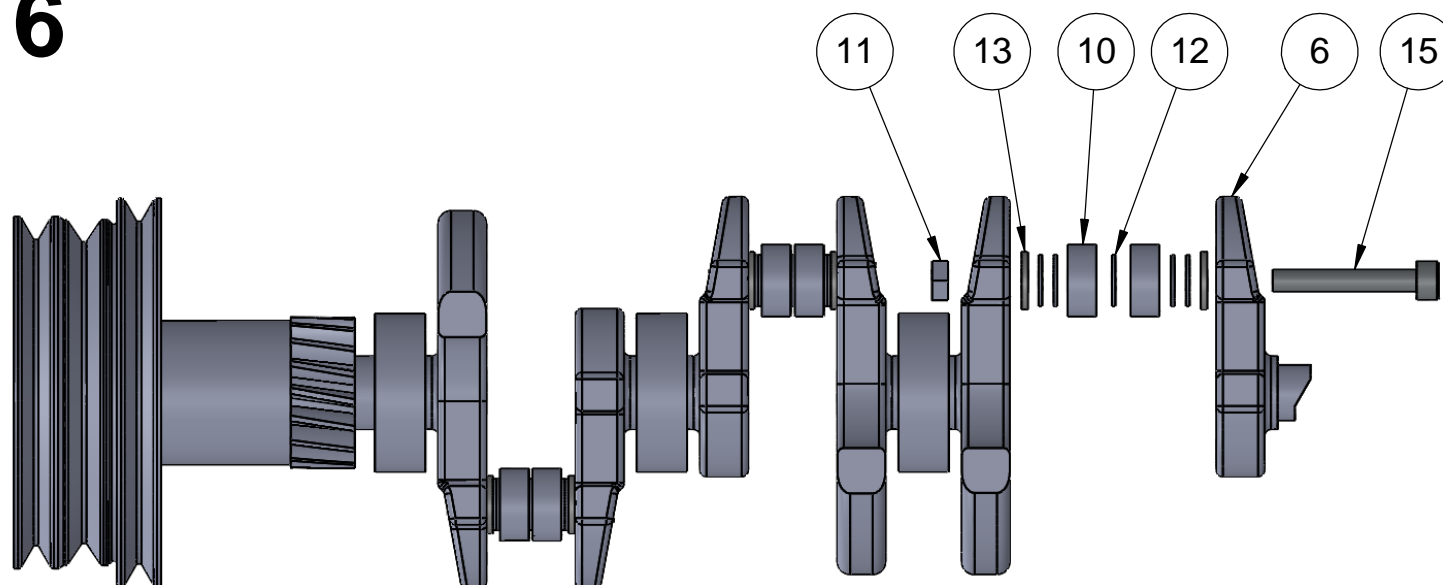
Step 4



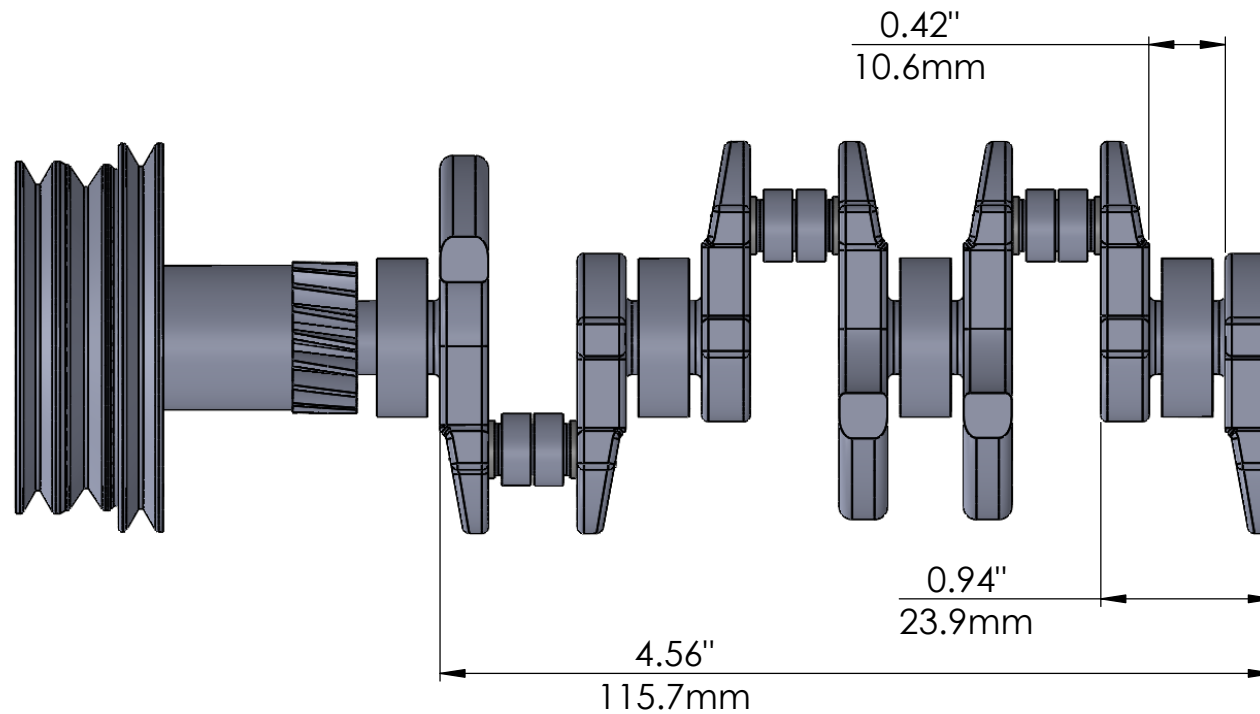
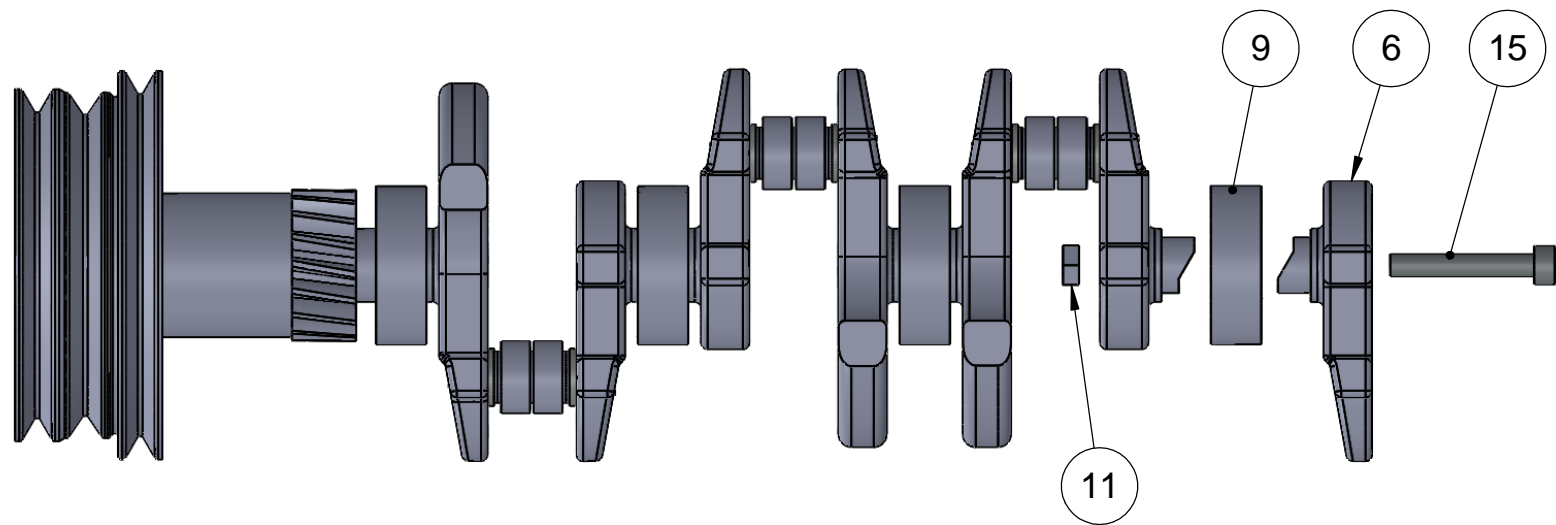
Step 5



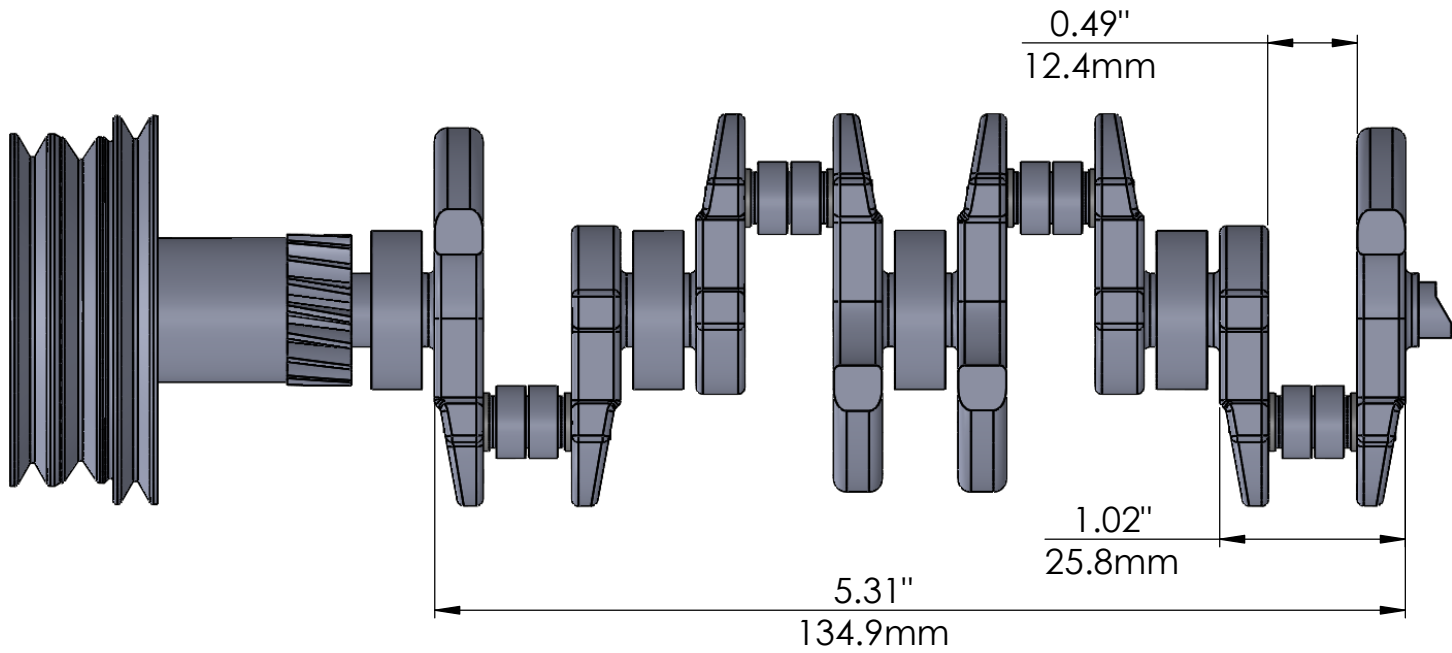
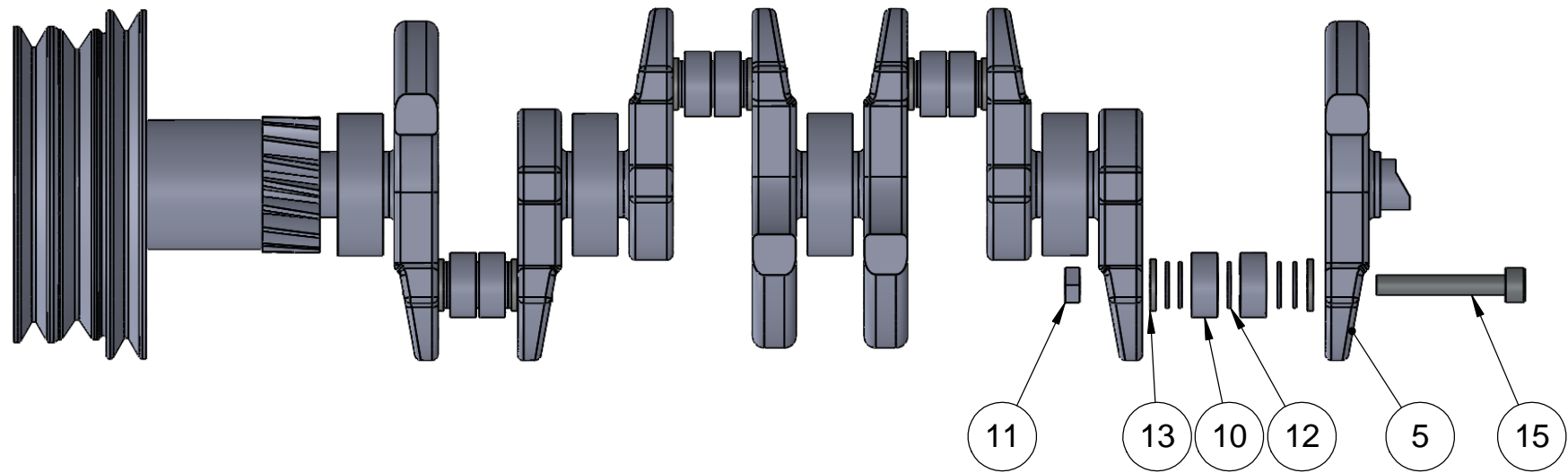
Step 6



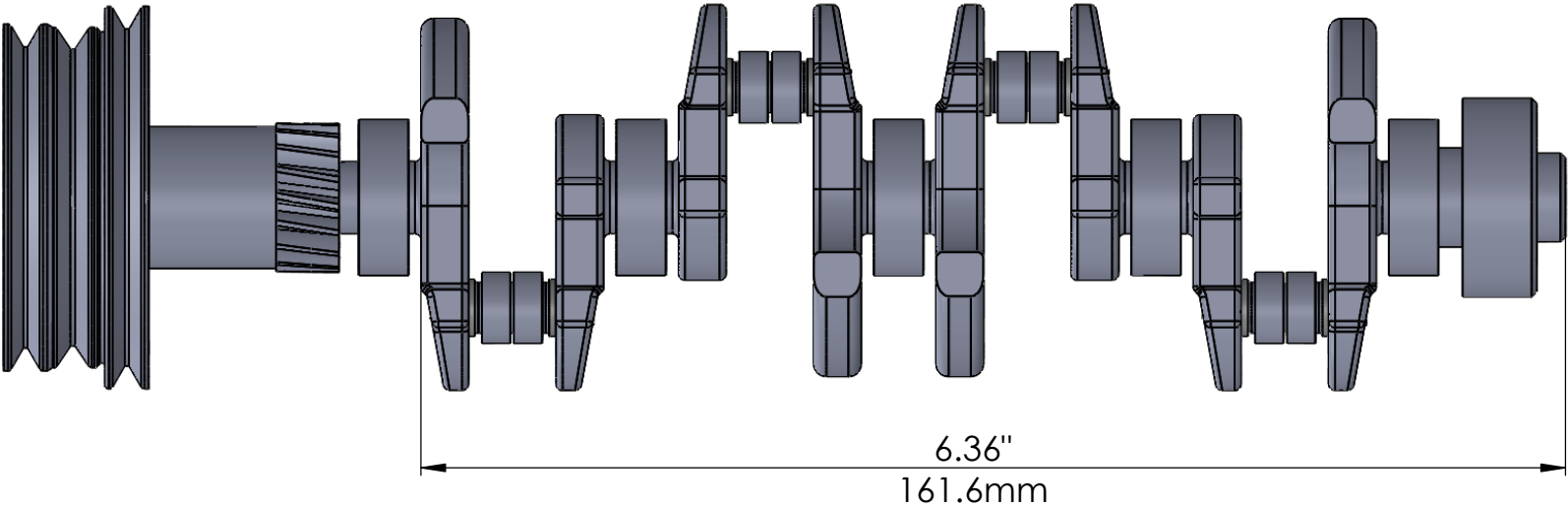
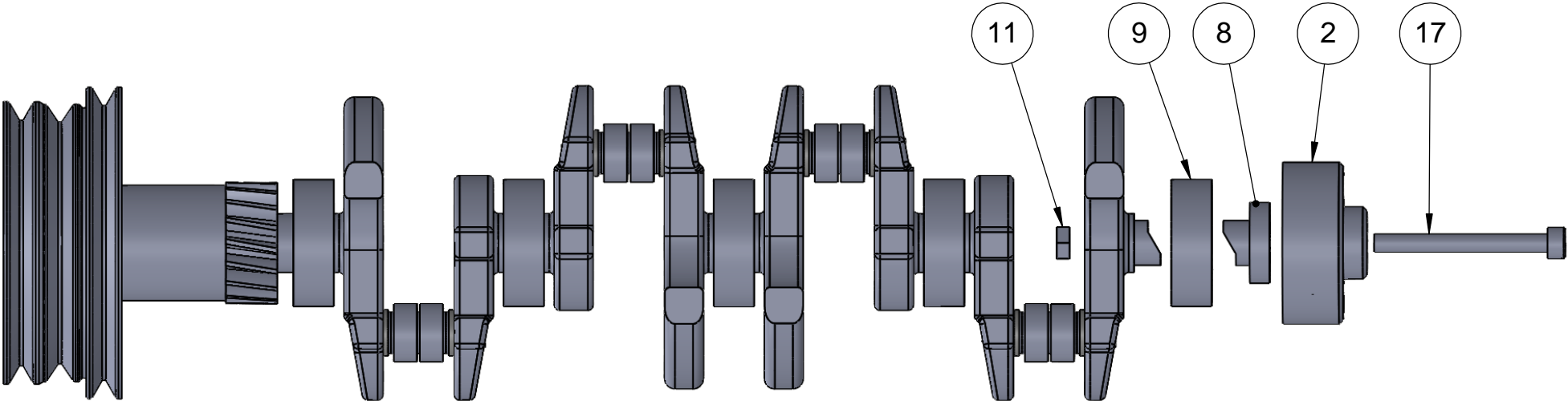
Step 7



Step 8

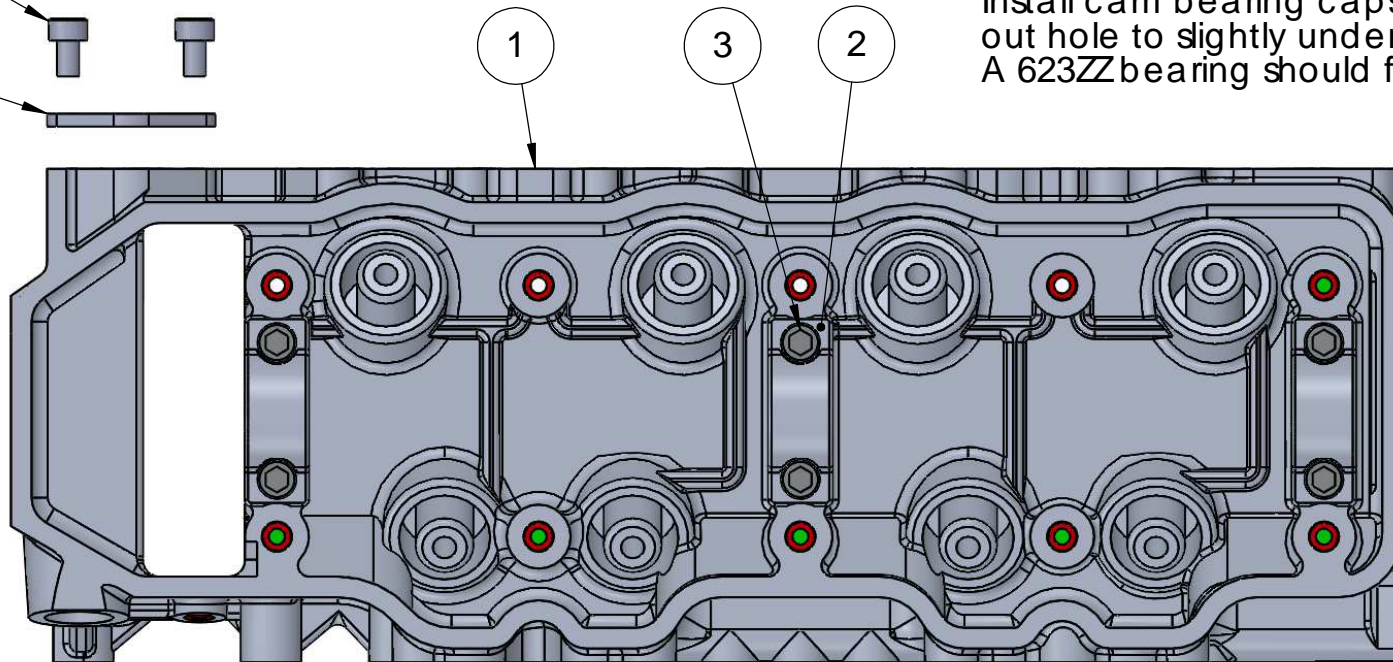
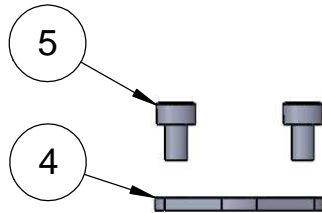
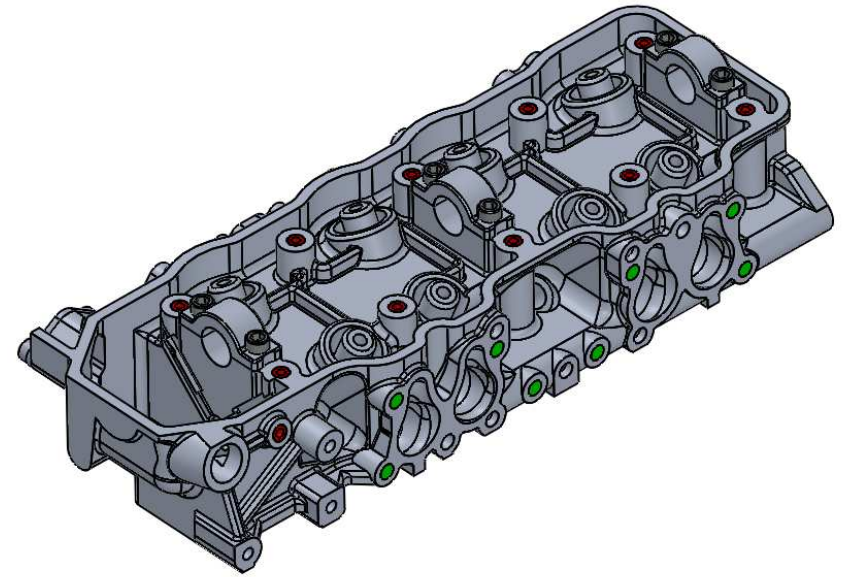


