How to measure and install Teflon encapsulated silicon O-rings. By Paul Lamar July 1999

In the RX8 engine there are four coolant sealing O-rings per aluminum rotor housing. Two outer and two inner. Two on one side two on the other.

In the 2nd gen RX7 and third gen RX7 engines the slots are in the cast iron end housings. There are two per end housing surface. An inner and an outer.

There are also four oil sealing O-rings per rotor. Two on each side of the rotor proper. These are located on the flanks of the rotor. Two per side.

Teflon encapsulated silicone O-rings are the best there is for this application. Teflon is about the most inert material you can find and it is resistant to most known chemicals. Unfortunately it is not rubber like and that is where the high temp silicone rubber core comes into play.

Here is the TES O-ring manufacturer's website.

These are the proper sizes for the 2nd gen RX7 and third gen RX7 engines.

1. Inner coolant oring -

circumference = 28.062

Inside diameter = 8.932

slot depth = 0.062

slot width = 0.141

section size = 0.093

2. Outer coolant oring -

circumference = 35.130

Inside diameter = 11.182

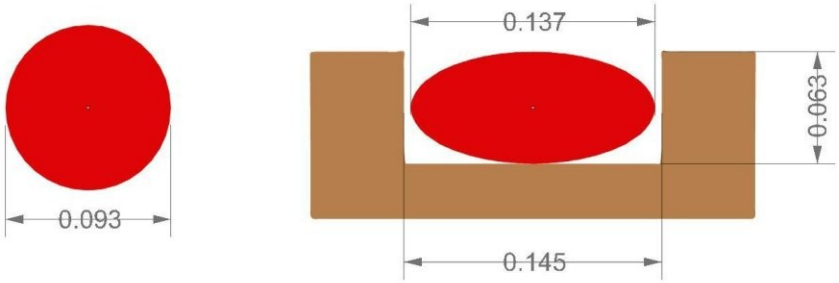
slot depth = 0.062

slot width = 0.120

section size = 0.093

This is critical! The proper section size is .093. Not 3/32 as a "3/32" O-ring is larger in section size than .093.

Here is what the proper size O-ring looks like in the slot and bolted solid. This leaves some slot area for heat expansion.



area = .00679 square inches in both cases.

