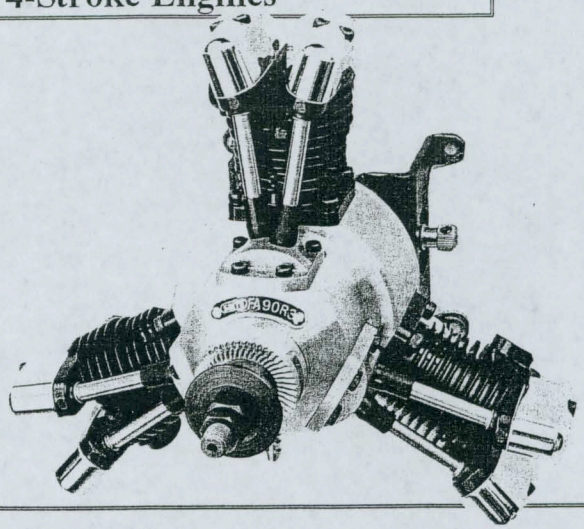
Instructions for SAITO FA-90R3 (AAC) 4-Stroke Engines



We would like to express our sincere thanks for your purchase of the SAITO FA-90R3 engine, which is manufactured by Saito Seisakusho, Ltd. Please read our instructions carefully and treat your engine with care. Should there be a manufacturing defect, Saito Seisakusho, Ltd. will make necessary repairs free of charge. You are requested to strictly avoid disassembling the engine since assembled with the use of special tools and jigs to assure perfect construction.

In the case of breakage or trouble, if encountered due to crash or others, please send the engine to our service station.

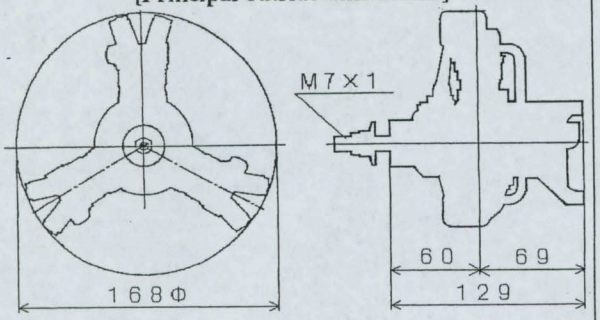
Please notice that our guarantee will not cover any breakage or trouble on the engine caused by your disassembling or modification.

Please refer to the following data to select engine models.

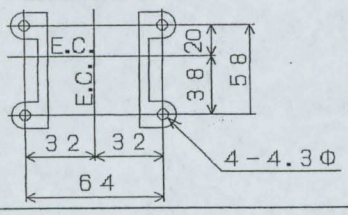
FA-90R3 data

Bore	20.0 ϕ mm x 3	Weight	Approx. 850 g (Engine only)	Propeller	Standard APC12" × 7" ~ 13" × 7"
Stroke	16.0 mm x 3	Engine outside diameter	Approx. ϕ168 mm	Practical speed	2,000 ~ 10,000 rpm
Stroke volume	15.09 cc	Explosion order	1-3-2 (See the figure below.)	Static thrust	Approx. 3.0 kg (by APC13" × 6" propeller)
Fuel flow	25 cc/min (at full throttle, fuel of synthetic oil type with 15 % of nitro content, propeller of APC13" × 6" at approx. 9,500 rpm)				
	*Fuel flow varies depends upon propeller load. More fuel flow with larger load and less fuel flow with smaller load.				

[Principal outside dimensions]



Mount size



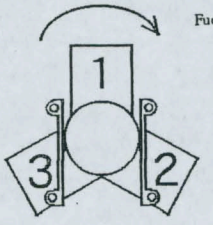
[Explosion order]

(1-3-2)

Propeller rotational direction
Cylinder numbers viewed from the rear

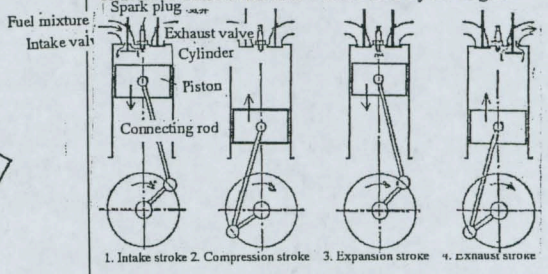
(1 – 3 – 2)

