It is of vital importance, before attempting to operate your engine, to read the general 'SAFETY INSTRUCTIONS AND WARNINGS' in the following section and to strictly adhere to the advice contained therein.

- Also, please study the entire contents of this instruction manual, so as to familiarize yourself with the controls and other features of the engine.

SAFETY INSTRUCTIONS AND WARNINGS ABOUT YOUR ENGINE

Remember that your engine is not a " toy ", but a highly efficient internal-combustion machine whose power is capable of harming you, or others, if it is misused or abused. As owner, you, alone, are responsible for the safe operation of your engine, so act with discretion and care at all times. If at some future date, your engine is acquired by another person, we would respectfully request that these instructions are also passed on to its new owner.

■ **The advice which follows is grouped under two headings according to the degree of damage or danger which might arise through misuse or neglect.**

⚠WARNINGS

These cover events which might involve serious (in extreme circumstances, even fatal) injury.

⚠ NOTES

These cover the many other possibilities, generally less obvious sources of danger, but which, under certain circumstances, may also cause damage or injury.

⚠WARNINGS

Model engine fuel is poisonous. Do not allow it to come into contact with the eyes or mouth. Always store it in a clearly marked container and out of the reach of children.

Model engine fuel is also highly flammable. Keep it away from open flame, excessive heat, sources of sparks, or anything else which might ignite it. Do not smoke or allow anyone else to smoke in the vicinity of operation.

Model engines generate considerable heat. Do not touch any part of your engine until it has cooled. Contact with the muffler (silencer), cylinder head or exhaust header pipe, in particular, may result in a serious burn.

Never operate your engine in an enclosed space. Model engines, like automobile engines, exhaust deadly carbon-monoxide. Run your engine only in an open area.

⚠ NOTES

- This engine is intended for model cars. Do not attempt to use it for any other purpose.
- Mount the engine in your model securely, following the manufacturer's recommendations, using appropriate screws and locknuts.
- Install an effective silencer (muffler). Frequent close exposure to a noisy exhaust (especially in the case of the more powerful highspeed engines) may eventually impair your hearing and such noise is also likely to cause annoyance to others over a wide area.
- The wearing of safety glasses is also strongly recommended.
- Take care that the glowplug clip or battery leads do not come into contact with rotating parts. Also check that the linkage to the throttle arm is secure.
- For their safety, keep all onlookers (especially small children) well back (at least 20 feet or 6 meters) when preparing your model for running.
- Before starting the engine, always check the tightness of all the screws and nuts especially those of joint and movable parts such as throttle arm. Missing retightening the loose screws and nuts often causes the parts breakage that is capable of harming you.
- To stop the engine, fully retard the throttle stick and trim lever on the trans-mitter, or, in an emergency, cut off the fuel supply by pinching the fuel delivery line from the tank.
- Warning! Immediately after a glowplug-ignition engine has been run and is still warm, conditions sometimes exist where by it is just possible for the engine to abruptly restart if it is rotated over compression WITHOUT the glowplug battery being reconnected.

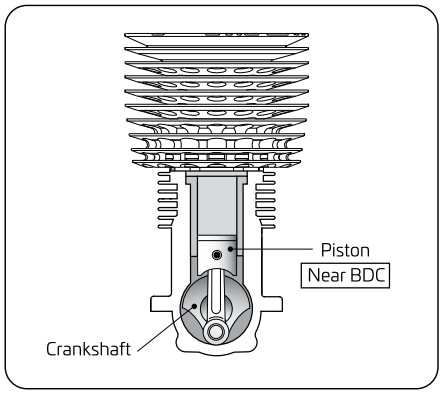
■ NOTES ON OPERATION

While Operating

- **Please do not run on a public street, this could cause serious accidents, personal injuries and/or propetry damage.**
- **Please do not run near pedestrians or small children.**
- **Please do not run in small or confined areas.**
- **Please do not run where loud noises can disturb others, such as hospitals and residential areas.**

■ How to stop the engine

To stop the engine, use a suitable tool to make contact with the flywheel. This will stop the engine. Next you should make sure the piston in the BDC (bottom dead center) position.



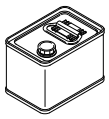
Warning!
Use care when touching rotating parts, engine and muffler when stopping the engine as they become very hot, and contact with them may result in a serious burn or injury.

■ TOOLS, ACCESSORIES, etc.

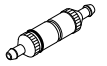
The following items are necessary for operating the engine.

● **Items necessary for starting**

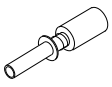
FUEL
Generally, it is suggested that the user selects a fuel that is commercially available for model two-stroke engines. When the brand of fuel is changed, or the nitro content increased, it is advisable to repeat the running-in procedure referred to in the RUNNING-IN paragraphs. Please note that with high-nitro fuels, although power may be increased for competition purposes, glow plug elements do not last as long and engine life will be shortened.



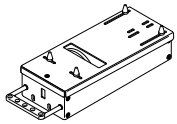
FUEL FILTER
To be installed in the fuel line between fuel tank and carburetor to prevent foreign matter from entering the carburetor.