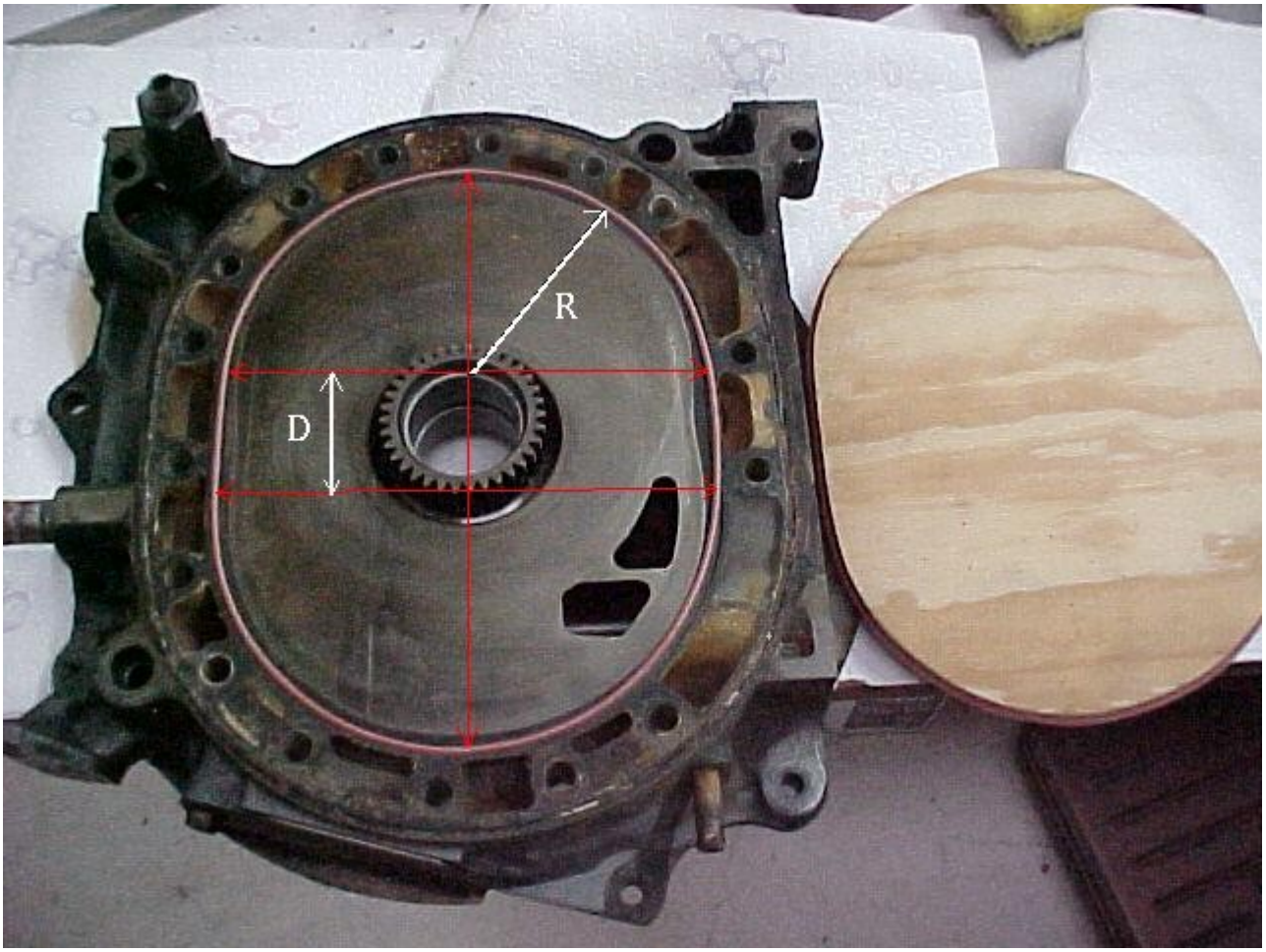
The TES O-rings are stiffer than the stock O-rings. It is harder to get them to lie in the groove. Even with Vaseline. When you buy them they don't come flat. I found that using a plywood form to pre set the slightly under size TES O-rings for a few days works well. Here is a picture.



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How to measure the lenght of the water O-rings.

Here is how to double check my work. We will do a little reverse engineering. The O-ring grooves are two half circles connected by straight sections to form sort of an oval.



Measure across from side to side on the end housing to the inner edge of the O-ring groves This then is the inner diameter of the half circle. We will call this dimension SSL. For the inner O-ring this diameter is 7.5" Outer diameter is is 9.75". These form two circles of 23.562 circumference and 30.63 circumference. C = D X Pi (3.1416)

Measure the distance up and down to the inner edge of the O-ring grooves. For the inner O-ring groove this dimension is 9.75 (confusingly). Outer o-ring groove is right on 12 inches.

We will call this dimension VL for vertical length. VL-SSL gives us the length of the straight sections. We have two straight sections 9.75- 7.5 or 2.25 inches in length for the inner o-ring slot and 12 - 9.75 or 2.25 for the outer O-ring slot straight sections.

Therefore the inner circumference is 23.562 + 2.25 + 2.25 or 28.062". Close to the number we got below. Divide by 3.1416 to get the equivalent inside diameter.

For the outer o-ring slot the circumference is 30.63 + 2.25 + 2.25 or 35.13. Also close to the number we got above.