Propeller rotational direction



[Explanation of 4-Stroke Engine]

The four-stroke engine provides four individual piston movements as illustrated below. The "Stroke" means the piston movement from the upper dead center to the lower dead center. In the four-stroke engine, one cycle of operation in change of gas state inside the cylinder and valve movement are completed at every four strokes (two to-and-fro movements) of piston that is every two revolutions of the crankshaft. Formally the engine is called the four-stroke one-cycle engine.



Unique features of SAITO FA-90R3 engines include:

- Optimum for small-size scaled airplane
- Low vibration (assured by constant-interval explosion)
- Easy engine starting (normal direction)
- Exhaust noise sounding like an actual airplane
- The engine is designed to equalize fuel mixture and minimize misfire due to insufficient distributing at idling by means of special port type intake manifold originally developed by Saito.
- Cylinder head: Improved semi-spherical combustion chamber assures better combustion efficiency and volumetric efficiency.
- Cylinder: The aluminum cylinder is directly hard-chrome plated on its inner surface without installing liners to reduce weight and increase durability. The monolithic structure of cylinder head and cylinder prevents distortion and improves cooling efficiency.
- Piston: The piston is made of high silicon content aluminum and attached with a compression ring to heighten engine performance.
- Crankshaft: Has a forged solid construction made of chrome molybdenum steel, and supported by two ball bearings.
- Cam: Features high cam providing longer maximum lift time.
- Carburetor: Of slow throttling type
- Propeller nut: Designed to have double nuts preventing loosening and fall-off for the safety.

Standard Accessories

1. Wrench for tappet adjust screw	1 pc.	Exhaust pipe/ gasket	3 pcs.
2. Limit gauge (0.1t) for tappet adjust screw	1 pc.	7. Needle valve extension bar	1 pc.
3. Slow needle adjust screwdriver	1 pc.	8. P-S glow plug	3 pcs.
4. Hexagonal wrench (Size: 1.5, 2.0 and 2.5)	1 set	9. Plug heating connector set	1 set
5. Double-ended wrench (Size: 10 × 12)	1 pc.	(3pcs. of red cord, 1 pc. of black cord, 2 pcs. of fixture)	

(B) Manual starting method (For the safety, wear gloves, use a safety stick and etc.)

① First turn on the transmitter switch. (Before turning on the transmitter switch, check if the throttle stick is located at the full-close position.) Then turn on the receiver switch to check throttle valve operation. (After checking fully close the throttle valve.)

② Open main needle by about 3 turns. (This is just for a guide. Further open the main needle if fuel mixture is lean or close if rich after starting the engine. Additionally note that larger propeller requires further opening and smaller propeller closing.)

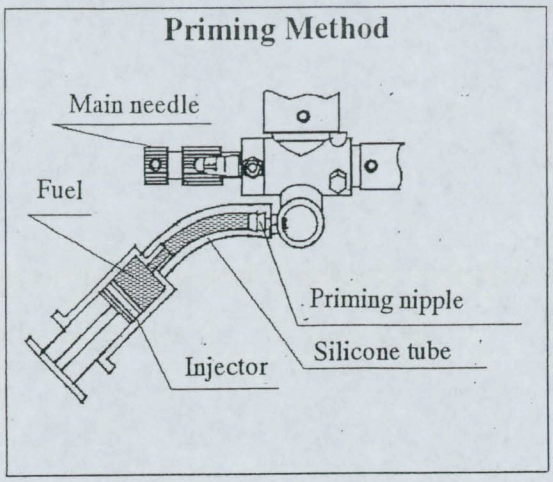
③ Prime the engine. Open the throttle valve fully by using the throttle stick. Insert a proper length of silicone tube into the priming nipple. Use an injector to fill a proper amount (1 ~ 2 cc) of fuel into the carburetor.

④ Manually crank the engine 2 to 3 turns to supply fuel into cylinders. Then use the throttle stick to fully close the throttle valve.