Step 9



Head Assembly

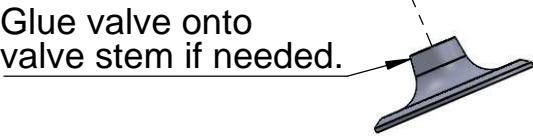
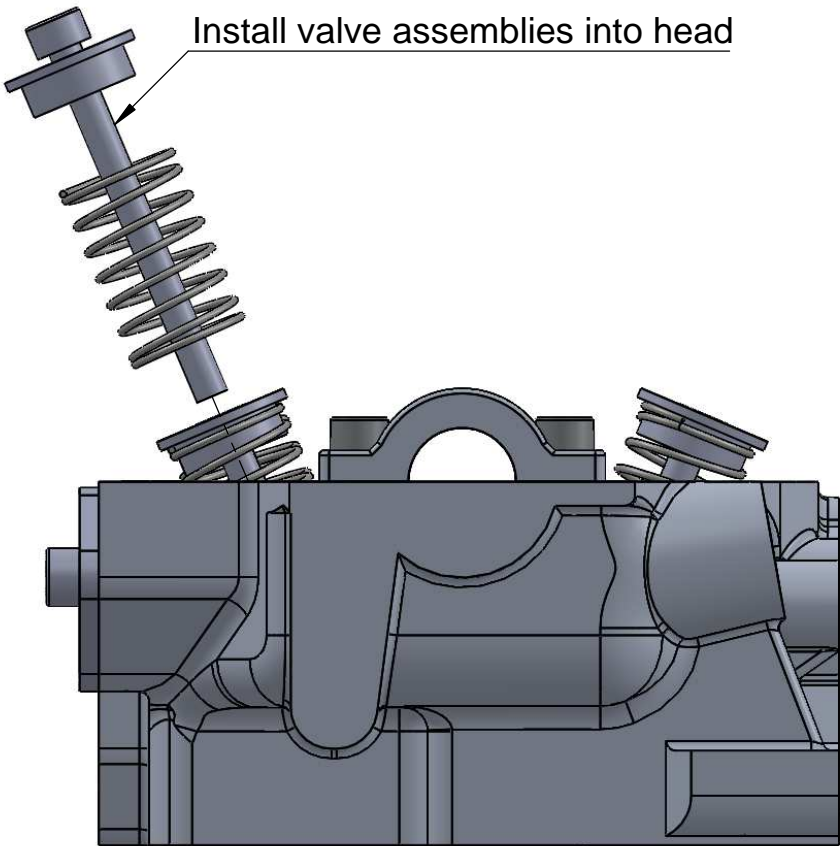
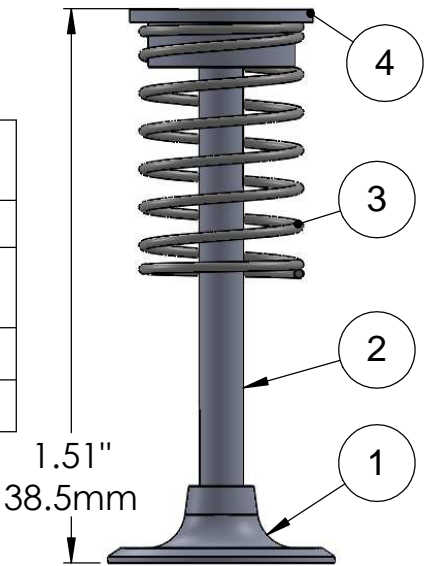
ITEM NO.	PART	QTY.
1	Head Insert and Magnet Assembly	1
2	Cam bearing cap	3
3	M3 x 8mm SHCS	6
4	Fuel pump block off plate	1
5	M3 x 5mm SHCS	2



Install cam bearing caps and ream out hole to slightly under 10mm.
A 623ZZ bearing should fit tightly.

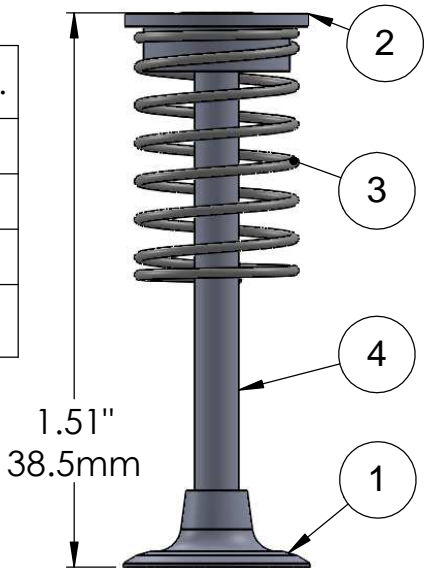
Intake Valve

ITEM NO.	PART	QTY.
1	Intake valve	1
2	M3 x 45mm SHCS cut down to 35mm	1
3	Valve Spring	1
4	Spring retainer	1



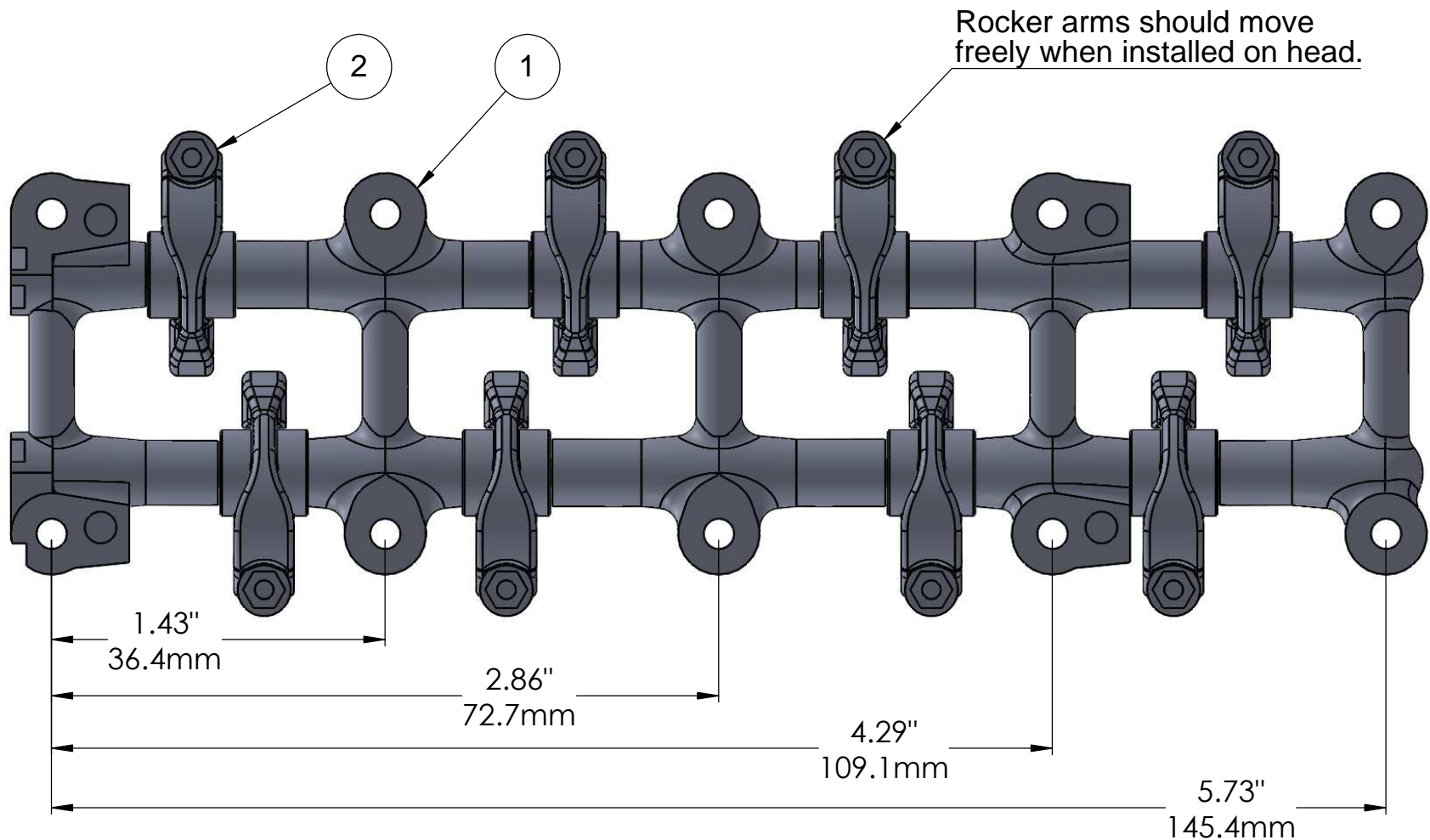
Exhuast Valve

ITEM NO.	PART	QTY.
1	Exhuast valve	1
2	Spring retainer	1
3	Valve Spring	1
4	M3 x 45mm SHCS cut down to 35mm	1



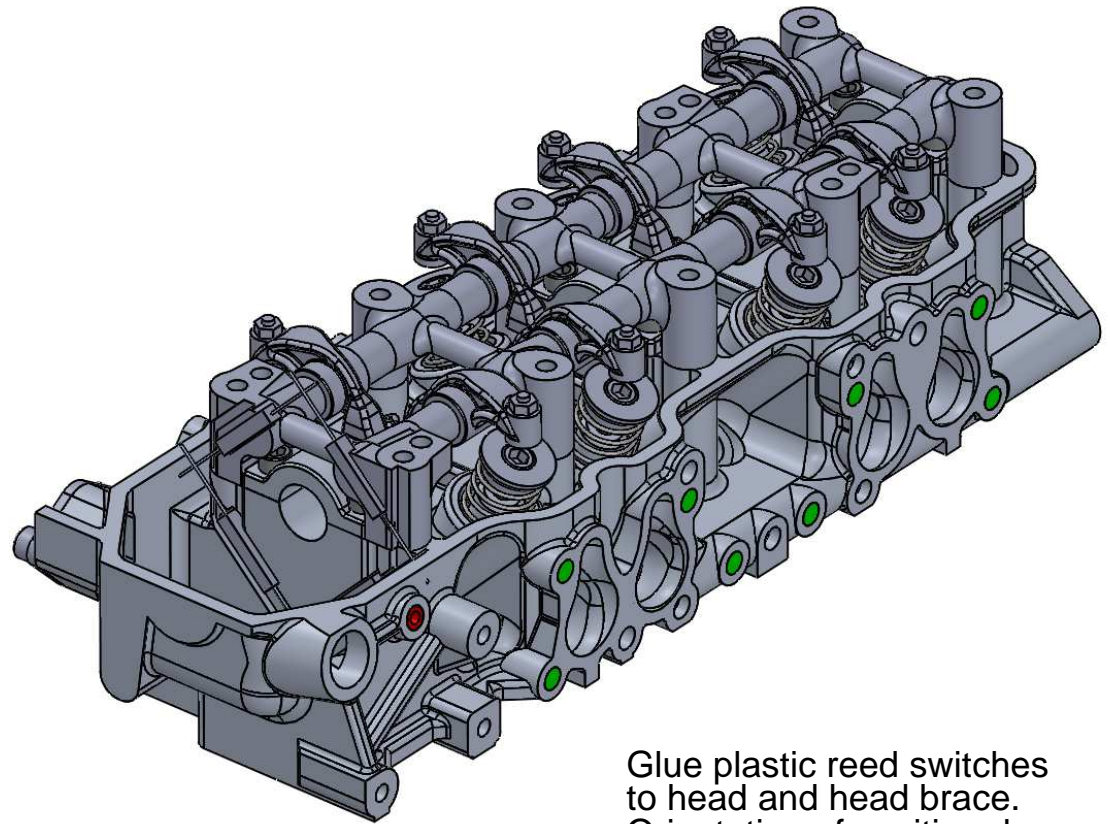
Head brace and rocker arm assembly

ITEM NO.	PART NUMBER	QTY.
1	Head brace	1
2	Rocker arm	8
3	3mm or .125 rod x 137.5mm	2

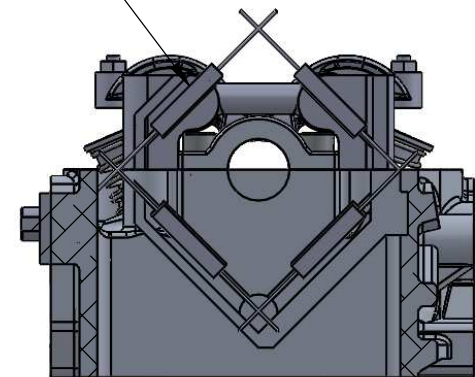
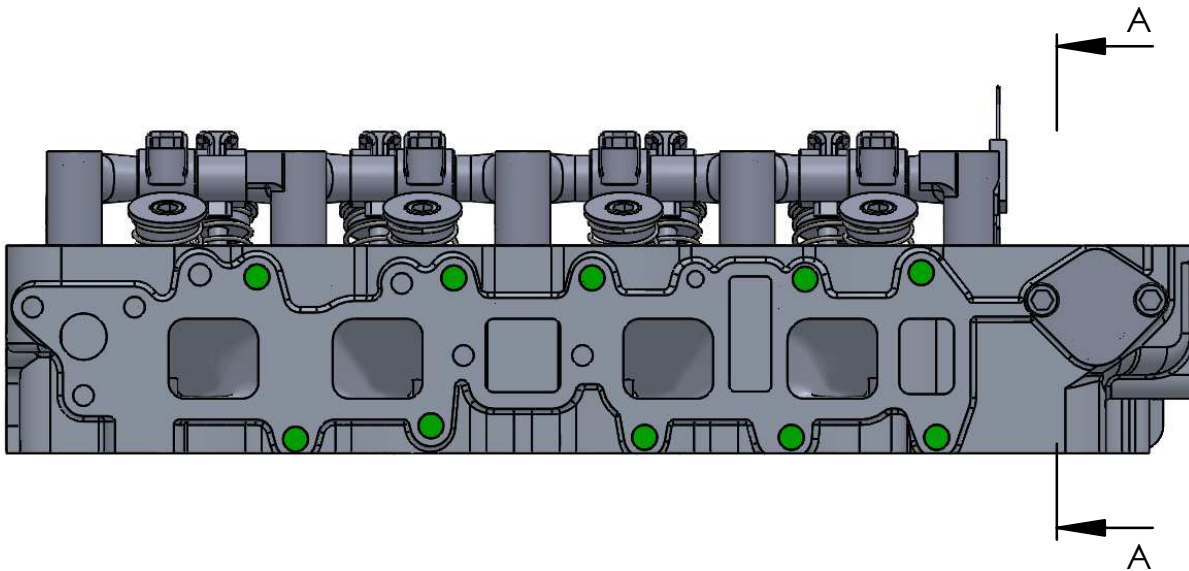


ITEM NO.	PART	Default/ QTY.
1	Head with Valve Spring Assemblies	1

Set Head brace and rocker
arm assembly on head.

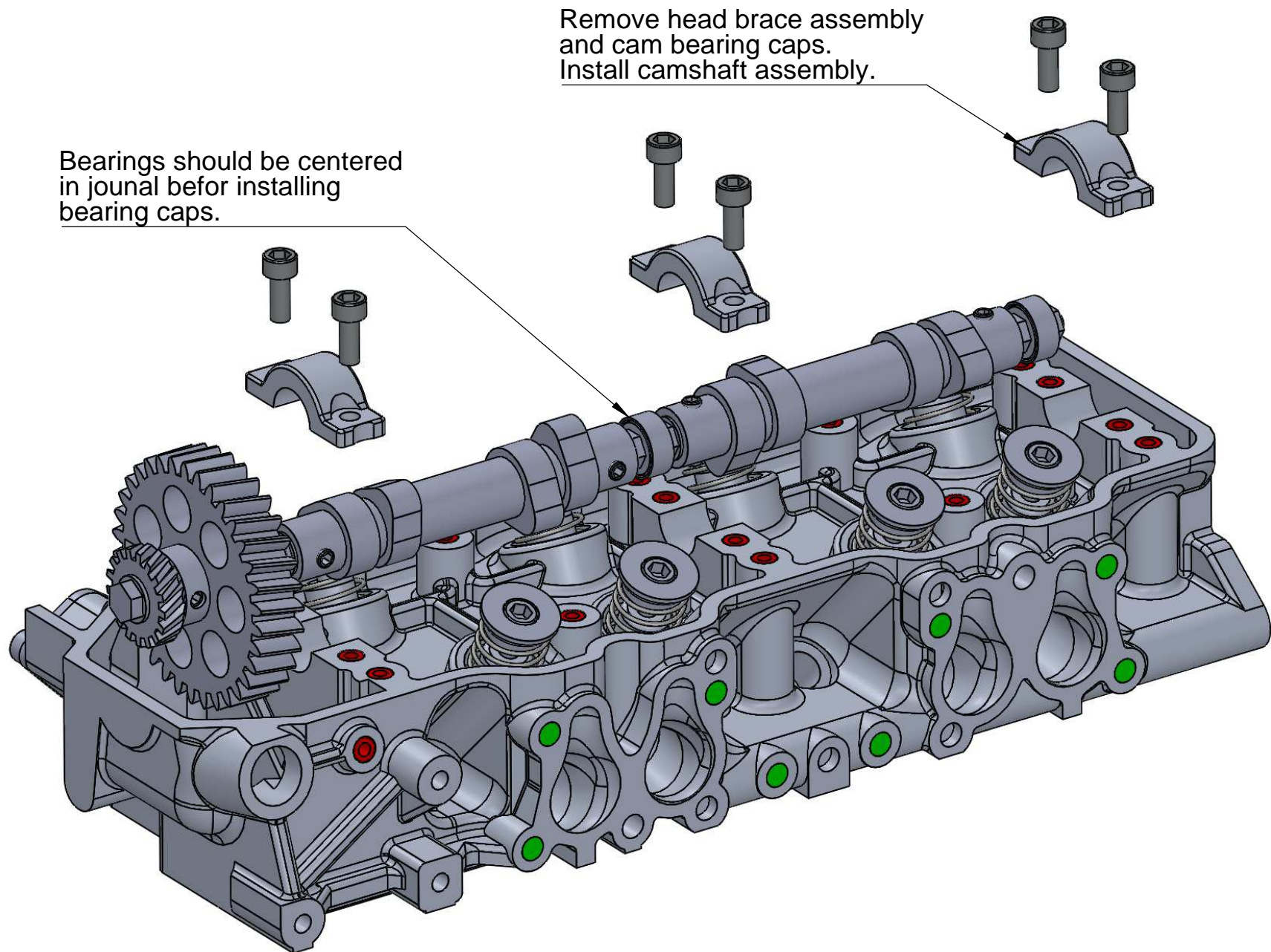


Glue plastic reed switches
to head and head brace.
Orientation of position does
not mater.