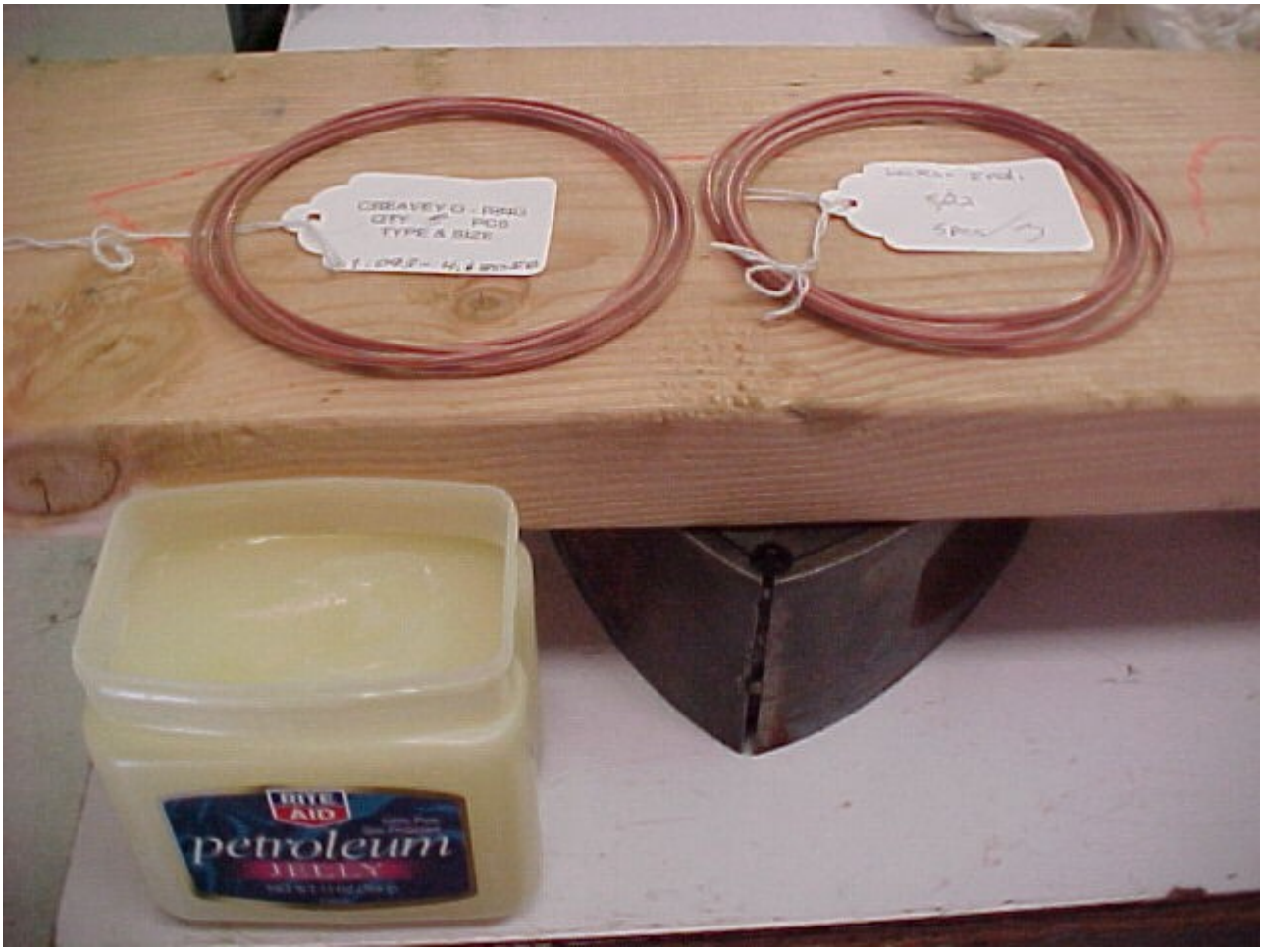
Now to be real precise you must repeat these measurements for the outer O-ring slot grooves.

In any event you want to err on the small side as you are going to cut pieces of plywood the exact size of the inside wall of both slots and slip the o-rings over this plywood form for for a few days so they will take a set. Other wise you will play hell getting the o-rings to lie flat in the grooves when you assemble the engine.