⑤ Open the throttle valve about 1/4 to 1/3 from the full close position by using the throttle stick. (Starting with excessively opened throttle is dangerous since the airplane jumps forward.)

⑥ Set the propeller at the point of 30 ~ 45 ° from the horizontal position, with the engine turned in normal direction (counterclockwise) to the position to be compressed.
Then power the plug for heating. (Heat three pieces of plug separately if the battery has lower capacity.)

⑦ Hardly crank the engine in normal direction (counterclockwise), to start the engine.



G. Break-in

As break-in is an important procedure to pull out maximum performance of the engine, it must be cautiously implemented.

① After filling up the fuel tank, start the engine as described in the above section F. Use the throttle stick to open the throttle valve to about half open. Adjust the main needle while observing tachometer reading, exhaust oil concentration and exhaust concentration from the breather, to run the engine at 5,000 rpm or lower speed in rich condition for full tank fuel consumption. (Run the engine with plugs powered as required.)

Caution: The purpose of break-in is initial adjusting of the master rod, link rod, bearings, gears and other mobile parts under the condition with rich fuel mixture. Never make the fuel mixture lean. Lean fuel mixture could cause seizure even if the engine drops to idling and runs at low speed.

② Next adjust the main needle and throttle valve opening to run the engine in rich fuel condition at 7,000~8,000 rpm for full tank fuel consumption. (In this stage also observe tachometer reading, exhaust oil concentration and exhaust concentration from the breather.)

③ Next fully open the throttle valve and adjust the main needle to run the engine at approximately 9,000 rpm for full tank fuel consumption.

④ Finally adjust the main needle to run the engine at peak speed and less speed alternately. When the engine comes to run at a peak speed stably, ground break-in has completed for the time being. Now adjust valve clearance by following the procedure of maintenance described later. Then adjust carburetor according to the next article and make test flights at less speed around ten times to complete break-in. (Thereafter make flights at less speed, to prolong engine life.)

Caution: During flight: In an earlier stage of flight days, fly airplane only in the windward keeping high altitude and closer distance so that the airplane is able to return to the airfield even at engine stop. If you fly airplane at lower altitude from the beginning, body of airplane may be damaged at emergency landing if required due to engine trouble.

Note: Rotary units and slide ways of the engine have been lubricated at assembly with black molybdenum oil to prevent wearing or seizure. Hence black exhaust oil comes out of the breather nipple and muffler at break-in operation. This could not be a trouble and you can continue flying the airplane.

H. Handling and Adjustment of Carburetor

(Strictly avoid changing the direction of carburetor installation. Failure to do this will cause engine malfunction.)
The Saito carburetor has been adjusted on its slow needle to our reference value before shipping. The slow needle requires some correction depending on various factors including the installation position of engine, types of proper/fuel/plug, or climate conditions. Readjust the slow needle referring to the figure shown below.

[Reference value (only for a guide)]

Main needle: Open the needle by two turns from the full close point.

Slow needle: Fully close the throttle valve and slow needle clockwise to the end. Then open the slow needle by about three turns from the full close point.

① After filling up the fuel tank, start the engine as described in the previous section F.

② Use the throttle stick to fully open the throttle valve. Adjust the main needle while observing tachometer reading, exhaust noise and exhaust smoke, to attain the speed peak.

Caution: Excessive closing of main needle could cause knocking and give damage onto the engine. In such occasion, immediately turn the main needle counterclockwise to lower speed.

③ Next control the throttle stick to gradually close the throttle valve to run the engine stably in the range of around 2,000~2500rpm. (Adjust the throttle stick while observing tachometer reading, exhaust smoke concentration, or exhaust/intake noise.

a. Rich fuel mixture: Turn the slow needle clockwise to make fuel mixture leaner.

b. Lean fuel mixture: Turn the slow needle counterclockwise to make fuel mixture richer.

④ Once idling speed is set, use the throttle stick to slowly open the throttle valve to full open. If the speed becomes irregular or suddenly increases on the way, carefully adjust the slow needle so that engine speed changes linearly from the idling to the peak speed.