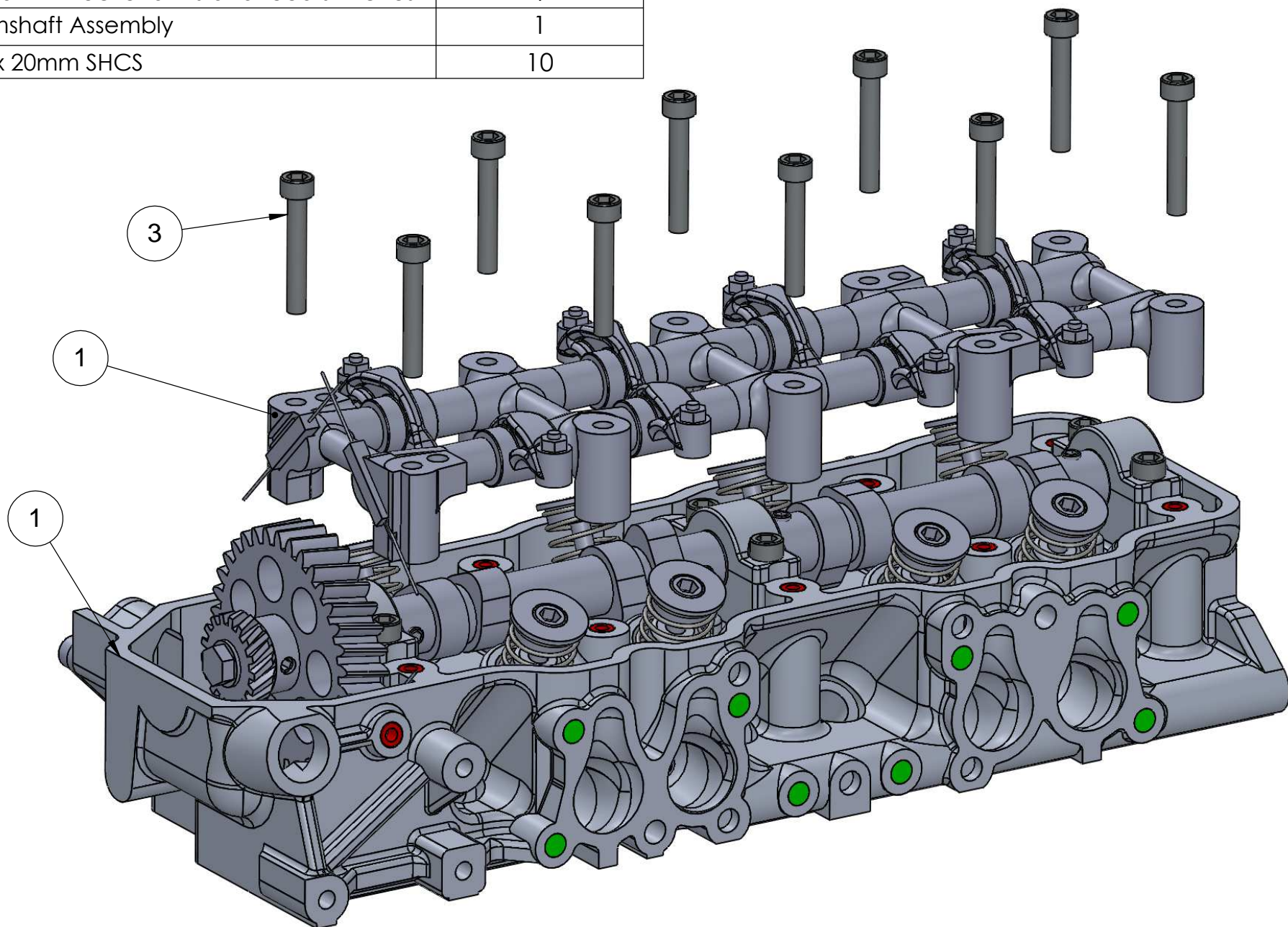
SECTION A-A

Camshaft Installation



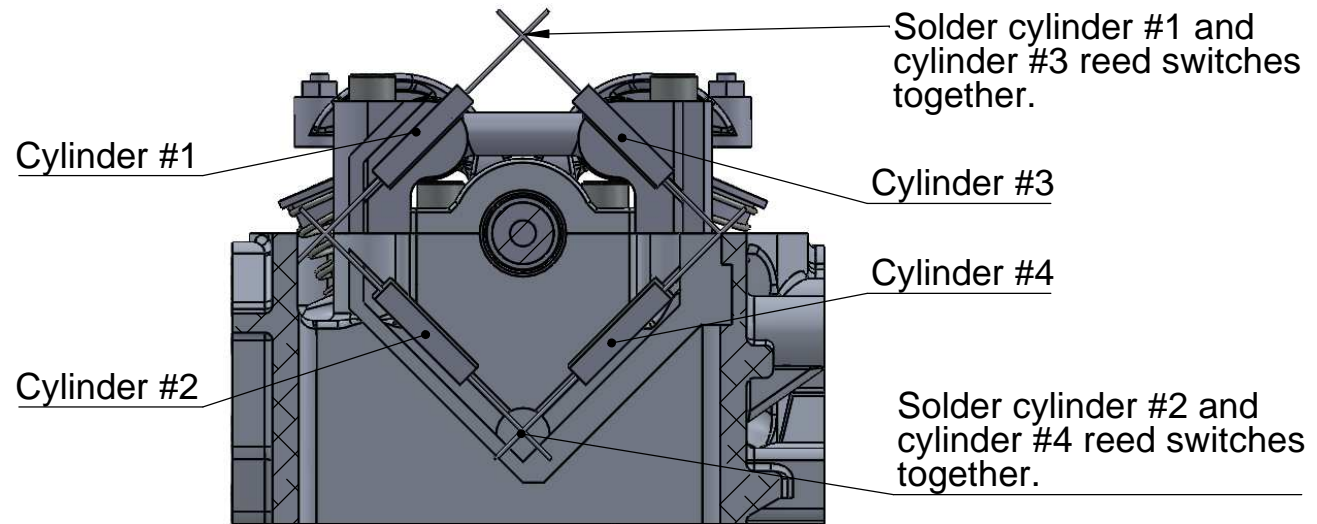
Head brace assembly installation

ITEM NO.	PART	QTY.
1	Head with rocker arms and reed switches	1
2	Camshaft Assembly	1
3	M3 x 20mm SHCS	10

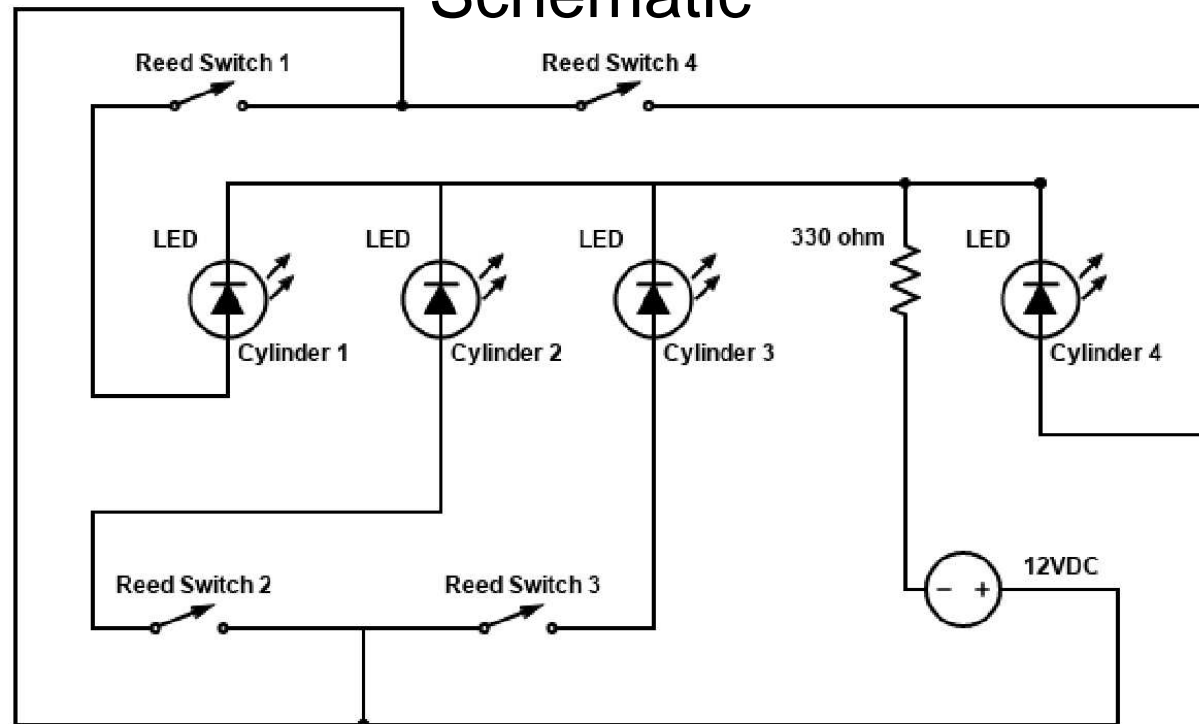


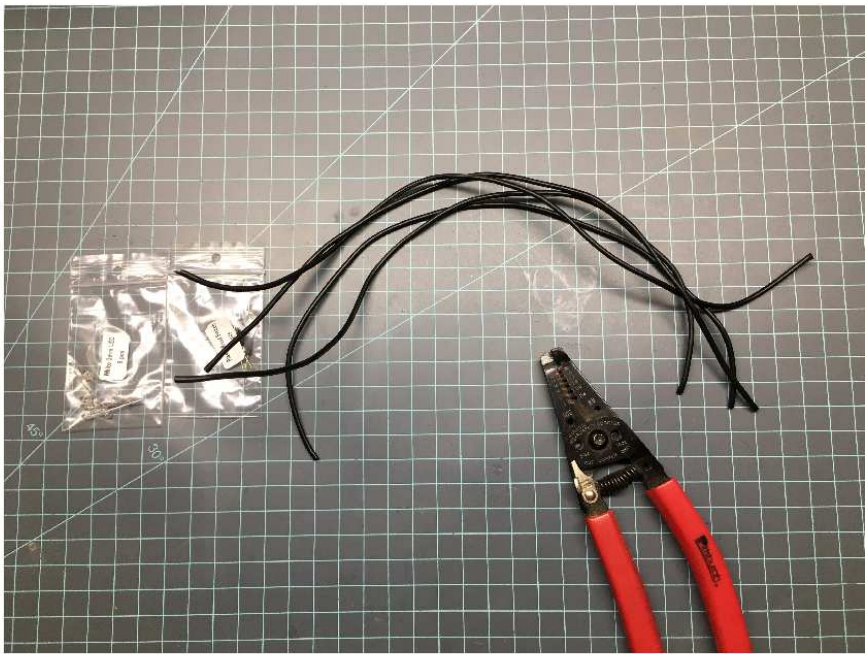
Spark plug wiring

Step 1:

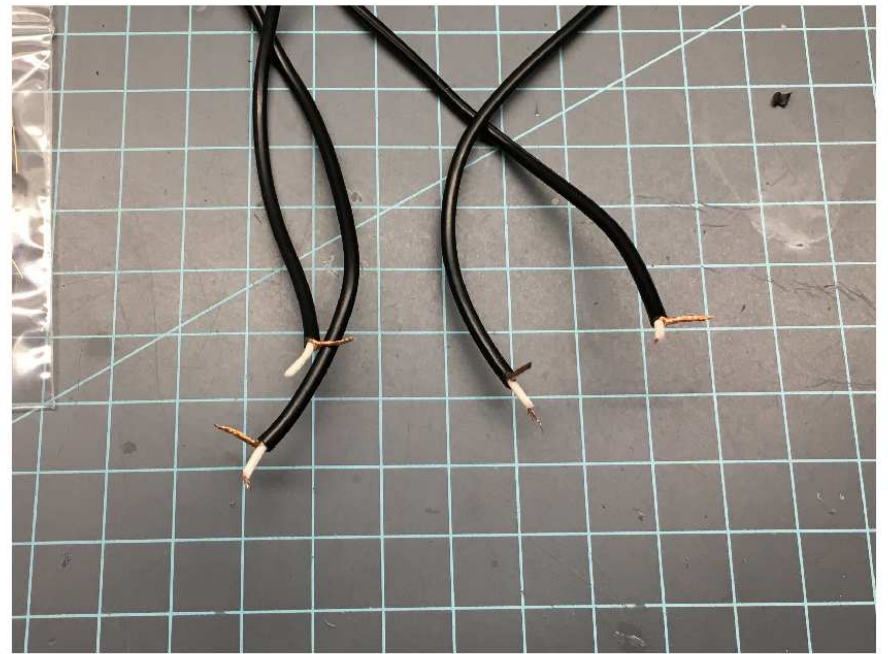


Schematic





Cut one 7 foot length of coaxial wire into four equal pieces. About 15 inches long each.



Strip one of each wire to expose both conductors.



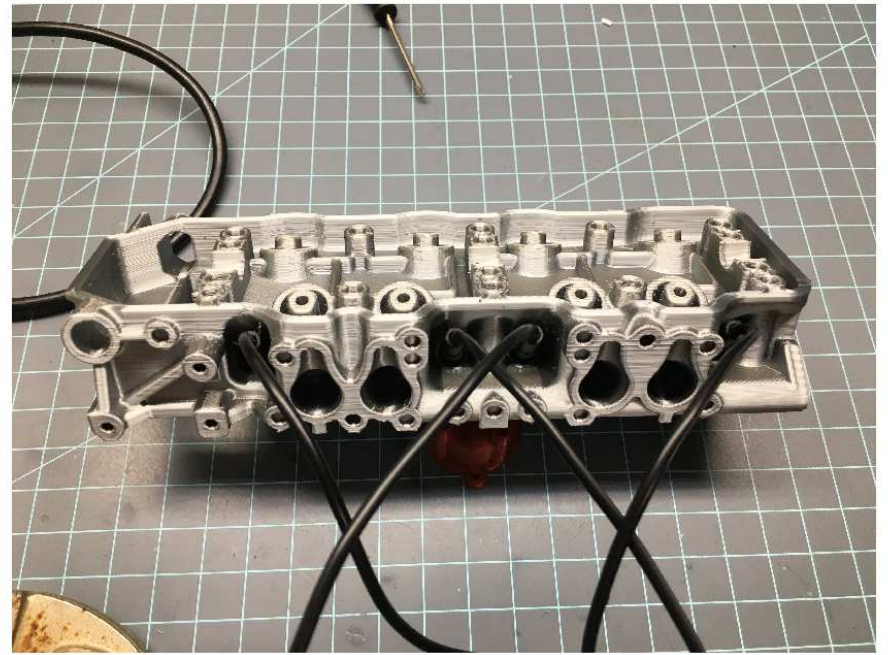
Solder negative side of LED to outer shielding wire on coaxial wire. (Negative is shorter leg)



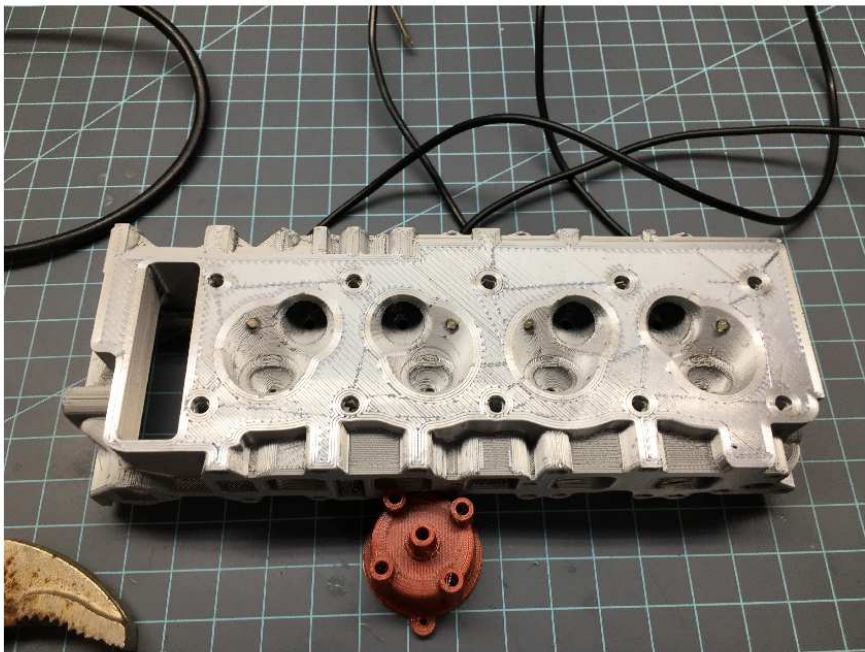
Slide spark plug boot on to coaxial wire.



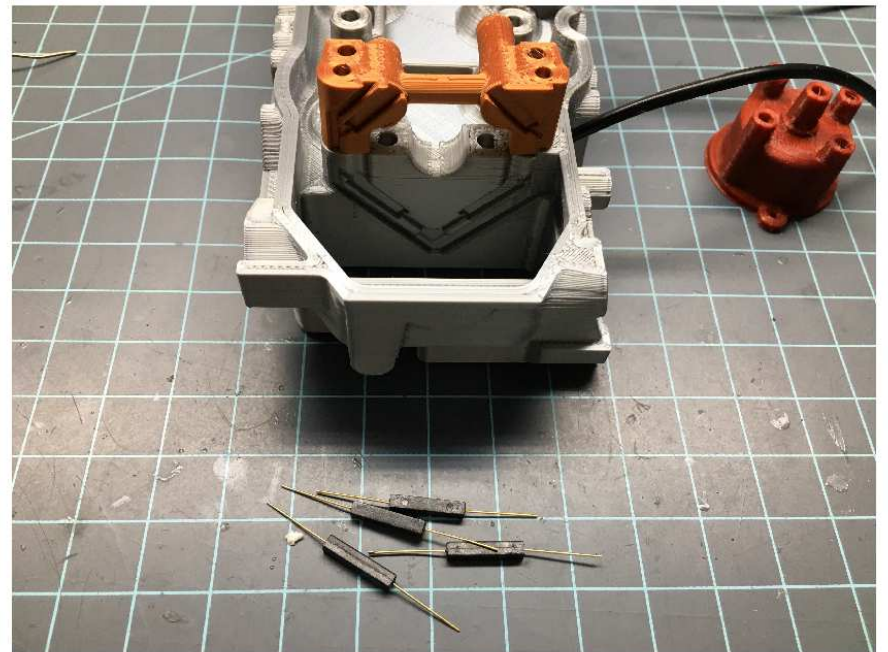
Glue base of LED to spark plug boot.



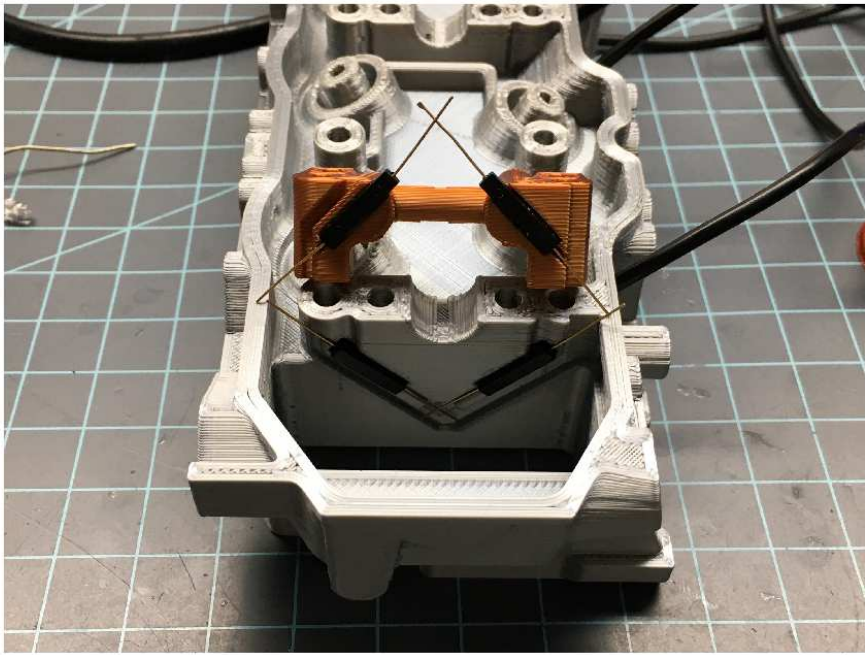
Insert spark plug boots into cylinder head.