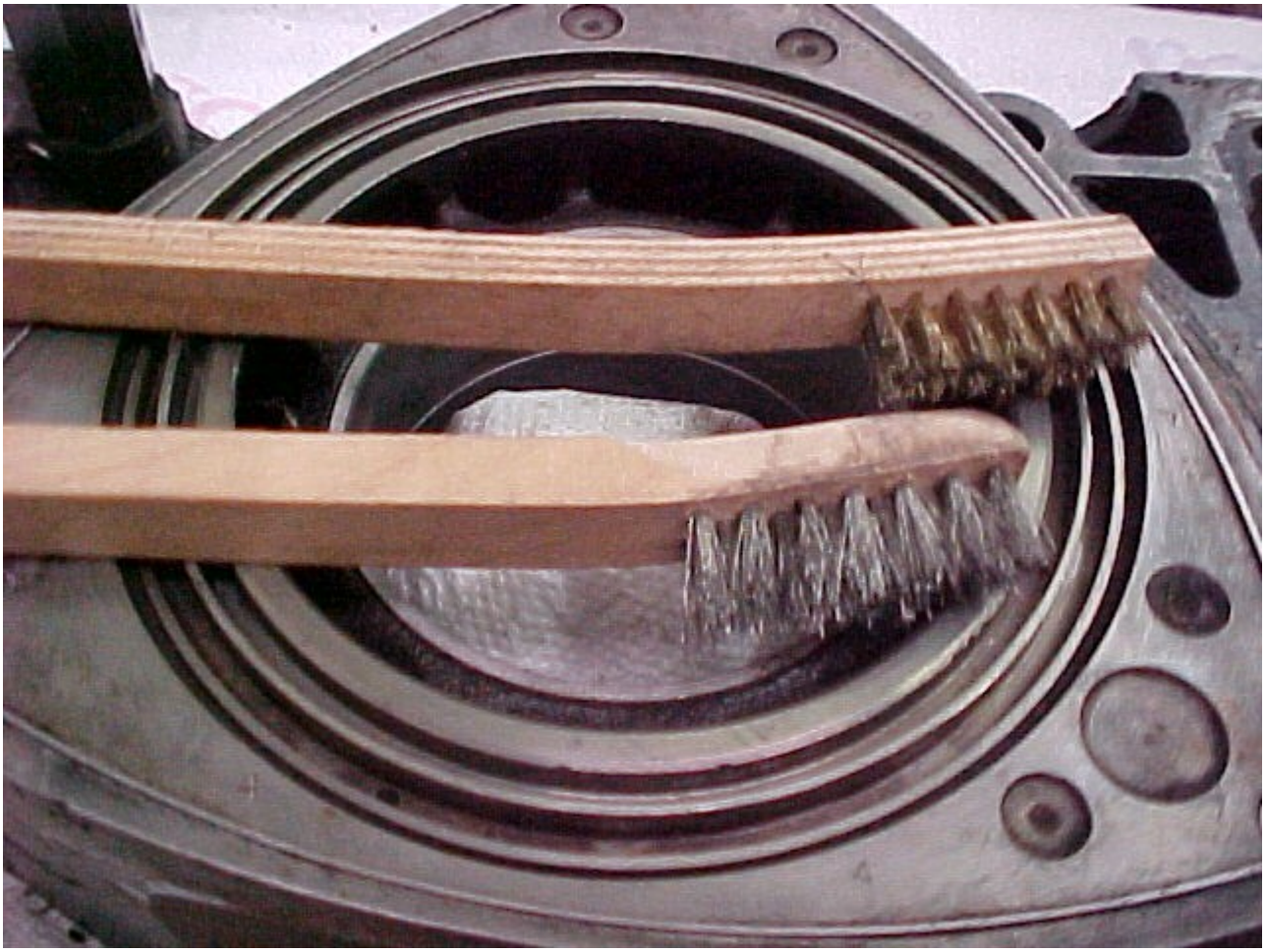
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Oil O-rings.