⑤ When the above adjustment is completed, quickly change the speed from idling to the peak. If the speed does not reach the peak on opening the throttle valve to full open point, return the main needle by the amount single knurl notch gives. Then quickly change the speed from idling to its peak again. Repeat this procedure cautiously to attain the best response.

⑥ When all conditions are set, return the adjustment of main needle slightly to lower the maximum speed by 200~300 rpm.

※ Suppose the peak speed with the tank filled full with fuel is at 9,500rpm, set the main needle to reduce the peak speed by 300 rpm into 9,200 rpm. Run the engine at a speed about 300 rpm lower than the peak to prolong the service life of engine and minimize rusting on bearings.

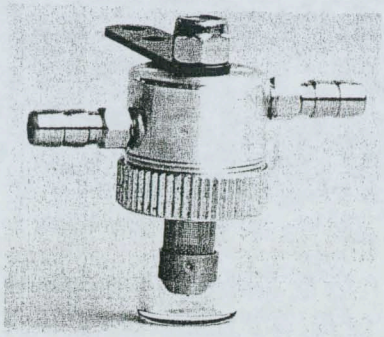
A. Fuel

We recommend the use of synthetic oil fuel having good quality for glow engine with 5 to 20% of nitro content. Since exhaust temperature of four-stroke engine is high, avoid using castor oil as it tends to accumulate the carbon. Also securely install a fuel filter.

Saito fuel filter "F-1" exhibits highest performance.

Fuel filter [F-1]

Weight: 10 g
Scale: ×2



B. Fuel tank

Select a suitable capacity of fuel tank for the model airplane available in the market referring to the data. Level the tank approximately 5 mm below the center of carburetor. Also place the weight of the fuel inlet at a distance of approximately 3 mm from the rear wall of the tank. Since Saito engine employs muffler pressure, careful attention is required for the leakage. Moreover regulate the silicon tube length of piping to the minimum necessary extent.

C. Plug

Since one explosion occurs in every two rotations in 4 stroke engine, selection of the plug is important. Use of improper plug causes engine trouble. Engine performance varies according to the matching with the fuel or to the season. We recommend testing various types of plugs for the best performance.
(Some types of plug by other manufacturers exhibit good matching with Saito engine. Also the plug deteriorates after many flight hours even if not broken. Hence frequent replacing the plug with new one would be necessary.)

Use of SAITO "SAI GP01" (S S) Glow Plug is recommended.

D. Propeller

The standard size propeller ranges from APC12" × 7" ~ 13" × 7" although it varies according to the body type of airplane. Select one with high reliability available in the market.
The propeller requires thorough balancing. (Use a propeller balancer to attain correct balancing.) Unbalanced propeller creates excessive vibration, lowers performance and invites danger. If you find flaw or other defects, replace the propeller with new one since dangerous.
Use a propeller that matches to the airplane and turns smooth in 8,500~10,000rpm of the maximum speed range on the ground in view of the characteristics of this engine. Propeller speed varies by manufacturers and also in some instances, among propellers of the same size by the same manufacturer. We recommend testing various types of propellers.

Note Avoid operating the engine with a propeller allowing over 10,000 rpm of speed on the ground or with a large load propeller lowering speed below 8,500 rpm. Crankshaft, bearings, master rod, cam or gear would be damaged otherwise.

E. Preparation for Engine Starting

① Mount the engine on the sturdy test bench with correct parallelism or on the body of airplane. (Fix the test bench or airplane body to prevent moving.)
② Use a fuel tank with a capacity of 400 ~ 500cc to test the engine on the bench, or use the tank already installed on the airplane body.
③ Use fuel with approximately 15 % of nitro content, other than low-oil fuel.
④ For test prepare APC13" × 7" propeller (standard rotation at approx. 9,500 rpm).
To mount the propeller on the engine, temporarily set the propeller on the engine first. Turn the propeller in normal direction (counterclockwise). Loosen the propeller once after compression is given to the engine. Reset the propeller at the point of 30 ~ 45 ° from the horizontal position. Set and securely tighten double nuts to fix the propeller. (Tighten the propeller at least once in ten flights.)
⑤ Attach silicon tube to the breather nipple to check the exhaust from the breather.
⑥ Use muffler pressure without fail. (The Saito engines have been designed to install the muffler pressure.)
⑦ Unlike 2-stroke engines it is difficult to judge the peak condition on 4-stroke engines clearly. Prepare a tachometer (essential article) to prevent over-throttling or overheating.
⑧ Prepare other necessary articles.