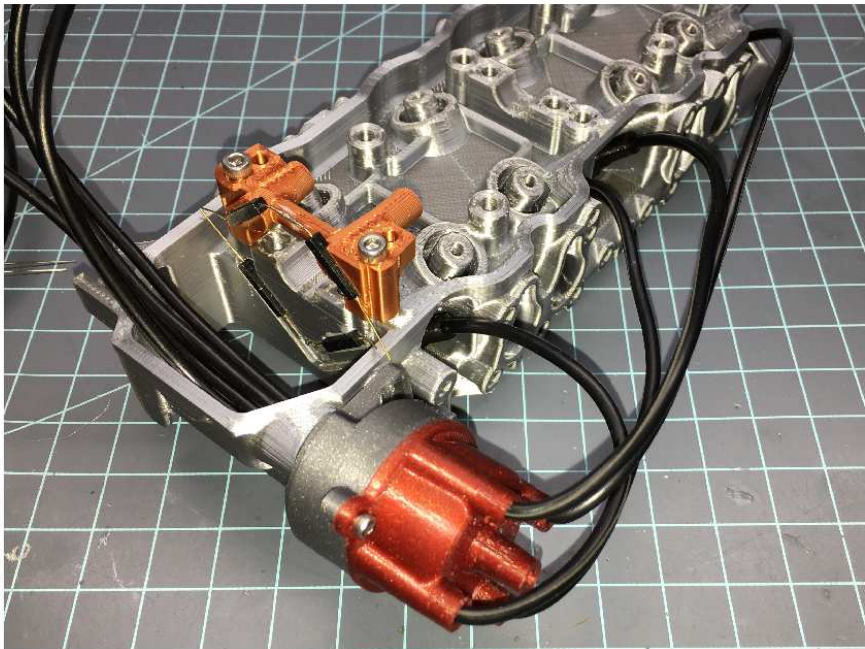
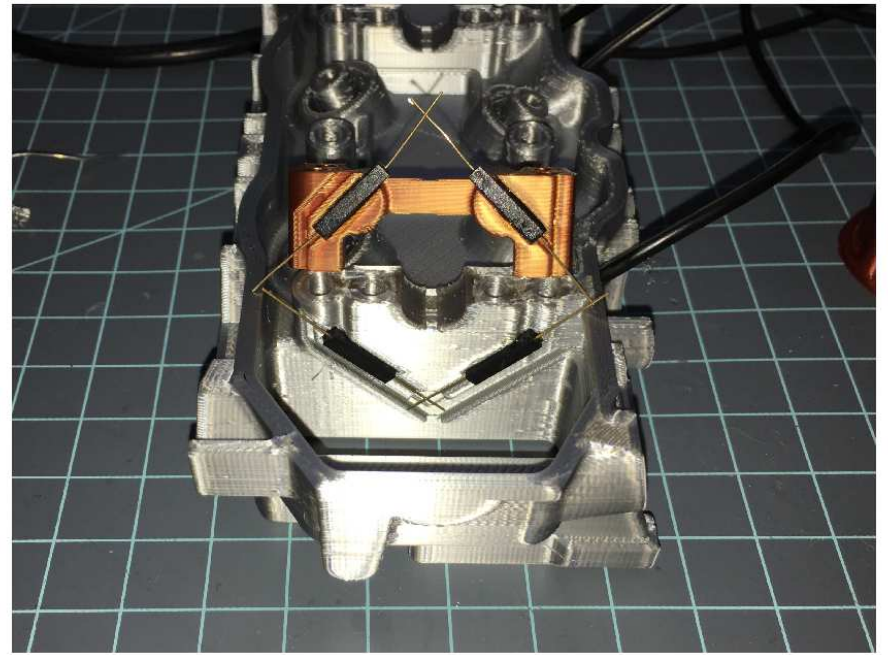
View from underside of head.



Set Front piece of head brace on cylinder head.



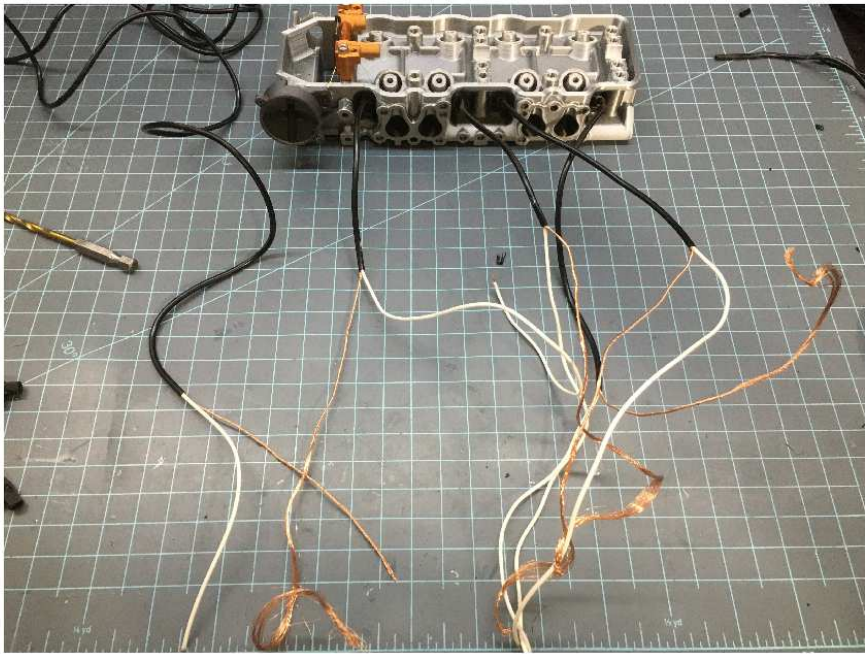
Glue plastic reed switches into place.



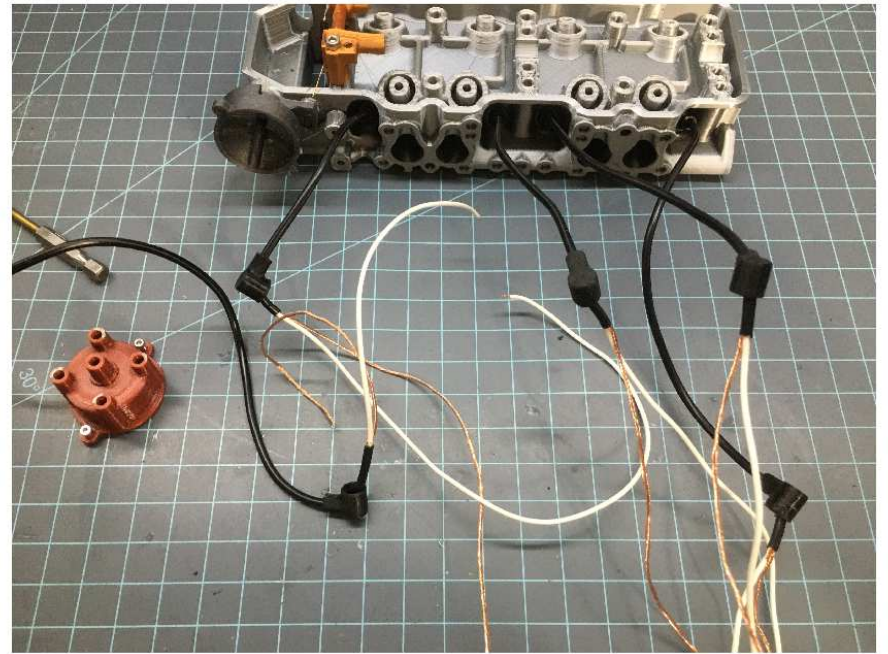
Pull spark plug wires through distributor and adjust to desired length. Firing order is 1-3-4-2.



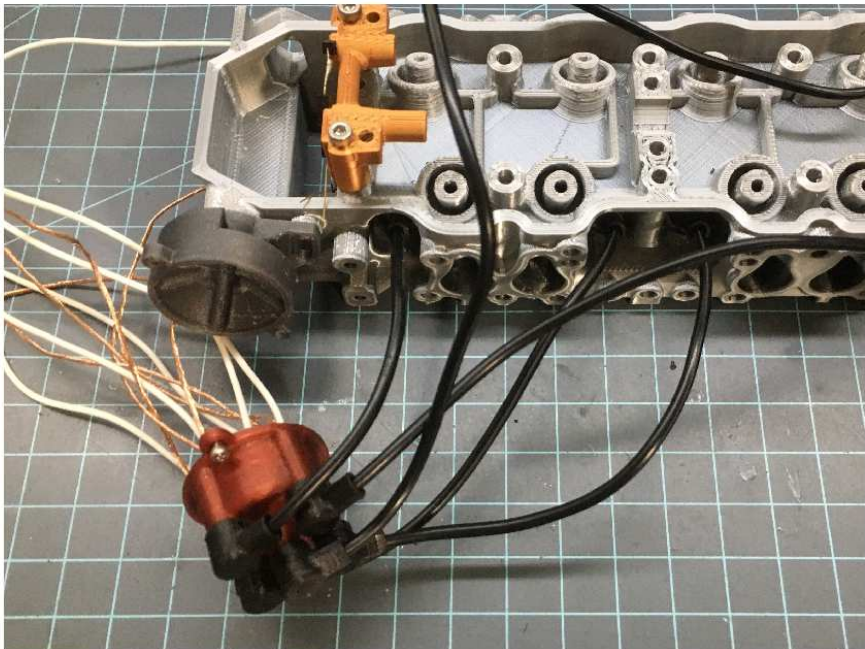
Mark coaxial wire where it goes into the distributor cap.



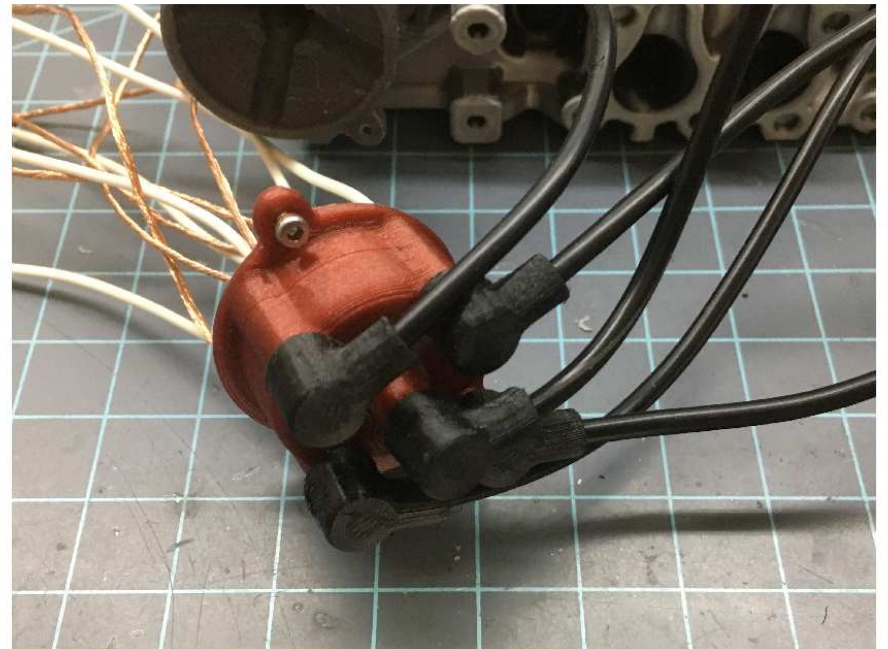
Strip the black insulation from the coaxial wire where marked. Remove about six inches of black insulation from second piece of 7 foot coaxial wire.

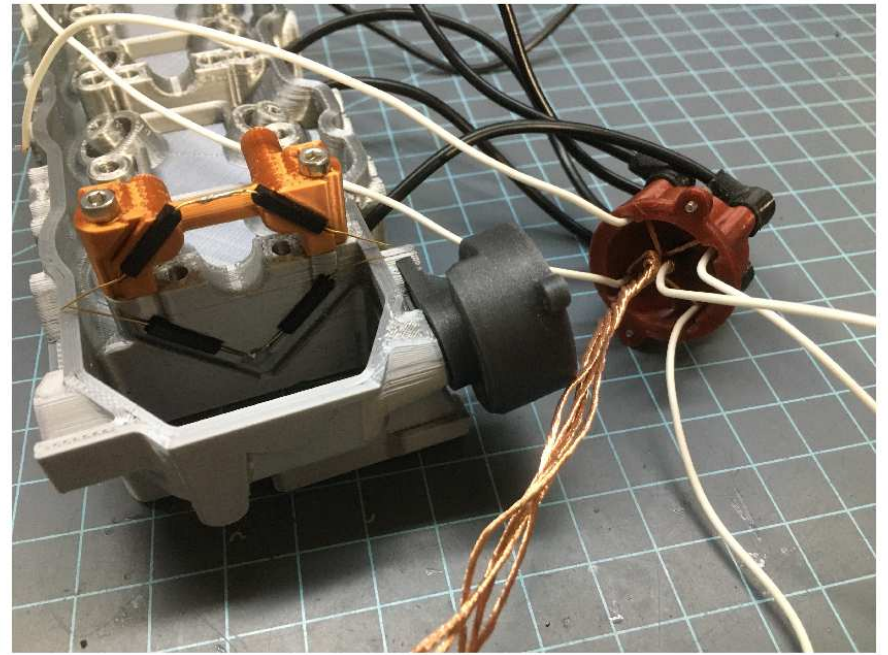
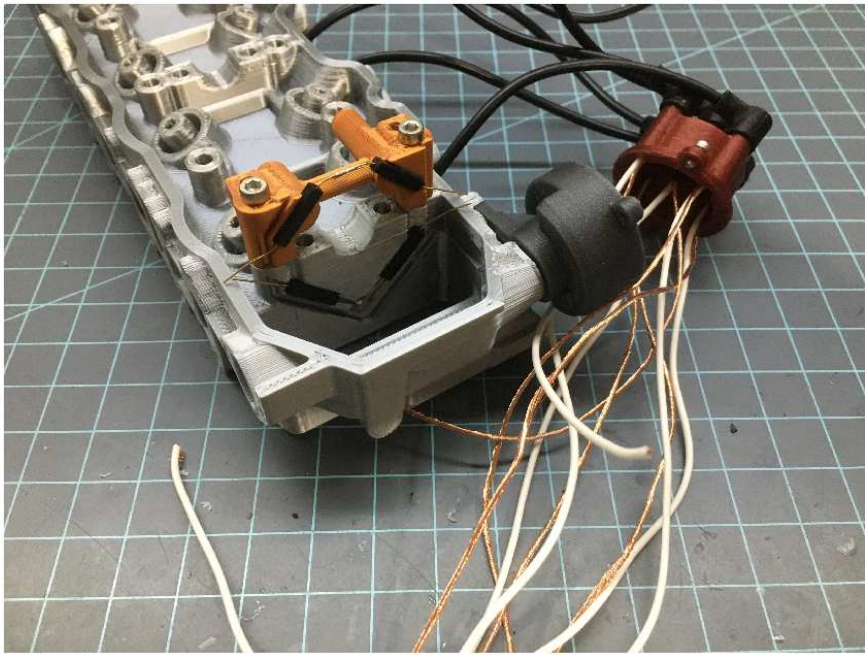


Install distributor boot covers on each wire.



Pull wires through the distributor cap. Firing order is 1-3-4-2.

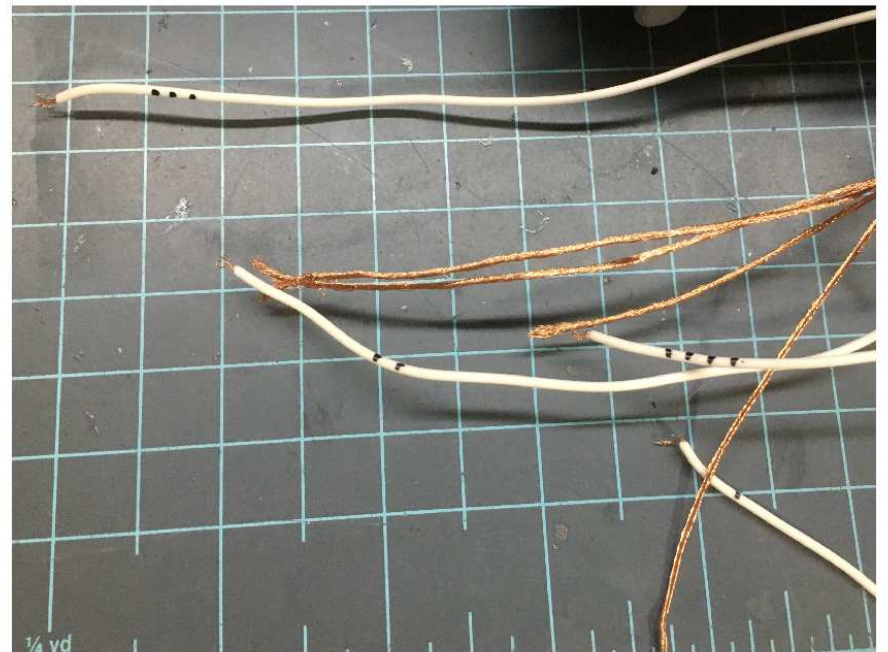




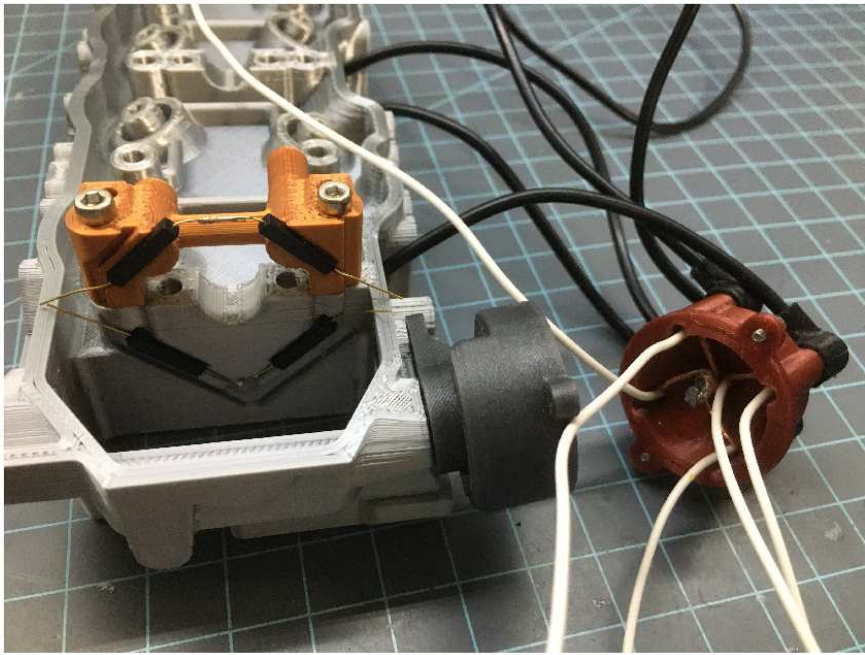
Twist the outer conductors from all five wires together.



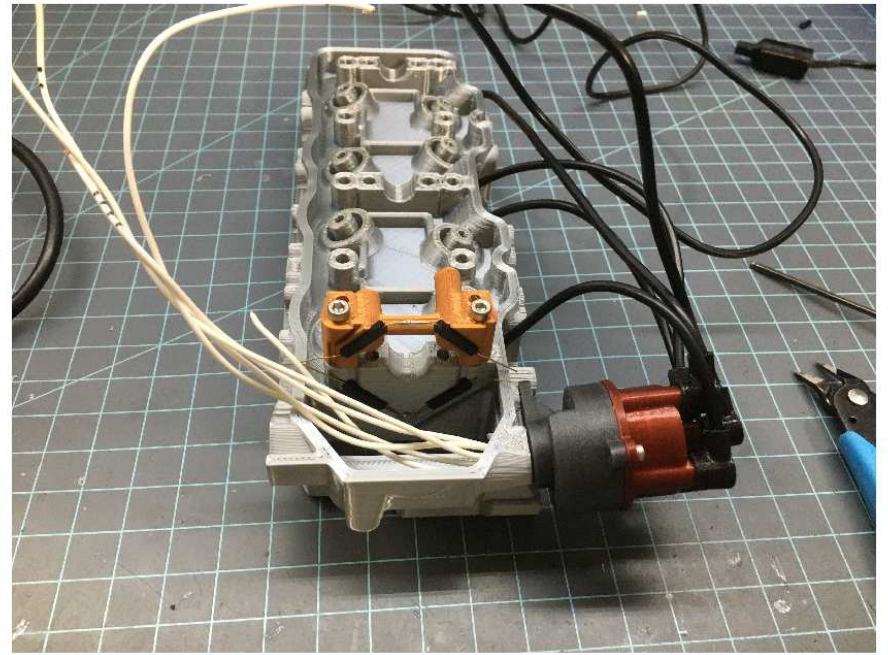
Solder together



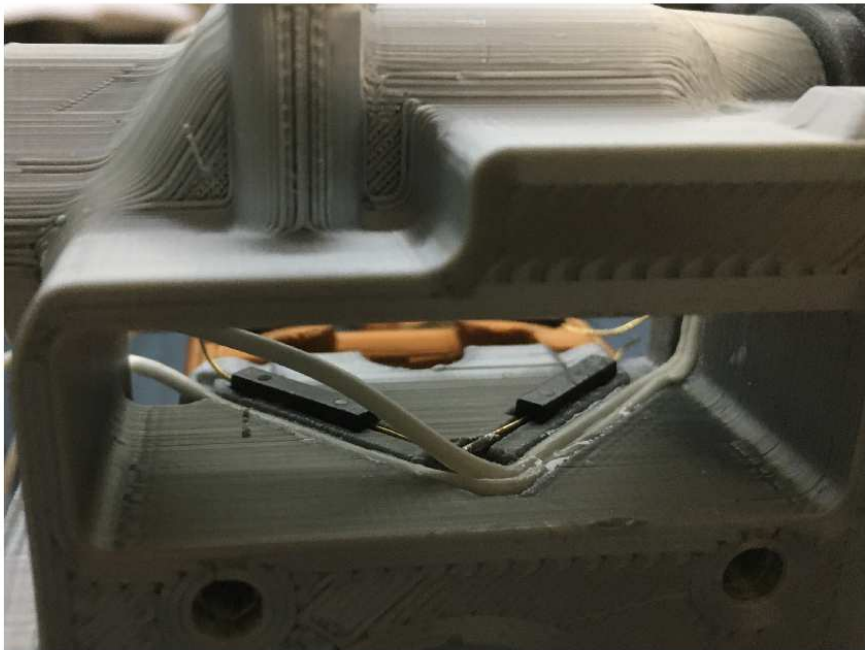
Mark the inner conductor to their corresponding cylinder.