You will need a little O-ring lube and a 2 by 8 to install them. They are also easy to remove with no signs of distortion.



One of the secrets is if you reuse the old metal oil scraper rings they must be spotlessly clean inside and out. Soak them in carb cleaner for a few days. If you use new scraper rings this will not be a problem of course. The second thing to watch out for is don't nick the rotor wall between the two scraper rings when you remove them. Very very important!!



These can be the same cost or just a little more than the stock oil O-rings from Mazda.

The proper oil O-ring sizes are:

0.093" section 4.68 inch ID

0.118" section 4.33 inch ID

I can vouch for the quality of the Creavey O-rings but some of those water TES O-rings from Mcmaster Carr I have seen are not as good. This is not to say they won't work. They just don't look as good around the joints as Creavey O-rings.

Viton is good only to 400 degrees F. The center of the rotor runs as high as 500 degrees F. I think 400 degrees F leaves's too little safety margin when 500 degrees F is available in TES O-rings at the same price probably.

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I have always thought of rubber, and that includes silicone, as being "compressible". What has been brought home to me after reading some bad O-ring experiences is; rubber is no more "compressible" than hydraulic fluid. Furthermore silicone expands greatly when heated. If it is contained in a closed chamber without expansion room such as an O-ring slot it will generate tremendous forces. Enough to crack cast iron and bend steel. Therefore it is extremely important to have the right section diameter when installing O-rings.

If the O-ring is oversize for the slot the process of tightening down the tension bolts will cause the hydraulic force of the rubber to break the cast iron end housings. The problem will compound itself when the engine is

warmed up to operating temperature as the silicone expands.

Bottom line is measure the O-rings you get and don't use anything larger than .093" diameter in the inner slot. Don't use RTV to hold the rings in place as it could harden and add to your problems. Buy the O-rings slightly under size on the overall diameter (no more than 5% undersize) and stretch them on a plywood form for a few days before installing them. They will then lie in the slot perfectly as we discovered. Don't try to stretch the ring by hand or by another method as you could permanently neck them down. Be careful when buying standard 3/32 O-rings sizes as they may be larger in section diameter than .096. They could be as large as .115 or so which is way too large for the outer slot and inner slot.

Best to buy the O-rings directly from Creavey the manufacturer. In most cases the prices are lower than what Mazda charges for lower temperature stock O-rings.

Here is a part of their catalog again showing the small increments in section diameter that they sell.

Cross Section A	mm	Nominal Squeeze S	Groove Depth D	Groove Width W	I.D. Min. (in.)	O.D. Max. (in)
.062 ± .005	1.57	.018	.044	.085	.300	2.50
.070 ± .005	1.78	.022	.048	.097	.300	5.50
.077 ± .005	1.96	.022	.055	.104	.480	5.50
.080 ± .005	2.03	.022	.058	.107	.480	5.50
.093 ± .005	2.36	.025	.068	.123	.480	10.0
.098 ± .005	2.49	.025	.073	.128	.480	10.0
.100 ± .005	2.54	.025	.075	.130	.480	10.0
.103 ± .005	2.62	.025	.078	.133	.480	10.0
.107 ± .005	2.72	.028	.079	.140	.500	10.0
.110 ± .005	2.79	.030	.080	.145	.500	10.0
.115 ± .005	2.92	.030	.085	.150	.500	10.0
.118 ± .005	3.00	.030	.088	.153	.500	10.0
.122 ± .005	3.10	.030	.092	.157	.500	10.0
.125 ± .005	3.18	.030	.095	.160	.500	20.0
.135 ± .006	3.43	.030	.105	.170	.500	20.0
.139 ± .006	3.53	.030	.109	.174	.500	20.0
.148 ± .006	3.76	.032	.116	.188	.750	20.0
.157 ± .006	3.99	.032	.125	.197	.750	25.0
.165 ± .006	4.19	.032	.133	.205	1.00	25.0

Here is the O-ring manufacturer's website again.

Take your time and double check your work.

Paul Lamar