Caution: If spectators stand forward, be sure to have them move behind the airplane prior to start the engine. Also keep one of your arm holding the airplane away from the propeller. On starting the engine, move to the rear of airplane. Make needle adjustment or other controlling from the rear of airplane. If airplane cannot be fixed, ask your assistant to hold the airplane for the safety.

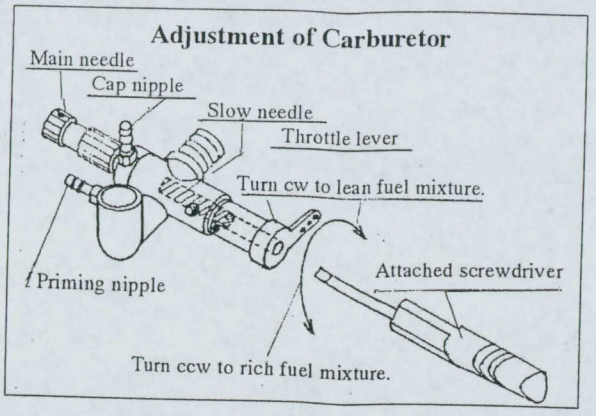
F. Engine Starting

The following is the procedure with the engine mounted on the airplane.

(A) Starting method with a starter (This method is recommended for the safety.)

① First turn on the transmitter switch. (Before turning on the transmitter switch, check if the throttle stick is located at the full-close position.) Then turn on the receiver switch to check throttle valve operation. (After checking fully close the throttle valve.)
② Open main needle by about 3 turns. (This is just for a guide. Further open the main needle if fuel mixture is lean or close if rich after starting the engine. Additionally note that larger propeller requires further opening and smaller propeller closing.)
③ Open the throttle valve about 1/4 to 1/3 from the full close position by using the throttle stick. (Starting with excessively opened throttle is dangerous since the airplane jumps forward.)
④ Turn propeller in reverse direction (clockwise) until engine is compressed.
⑤ Power the plug for heating. (Heat 3 pieces of plug separately if the battery has lower capacity.)
⑥ Apply the starter to the propeller and activate for about 5 seconds, to start the engine easily.

Caution: Do not activate the starter to start the compressed engine in forward direction since dangerous.



I. Normal Operation and Maintenance

(a) Do not operate your engine too lean at full throttle since the engine might be overheated. Adjust the main needle slightly lower than the peak. (Too lean operation causes knocking, stoppage or negative influence on the connecting rods and cam gear.)

(b) After completing ground break-in or operating the engine for one hour, adjust tappet gaps (valve clearances) by following the procedure below to compensate initial wearing, while the engine is cold.

① Remove plugs and rocker arm covers of all cylinders.

② For instance start adjusting from the No. 1 cylinder. Turn the propeller slowly forward by hand, to stop the rocker arm of the No. 1 cylinder. Further turn the propeller, to bring the piston to the upper dead center of compression stroke.

③ Use the attached wrench and hexagonal wrench to adjust the gap indefinitely close to zero within the range compression exists.

④ On checking the gap, securely tighten (but not excessively) the locking nut.

※ In the case of general model airplane engine, small gap is given to tappets to absorb valve elongation. In the case of Saito engine, gap becomes larger in operation due to thermal expansion of the cylinder (mode of aluminum). Therefore set the gap indefinitely close to zero while the engine is cold.

Occasionally check tappet gap by following the above procedure. When the attached gauge (limit gauge, t = 0.1 mm) comes to be inserted, gap has been enlarged beyond the allowable limit. Make an adjustment to lessen the gap. Tappet gap is the most important factor in the maintenance of 4-stroke engine. Operating the engine with the tappet gap enlarged excessively will cause poor performance or trouble.

(c) Lubricate the rocker arm and valve area at inspection as required.