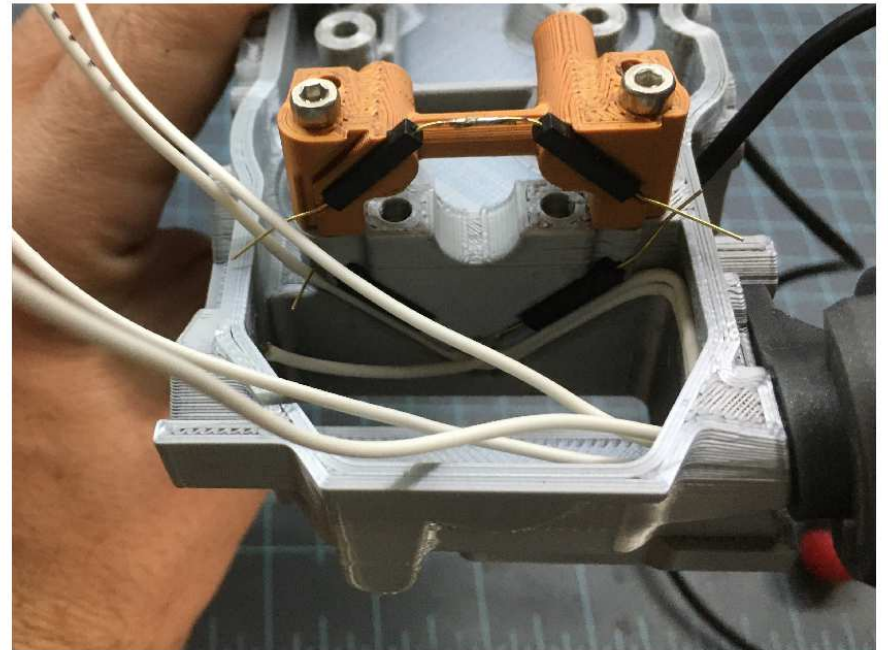
Trim off excess wire.

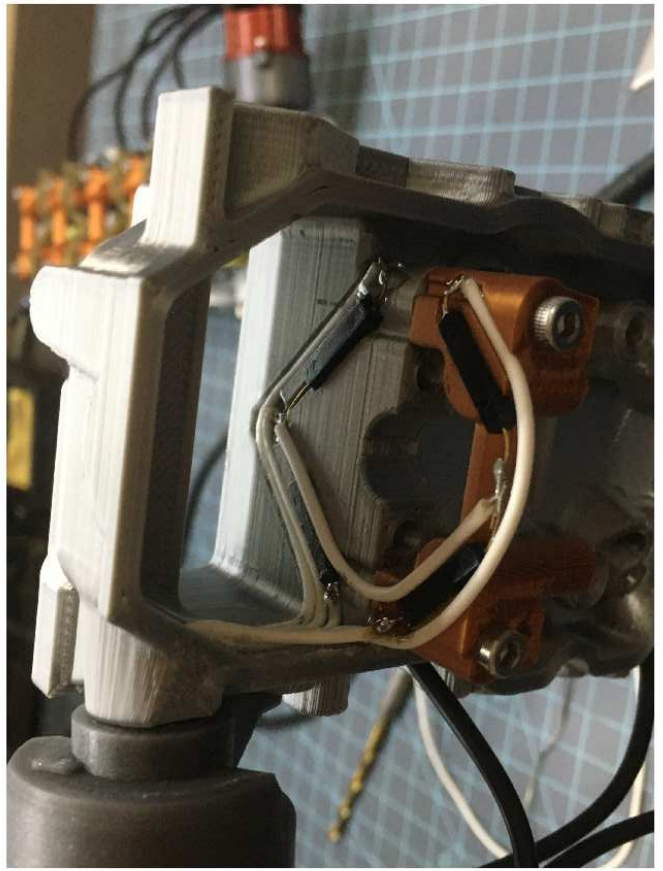
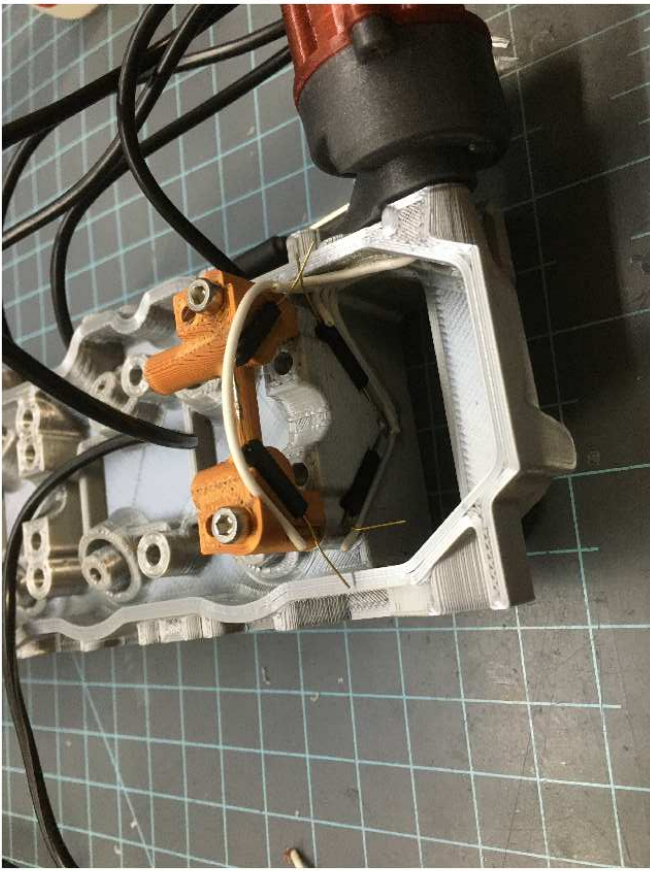


Pull all inner conductor wires through the distributor.



Route wires to their corresponding reed switch.
Glue wires into grooves.







Trim center wire from the distributor cap to desired length and strip insulation.



Install 330 ohm resistor to the outer conductor and to the barrel jack. Solder inner conductor to barrel jack.



Glue barrel jack into barrel jack cover and test spark plug LEDs by hooking up 12V power to jack and running a magnet over each reed switch.

Timing camshaft and cam gear.

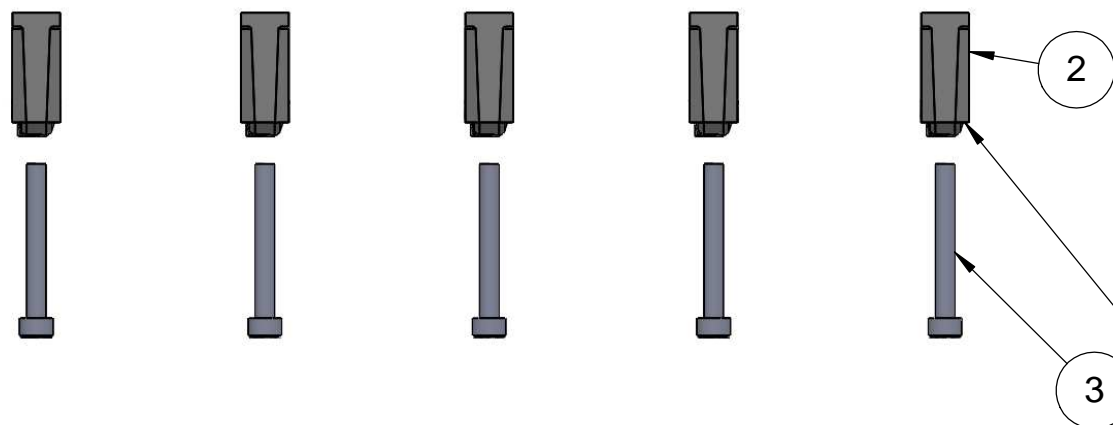
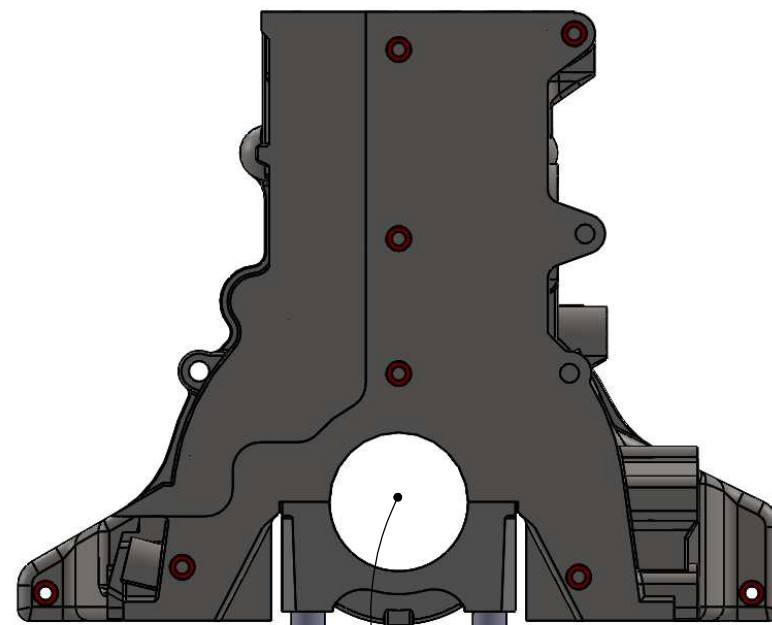
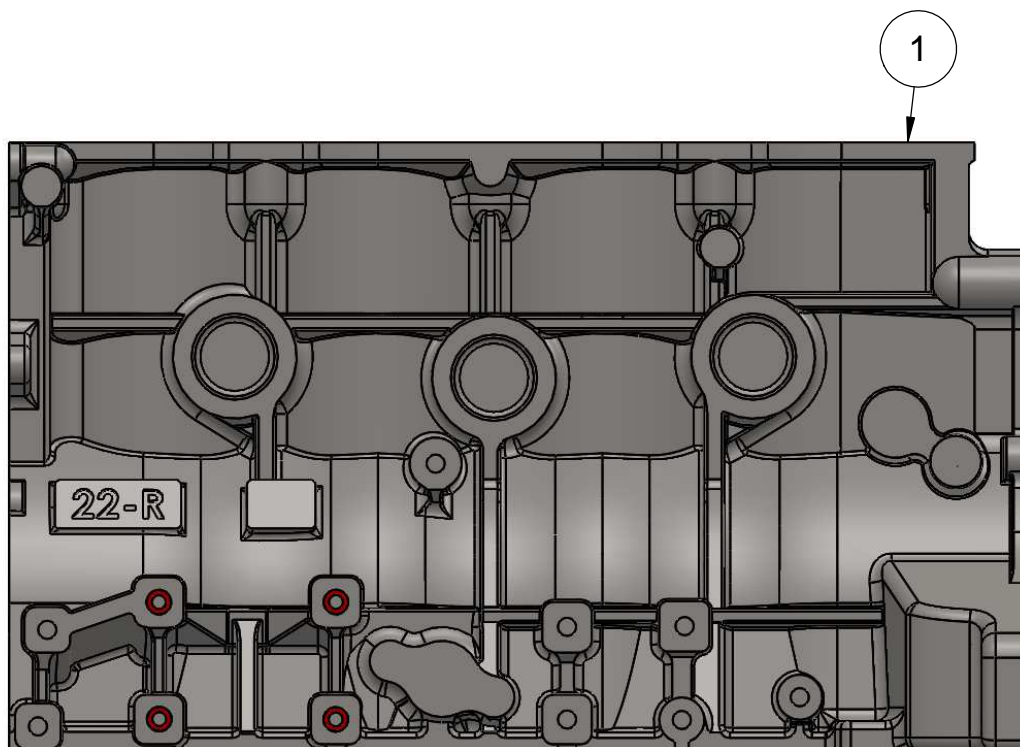
Step 1: Position crankshaft so that cylinder number one is at top dead center.

Step 2: Position camshaft so that cylinder number one is at top dead center.

Step 3: With the LEDs plugged into power, loosen the set screws on the cam gear. While holding the camshaft section stationary, lift the cylinder head slightly off of the engine block and rotate the cam gear until the number 1 cylinder LED fires. Tighten set screws on cam gear and rotate engine assembly to check LED spark timing. Re-adjust cam gear if needed.

Main bearing cap installation

ITEM NO.	PART NUMBER	QTY.
1	Engine Block - Insert and Magnet Assembly	1
2	Main cap	5
3	M3 x 25mm SHCS	10

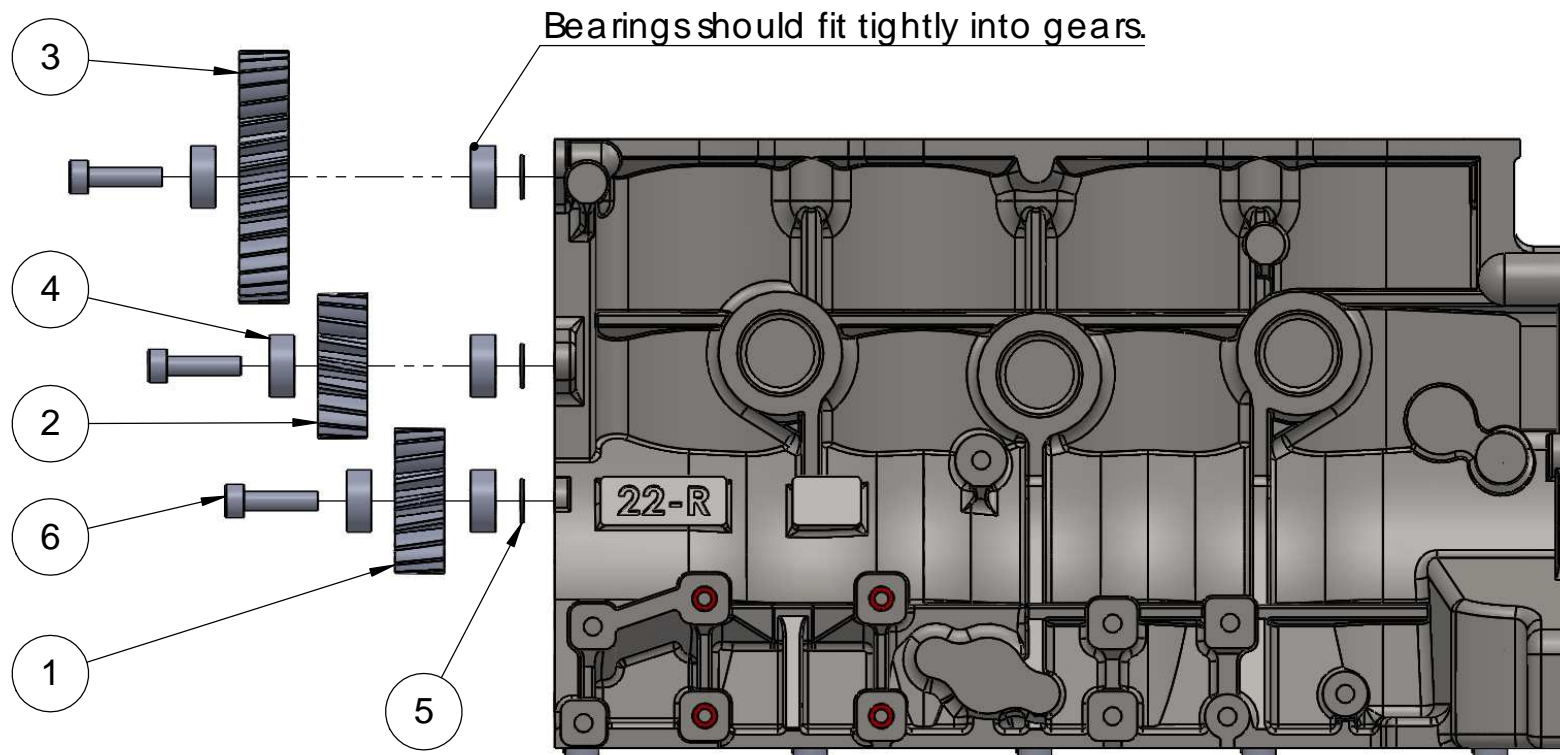
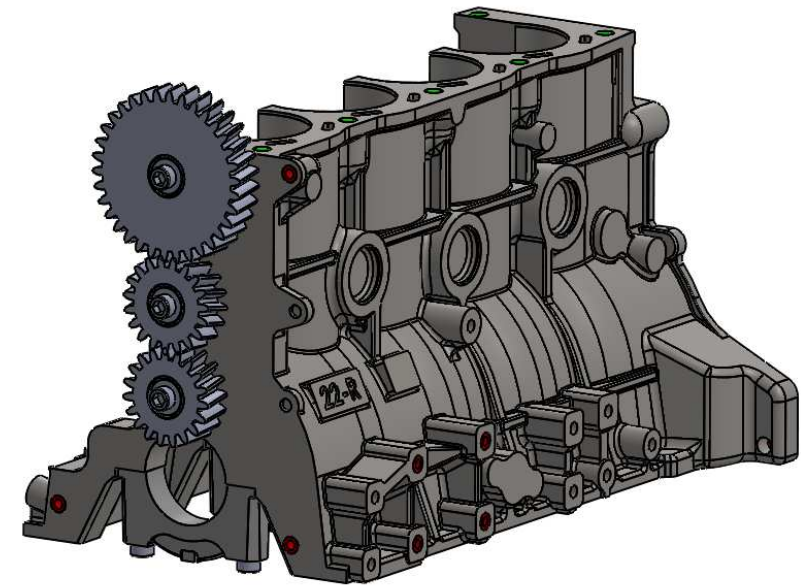


Ream crankshaft bearing surface to slightly under 22mm using a rolled up piece of sand paper. 608ZZ bearings should fit tightly when main bearing caps are installed. If bearing fit is too loose, sand down main bearing caps.

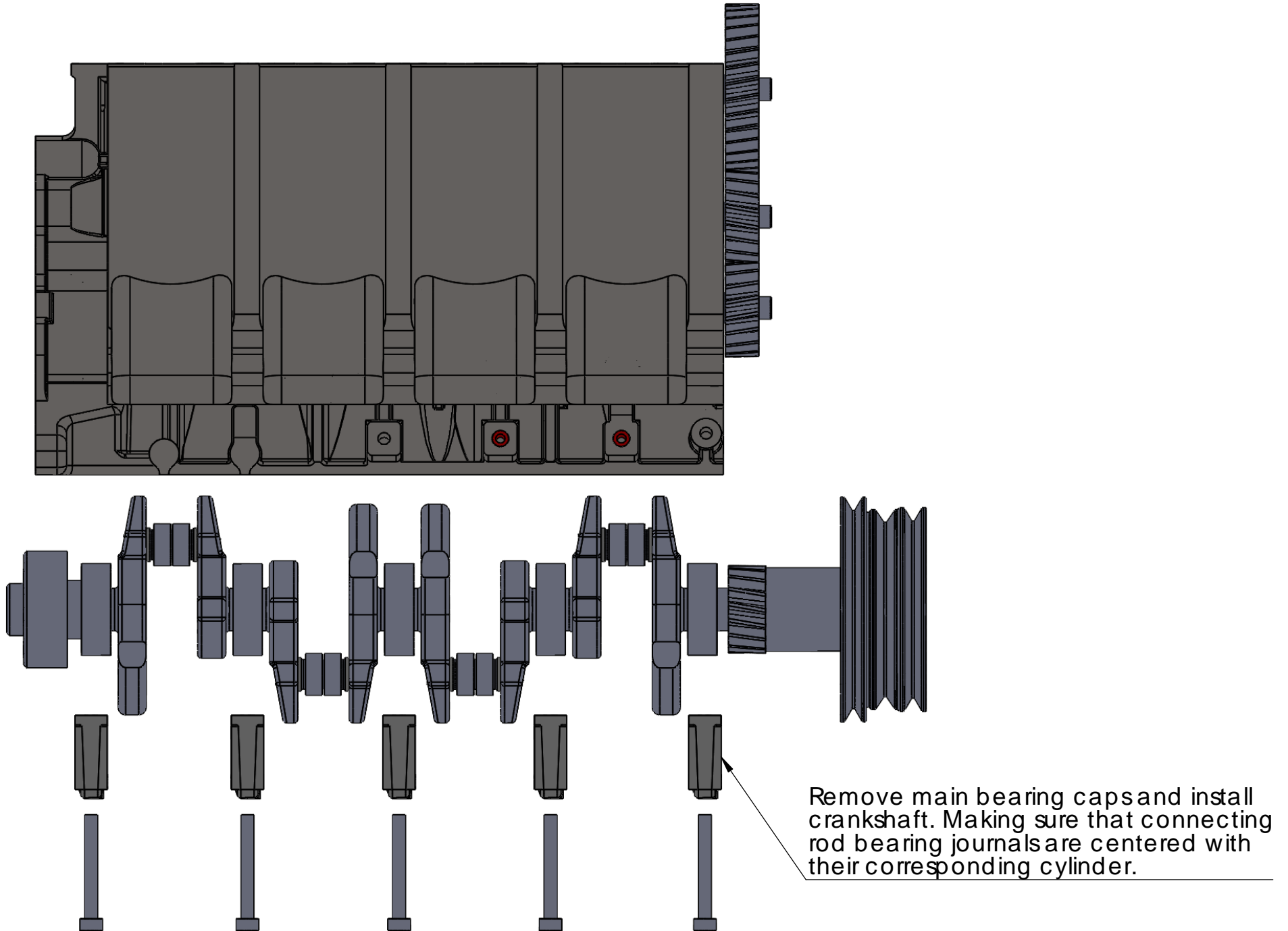
Arrows on bearing caps should point to rear of engine block.