(d) When connecting the exhaust pipe to the cylinder or attaching the propeller nut, apply thin coat of silicon rubber (not excessively) on the thread section before tightening. This prevents leakage or loosening.

(e) Occasionally tighten the propeller nut and exhaust nut (while it is hot).

(f) After a flight, lubricate the entire engine with spray type preserve lubricant through the carburetor or breather.

(g) If the engine is not operated for a longer period of time, lubricate the entire engine before placing a plastic cover on.

J. Internal Lubrication of Engine and Waste Oil Disposal

Oil contained in fuel enters into the crankcase through the clearance between the piston and cylinder to lubricate the piston, connecting rod, bearings, cams and gears. Waste oil is discharged from the breather nipple located at the lower part of crankcase. Connect a silicone tube to the breather nipple and clamp the other end of tube at the end of exhaust pipe by using bands.

J. Supplementary Notes:

(a) Precautions for wiring of attached connector set to heat plugs:
To equalize current, bind cables without cutting them even if long.
※ The engine adjusted properly does not require plug heating at idling (2,000 ~ 2,5000 rpm).

(b) Causes of reversing at starting:
* Priming amount is inadequate.
* Manual-cranking speed is insufficient.
* Voltage or current for plug heating is low.

(c) Please notice that our guarantee will not cover any breakage or trouble on the engine caused by your disassembling or modification.
If disassembling becomes necessary, observe the following precautions.
Place match marks by yourself as required while checking direction of parts in proper sequence to disassemble the engine with sufficient care. In particular, careful attention is required for valve timing and installation directions of rear cover, piston, master rod, or link rod.

(d) Notes for purchasing parts:
Please give orders directly to us, together with a sheet entered with engine name, part name, part number, and marking (alphabet on the lower face of rear cover).

(e) Take an extreme care for the safety when operating the engine or flying the model airplane not to bother others.

(f) Engine for model airplane is not a toy. Handle it with an extreme care.

All specifications and models are subject to change without notice.

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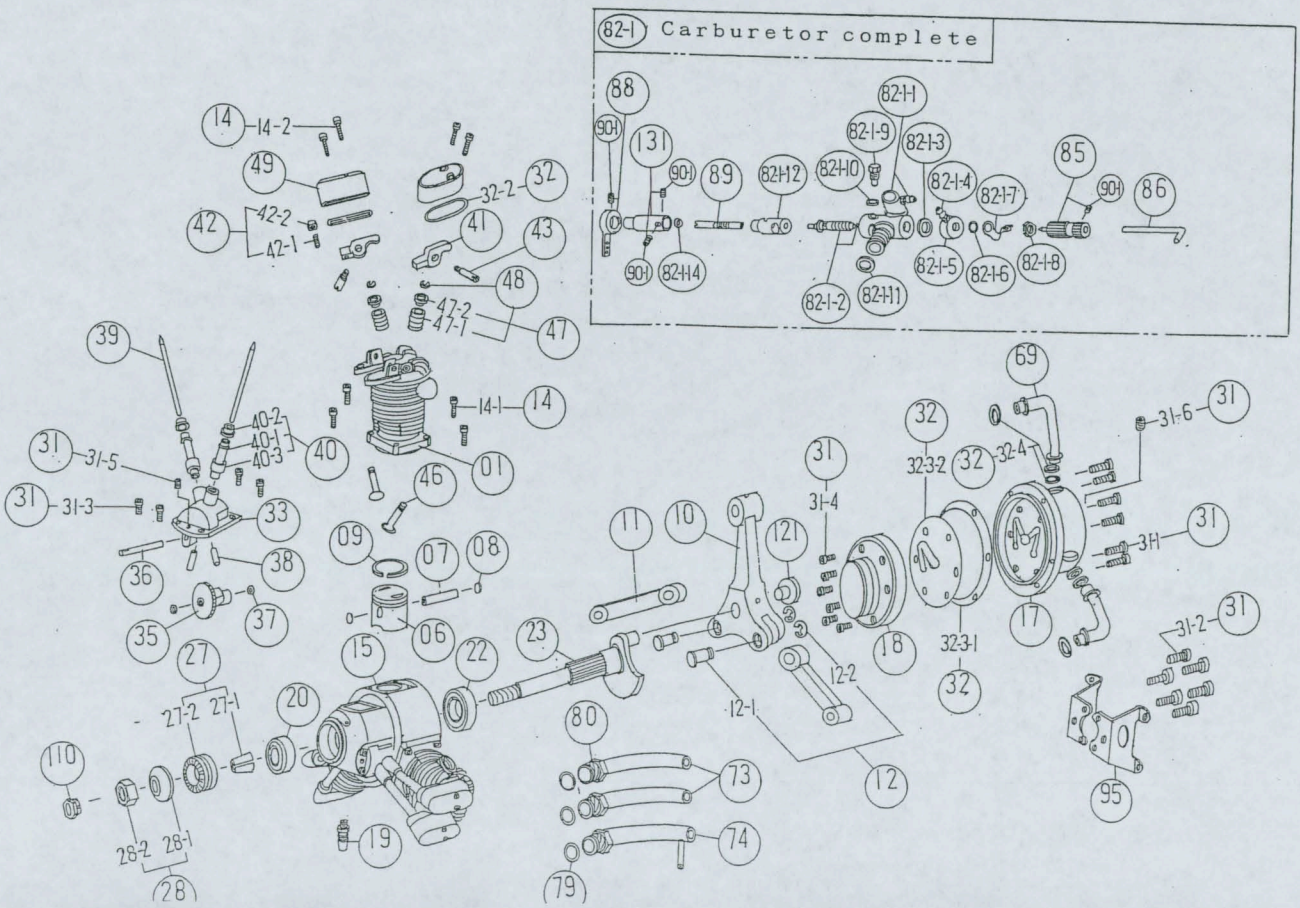
SAITO FA-90R3 Parts List

NO	Description	Q'ty
01	Cylinder	3
06	Piston	3
07	Piston pin	3
08	Piston pin retainar	6
09	Piston ring	3
10	Connecting rod(Master rod)	1
11	Linked conrod(Link rod)	2
12-1	Linked conrod pin(linkpin)	2
12-2	Linked conrod pin retainar(E-ring)	2
14	Cylinder screw set(14-1,14-2)	3set
15	Crankcase	1
17	Rear cover(A)(Intake manifold)	1
18	Rear cover(B)	1
19	Breather nipple	1
20	Front bearing	1
22	Rear bearing	1
23	Crankshaft	1
27	Taper collet & Drive flange(27-1,27-2)	1ea.
28	Prop washer & Nut(28-1,28-2)	1ea.
31	Crankcase screw set	1set
	31-1,31-2,31-3,31-4,31-5,31-6	
32	Engine gasket set	1set
	32-2,32-3-1,32-3-2,32-4	
33	Cam gear housing(33,31-5)	3
35	Cam gear	3
36	Cam gear shaft	3

NO	Description	Q'ty
37	Steel Washer set	1set
38	Tappet(Valve lifter)	6
39	Pushrod	6
40	Pushrod cover & Rubber seal(40-1,40-2,40-3)	6ea.
41	Rocker arm	6
42	Rocker arm screw & Nut(Adjust screw& lock nut)	6ea.
	42-1,42-2	
43	Rocker arm pin	6
46	Valve (in & out)	6
47	Valve spring & Keeper & Retainer lock	6ea.
	47-1,47-2,48	
48	Valve spring retainer lock	6
49	Rocker arm cover	6
69	Intake manifold(Intake pipe)	3
73	Muffler	2
74	Muffler /nut w/pressure	1
80	Muffler nut	2
82-1	Carburetor complete	1set
83	Carburetor body assembly	1set
	82-1-1,82-1-2,82-1-3,82-1-4,82-1-5,82-1-6 82-1-7,82-1-8,82-1-9,82-1-10,82-1-11	
85	Full throttle needle	1
87	Throttle barrel assembly	1set
	82-1-12,82-1-14,82-1-15,88,89	
95	Engine mount	1set
110	Anti-loosening nut	1
121	Crank pin spacer(Master rod retainar)	1
131	Throttle valve extension adopter	1

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