Timing gear installation

ITEM NO.	PART	QTY.
1	Timing Idle gear 1	1
2	Timing Idle gear 2	1
3	Timing Idle gear 3	1
4	623zz bearing	6
5	3mm washer	3
6	M3 x 12mm SHCS	3

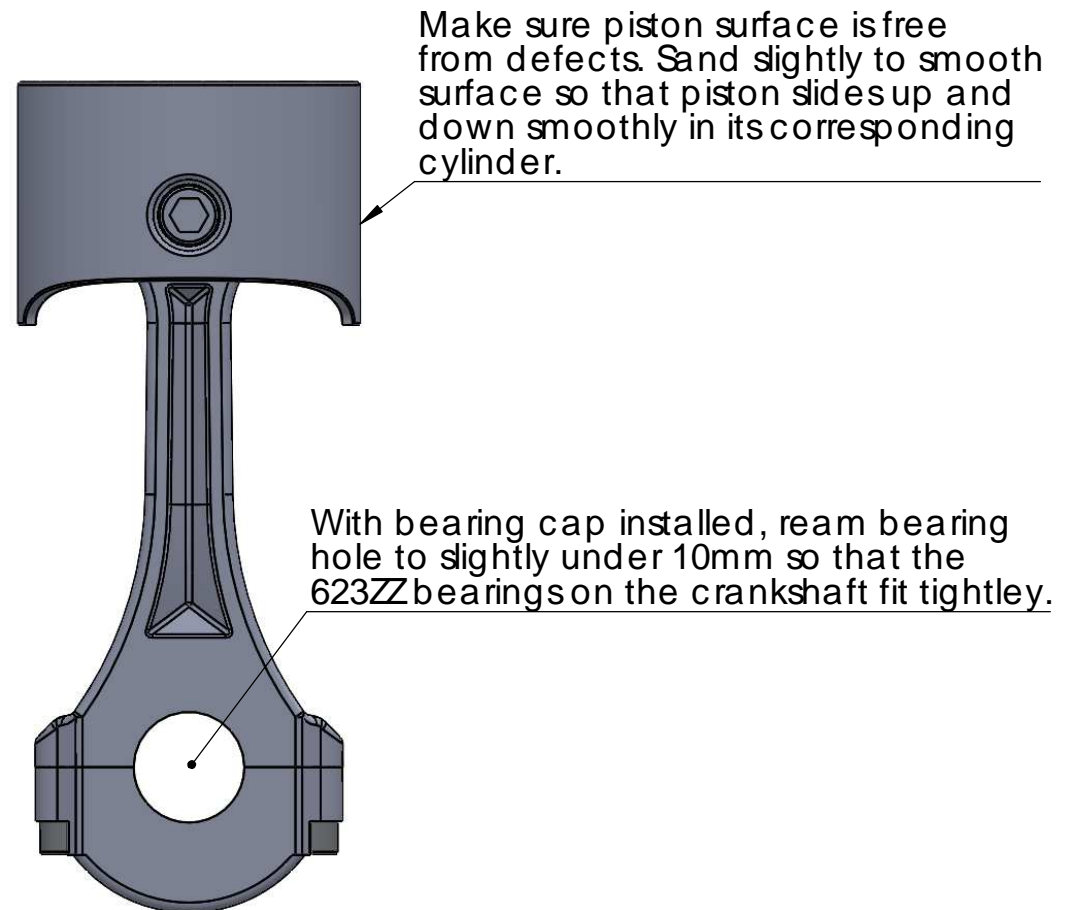
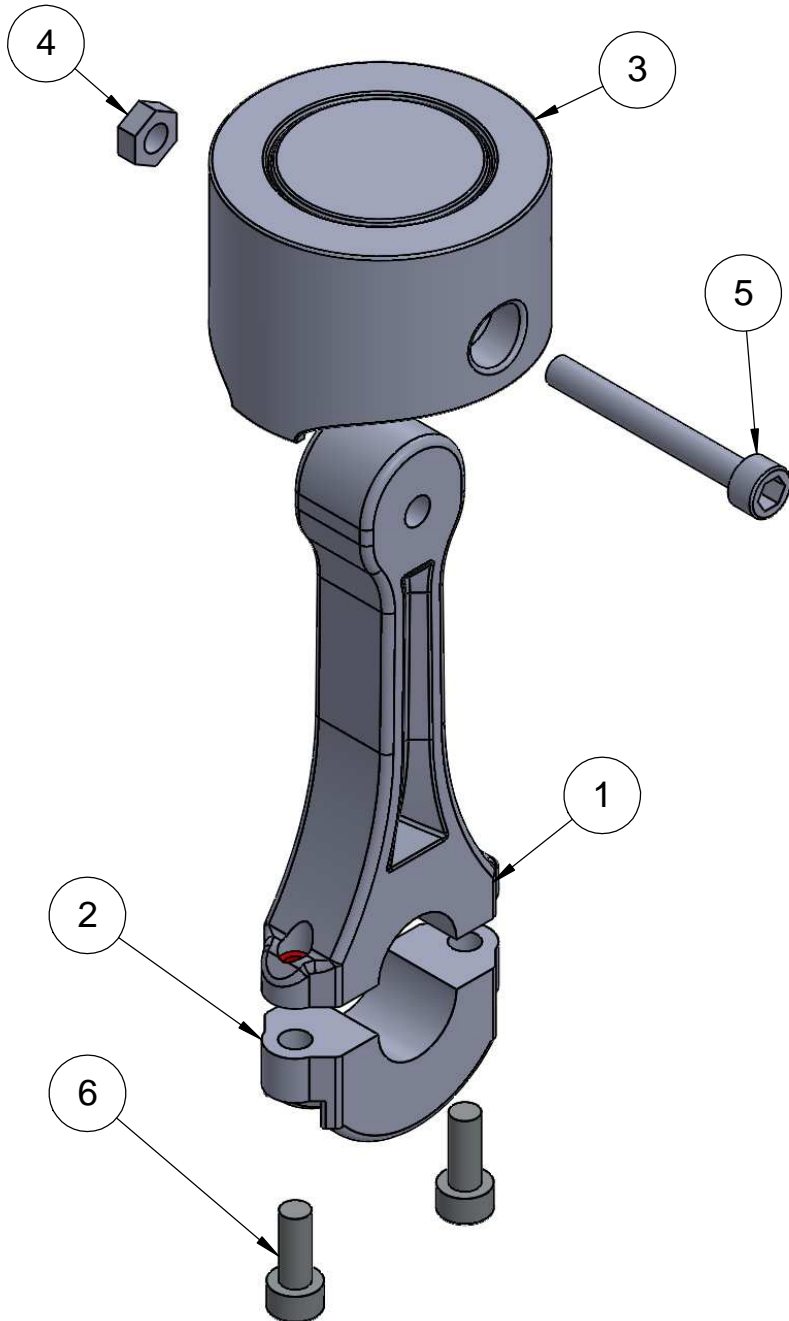


Crankshaft Installation

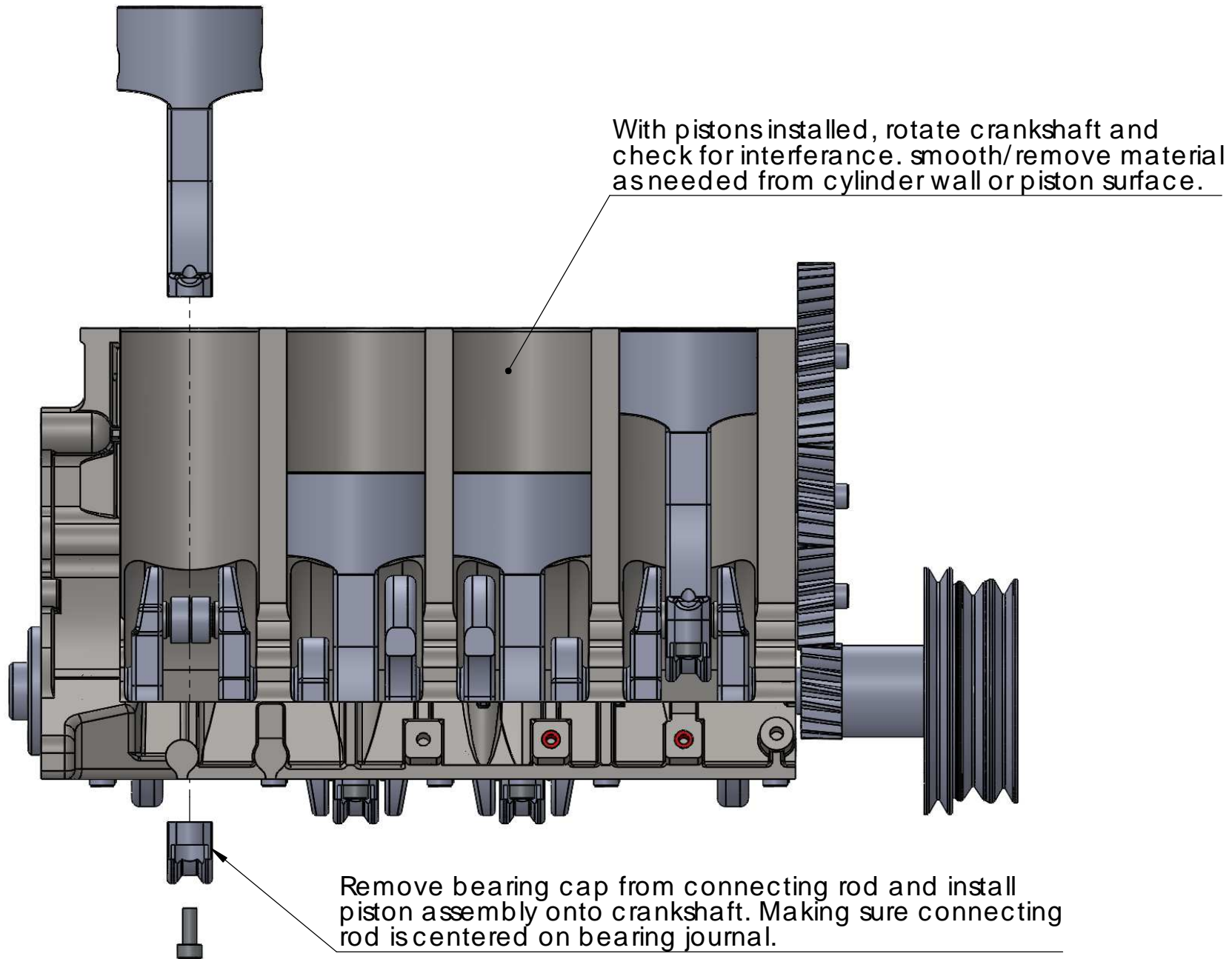


Piston assembly

ITEM NO.	PART	QTY.
1	Piston Assembly	1
2	Connecting rod cap	1
3	Piston	1
4	M3 Nut	1
5	M3 x 25mm SHCS	1
6	M3 x 8mm SHCS	2

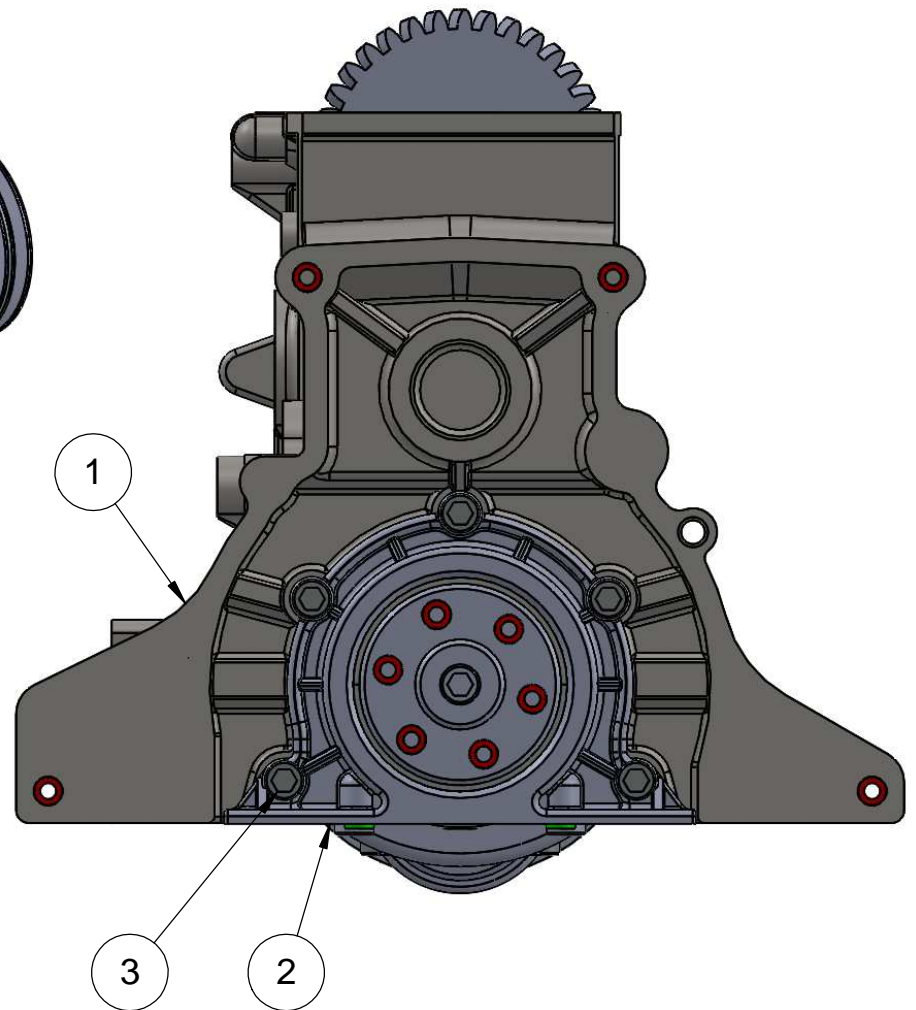
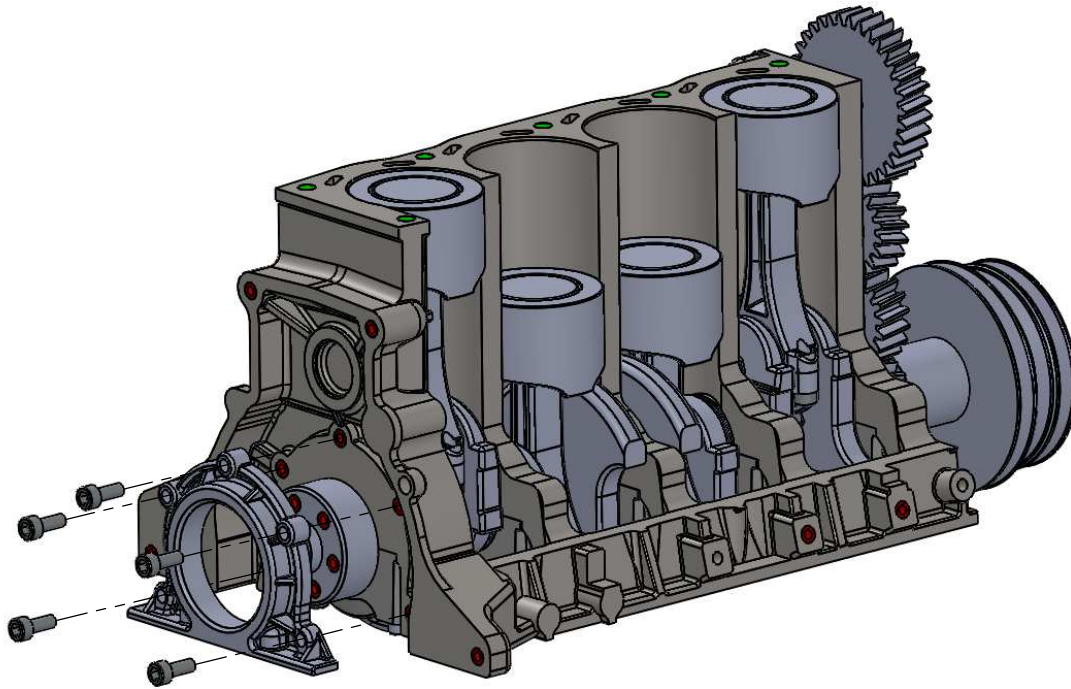


Piston installation



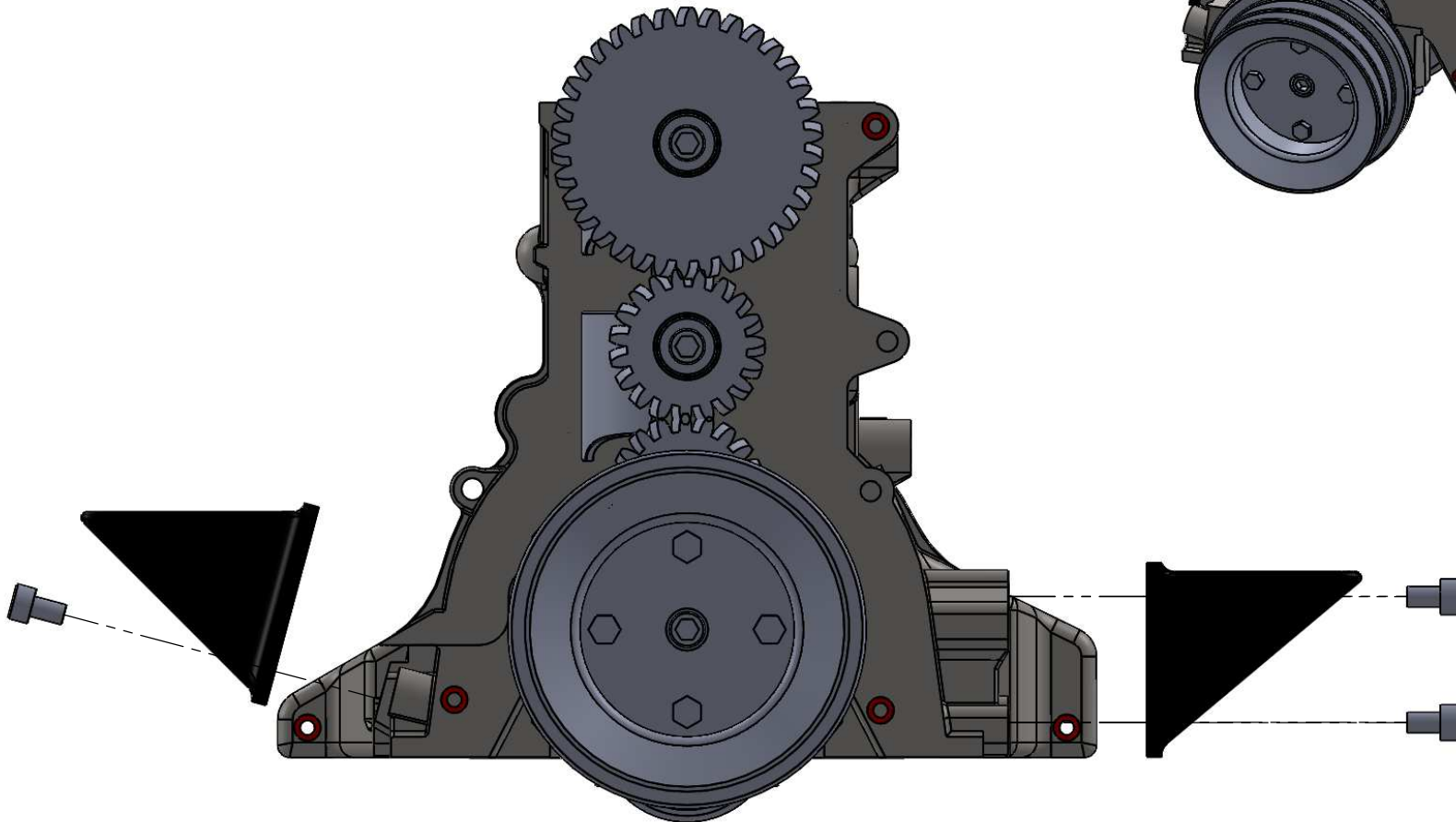
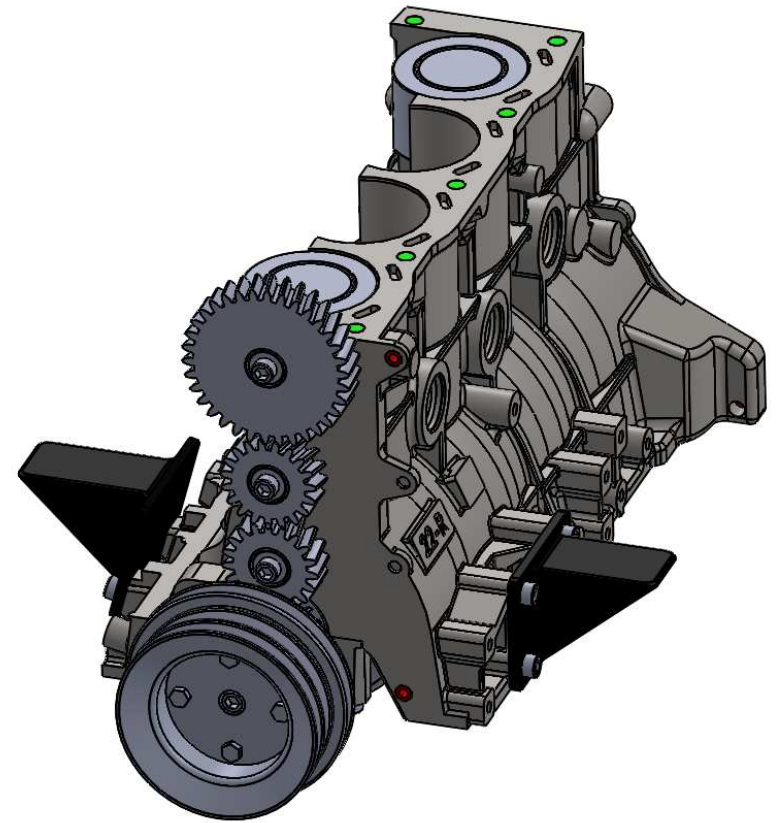
Rear main installation

ITEM NO.	PART	QTY.
1	Engine Block with Pistons Installed	1
2	Rear Main - Insert and Magnet Assembly	1
3	M3 x 8mm SHCS	5



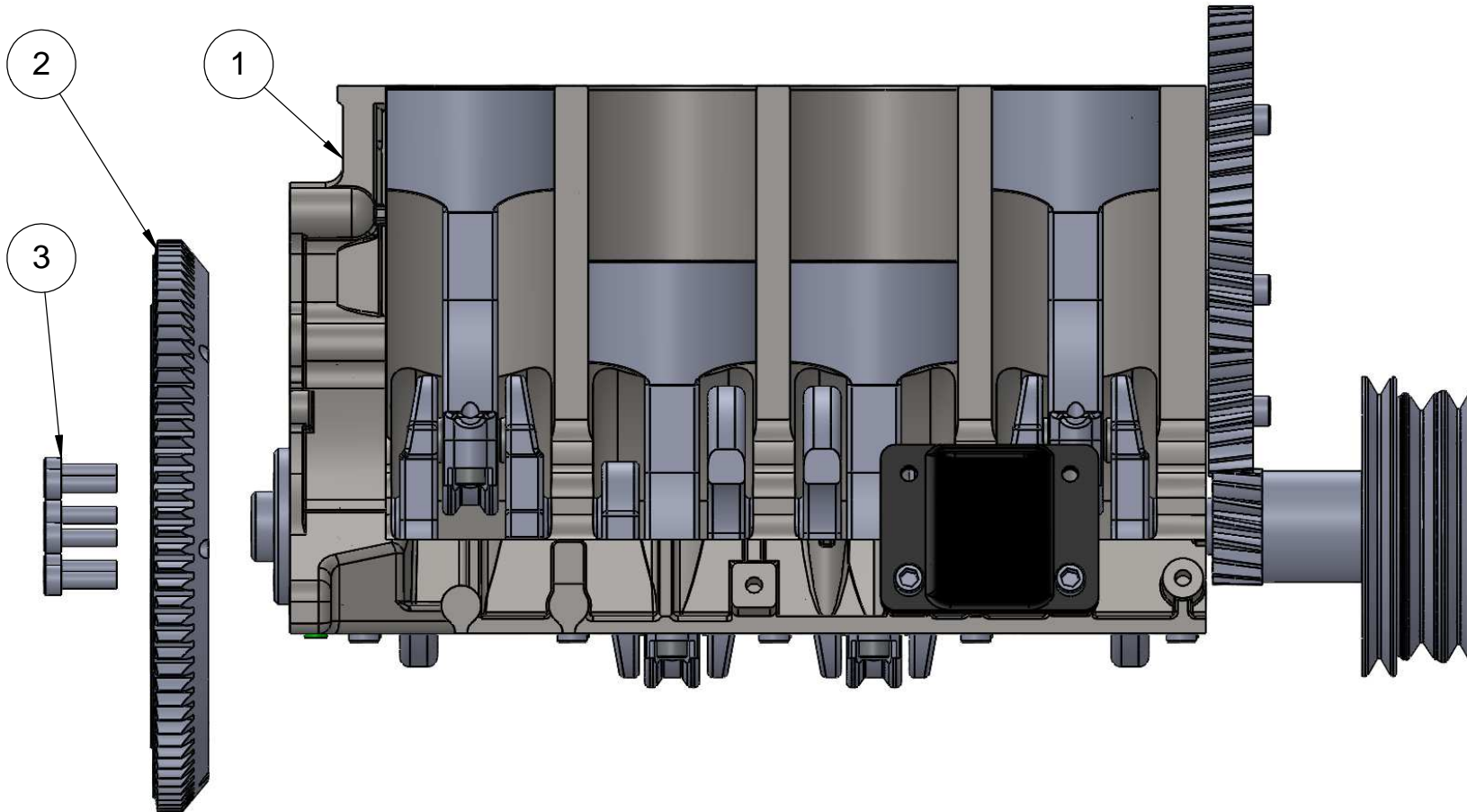
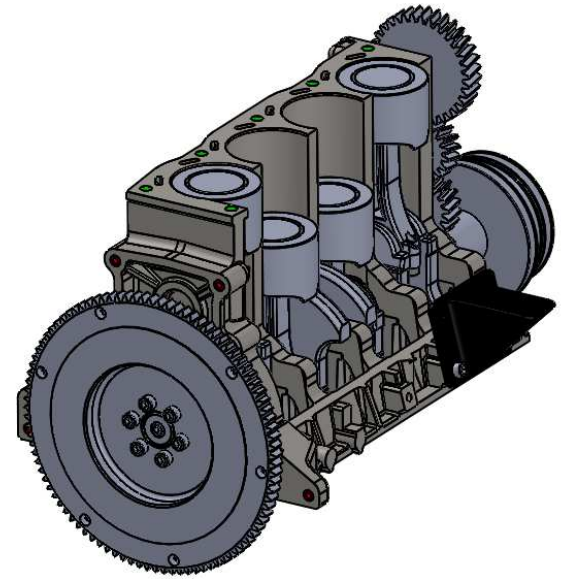
Motor mount installation

ITEM NO.	PART	QTY.
1	Engine Block Rear Main Installed	1
2	Left motor mount	1
3	Right motor mount	1
4	M3 x 5mm SHCS	6



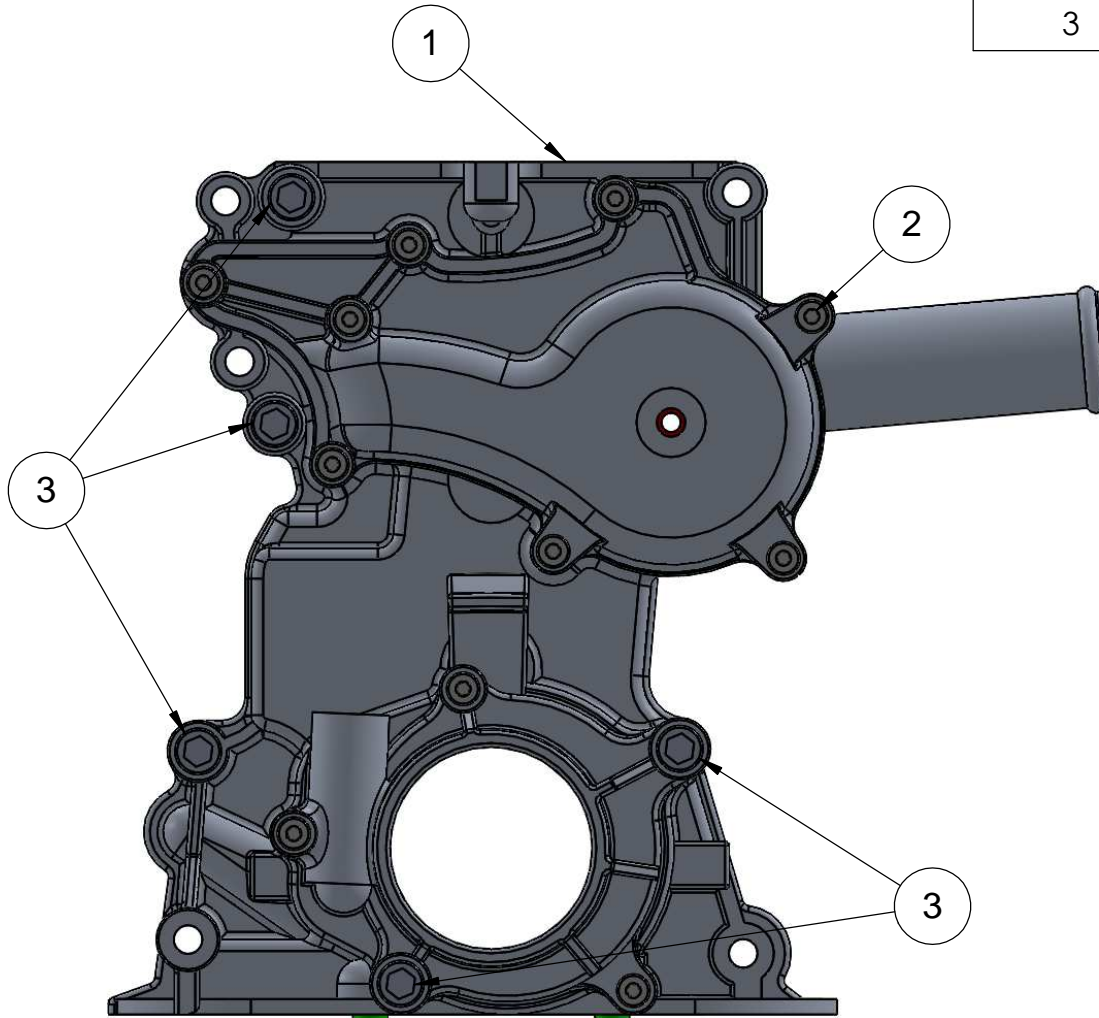
Flywheel installation

ITEM NO.	PART NUMBER	QTY.
1	Engine Block Motor Mounts Installed	1
2	Flywheel	1
3	M3 x 10mm SHCS	6



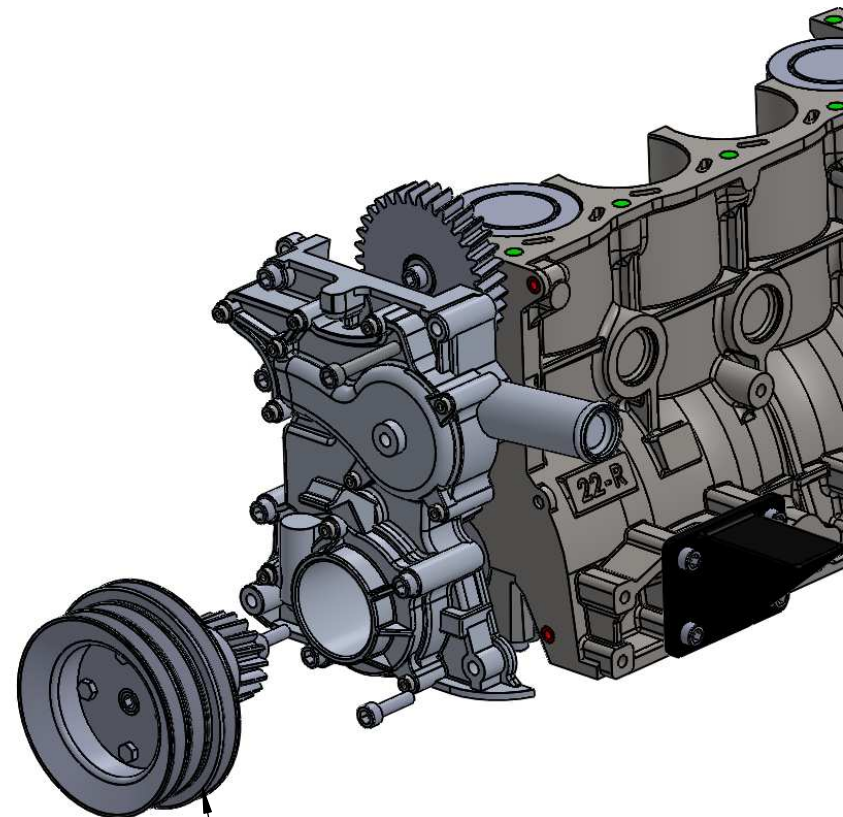
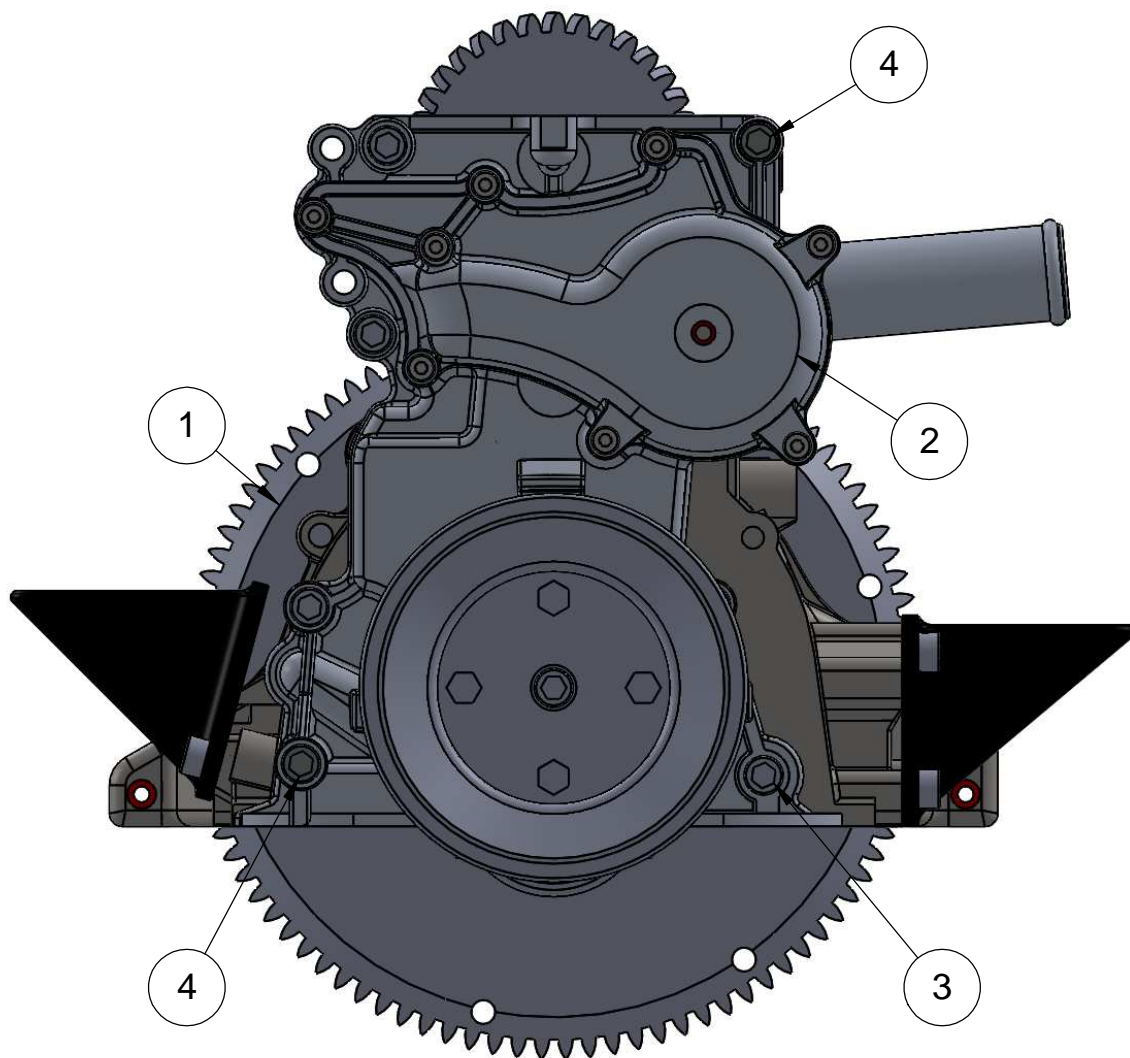
Timing cover screw installation

ITEM NO.	PART	QTY.
1	Timing cover	1
2	M2 x 5mm SHCS	11
3	M3 x 5mm SHCS	5



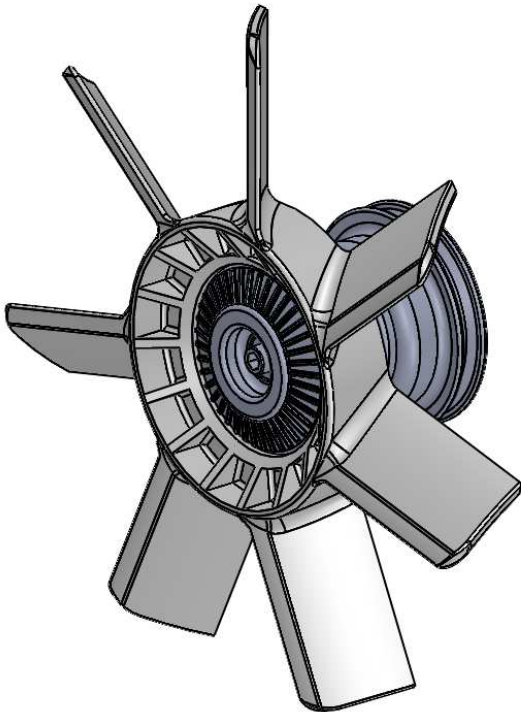
Timing cover installation

ITEM NO.	PART	QTY.
1	Engine Block with Flywheel Installed	1
2	Timing Cover - Insert and Magnet Assembly	1
3	M3 x 12mm SHCS	1
4	M3 x 20mm SHCS	2

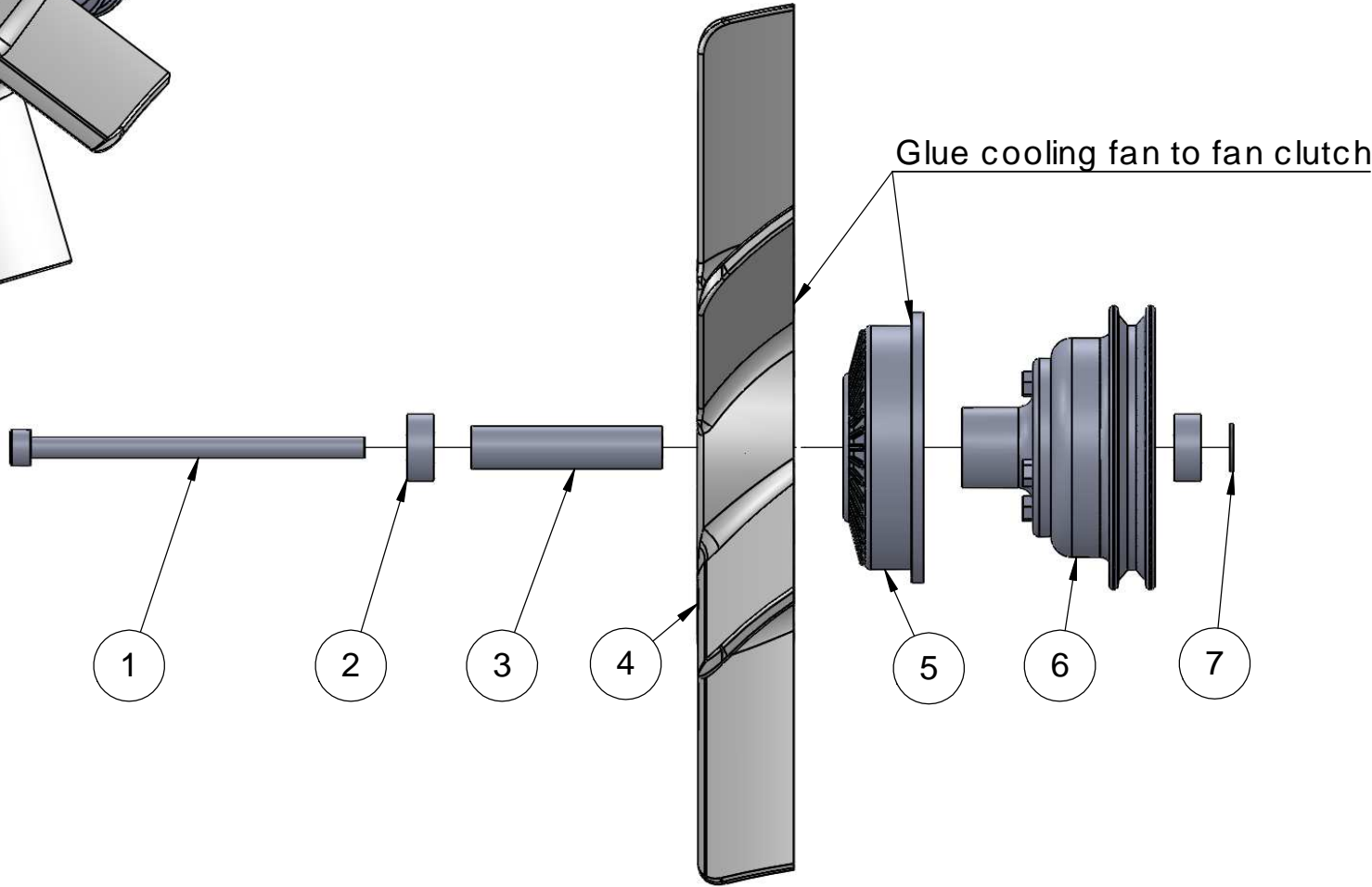


Remove crankshaft pulley and
install timing cover assembly.

Cooling fan assembly

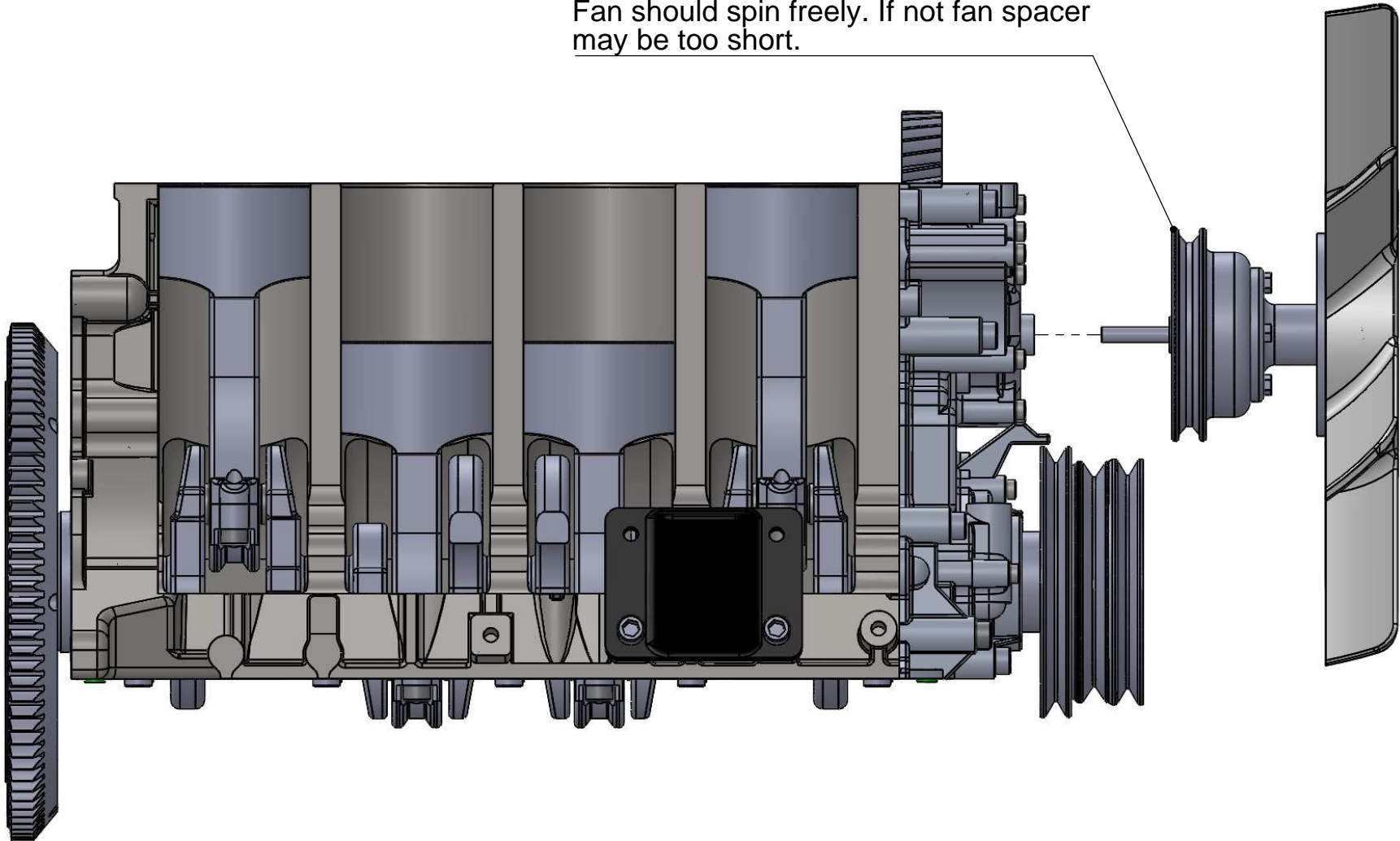


ITEM NO.	PART	QTY.
1	M3 x 50mm SHCS	1
2	623zz bearing	2
3	Fanspacer	1
4	Fan	1
5	Fan clutch	1
6	Fan pulley	1
7	3mm washer	1



Cooling fan installation

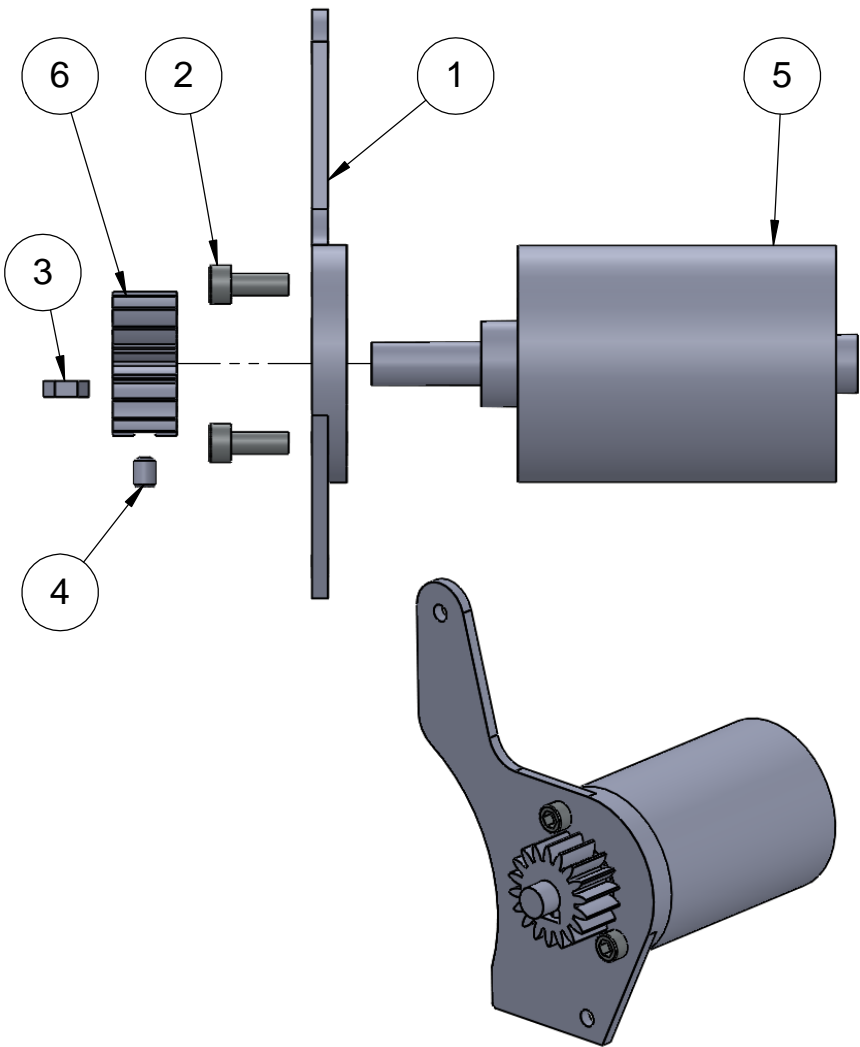
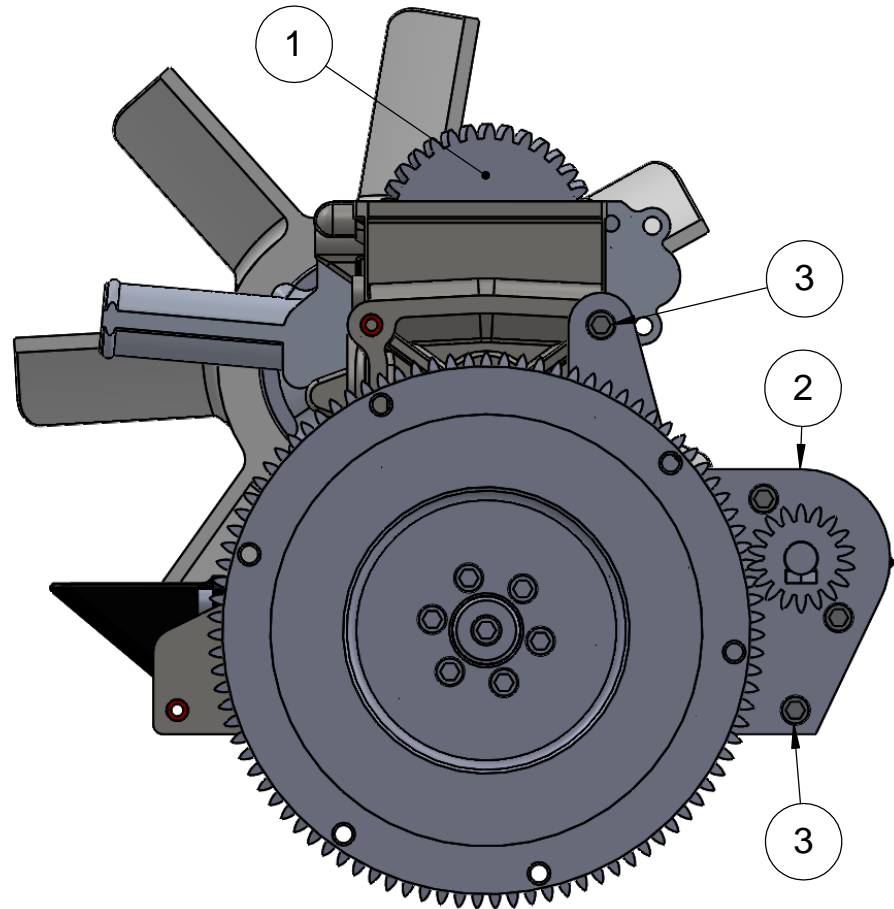
Install fan assembly onto timing cover.
Fan should spin freely. If not fan spacer
may be too short.



Starter motor installation

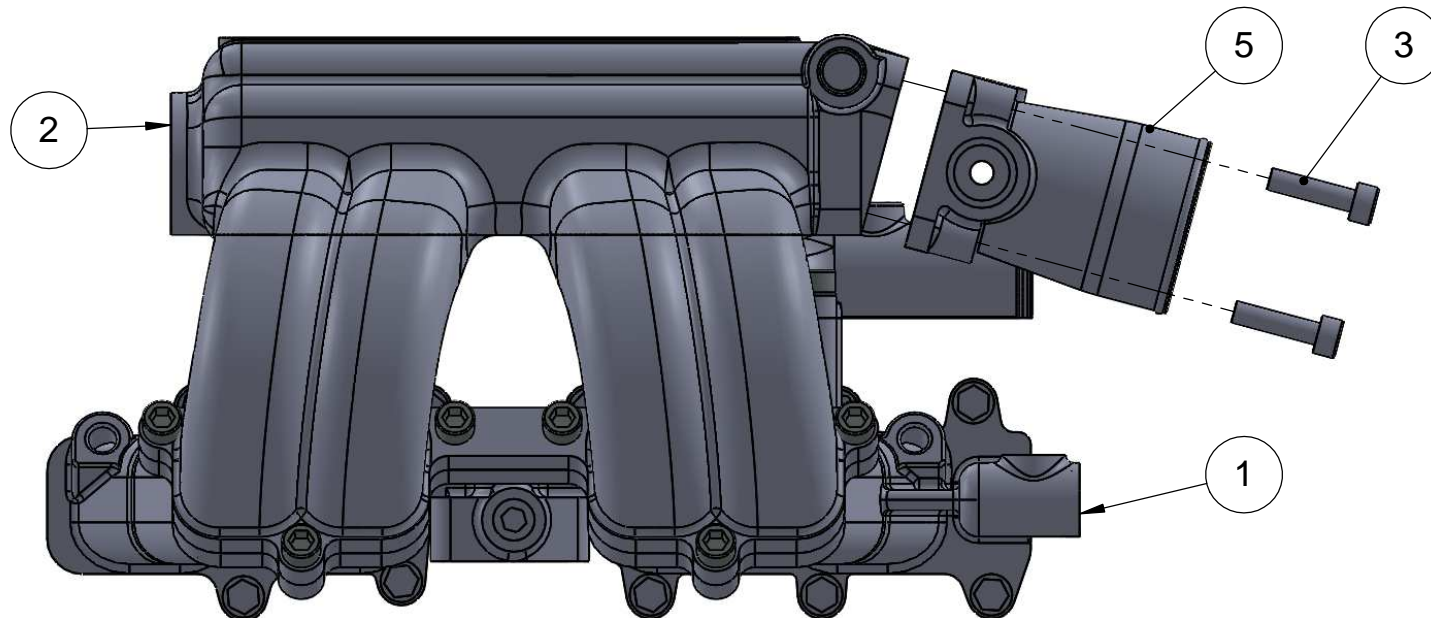
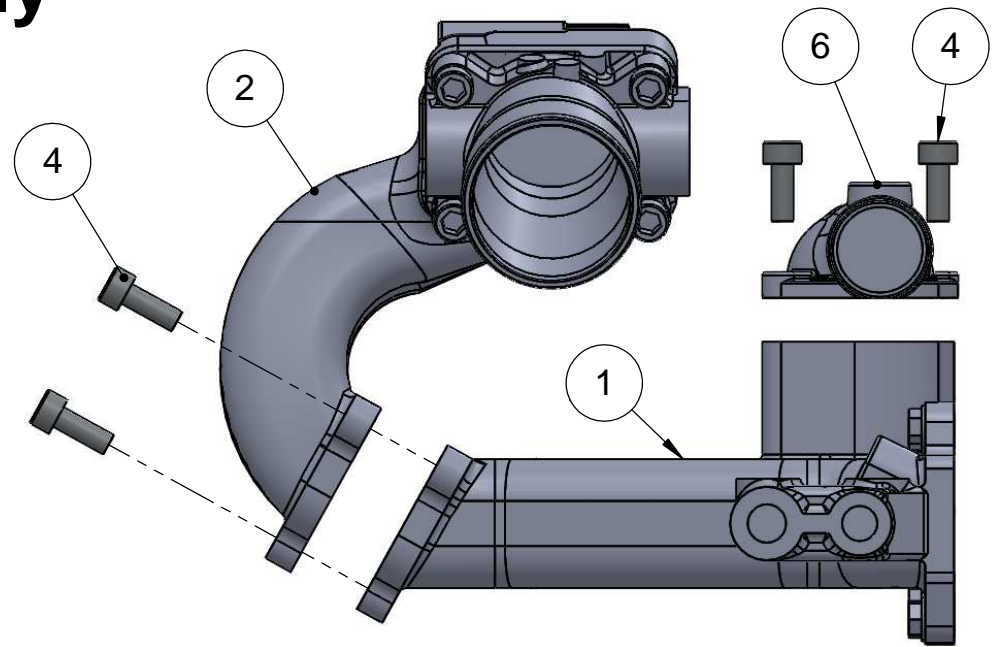
ITEM NO.	PART	QTY.
1	Engine Block with Fan Assembly	1
2	Starter Motor Assembly	1
3	M3 x 8mm SHCS	2

ITEM NO.	PART	QTY.
1	Starter Motor Mount	1
2	M3 x 8mm SHCS	2
3	M3 Nut	1
4	M3 4mm Set Screw	1
5	500rpm geared motor	1
6	Starter Drive Gear	1

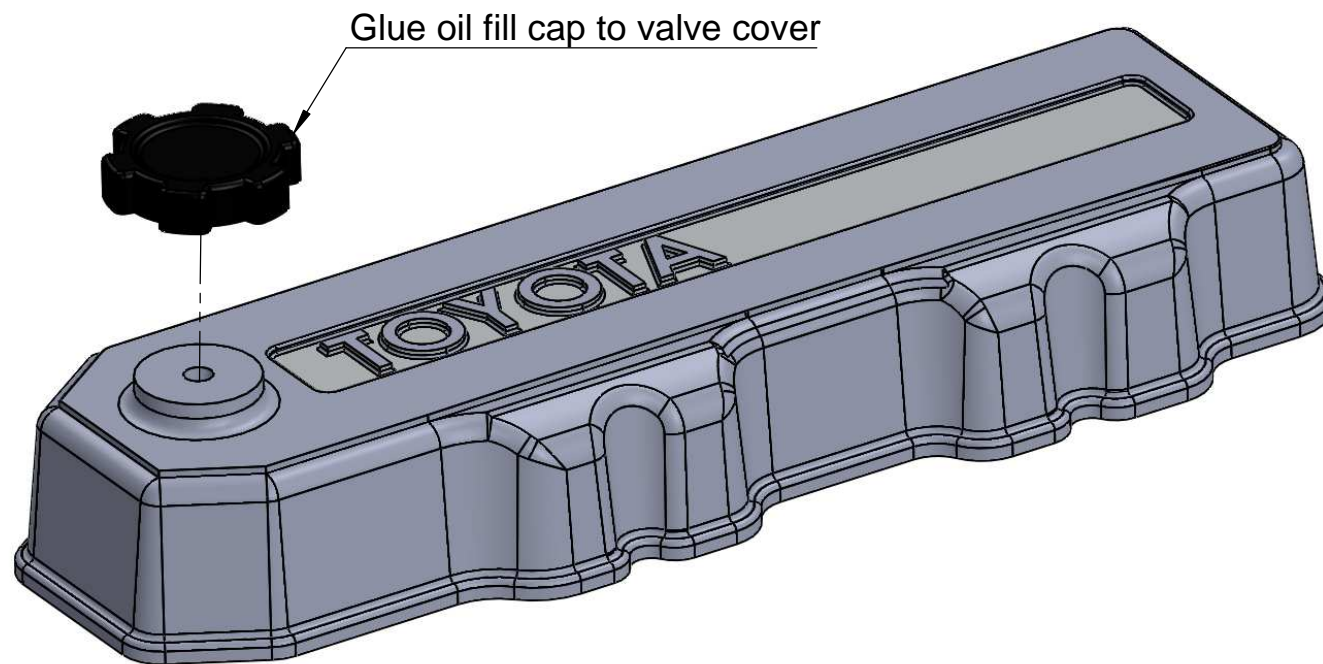


Intake manifold assembly

ITEM NO.	PART NUMBER	QTY.
1	Lower Intake - Insert and Magnet Assembly	1
2	Upper intake manifold - Glued Assembly	1
3	M3 x 12mm SHCS	4
4	M3 x 8mm SHCS	8
5	Throttle body	1
6	Thermostat housing	1



Valve cover assembly



Fully assembled pictures