GLOWPLUG IGNITER
Commercially available handy glowplug igniter in which the glowplug battery and battery leads are integrated.

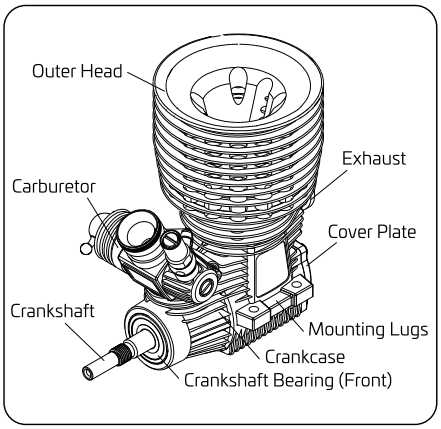


STARTER BOX
For starting the engine.



FUEL BOTTLE
For filling the fuel tank, a simple, polyethylene "squeeze" bottle with a suitable spout is required.

■BASIC ENGINE PARTS

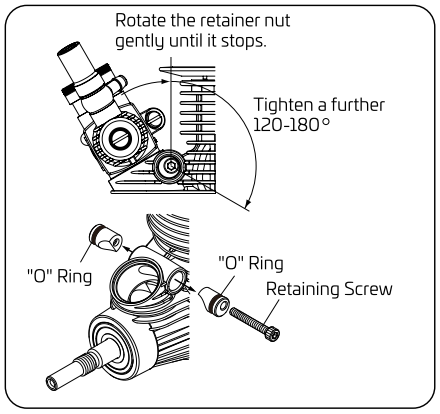


NOTE: While the needles are set at the standard position when the engine leaves the factory, readjustment may be necessary to allow for changes in fuel formula and climatic conditions. Readjust the controls only when satisfactory results cannot be obtained with the standard positions following the instructions mentioned in the "CARBURETOR ADJUSTMENT" section.

NOTE
As delivered, the engine has the carburetor lightly fit into its intake. Adjust its angle to best suit the vehicle and secure it in place.

■ INSTALLATION OF THE CARBURETOR

As delivered, the engine has its carburetor lightly installed in the intake boss. Secure it as follows.



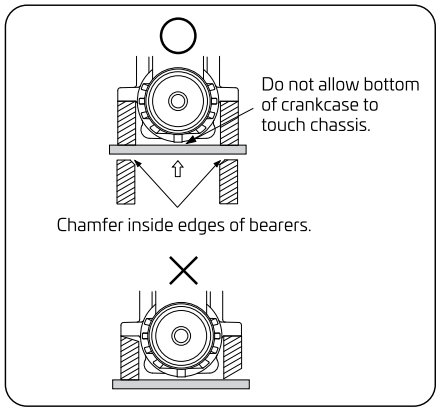
1. Loosen the retainer screw, rotate the carburetor to its correct position and make sure that it is pressed well down into the intake boss, compressing the rubber gasket, before retightening screw.

2. Rotate the retainer screw gently until it stops, then tighten a further 120-180°.
   Do not overtighten the screw as this will damage the thermo insulator.

Note:
Be careful not to damage the O rings when removing the carburetor retainer from the engine. First, remove the retainer Retaining screw, then pull out each part. Do not push the part in or damage the O rings.

■ ENGINE INSTALLATION

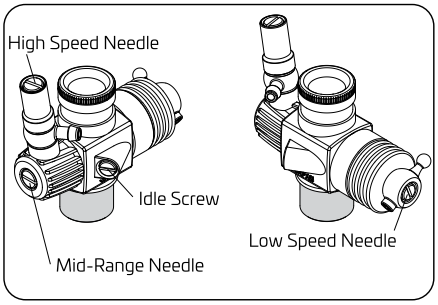
Make sure that the vehicle's engine mounting surfaces are level and in the same plane. Poor installation may cause distortion of the crankcase, bearings, etc., resulting in erratic running and loss of performance.
The recommended screws for securing the engine are 3mm or 4-40 steel Allen hexagon socket type. If existing holes in the engine mount do not align perfectly with engine mounting lugs, enlarge them slightly with a needle-file so that screws are in alignment with the mounting holes.



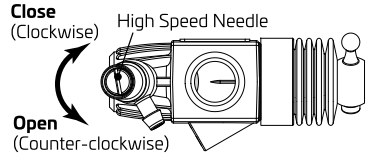
NOTE:
The engine bottom may interfere with chassis of some models. In this case, file off the chassis so that the engine may not interfere with the chassis when it is installed.

■ CARBURETOR CONTROLS STANDARD POSITIONS (POSITIONS WHEN THE ENGINE LEAVES THE FACTORY)

Four adjustable controls are provided on this carburetor.

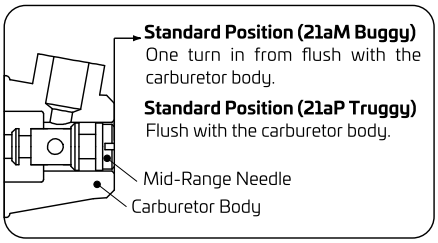


- **The High Speed Needle:**
  For adjusting air/fuel ratio (air-fuel mixture) at maximum rpm (fully opened throttle).

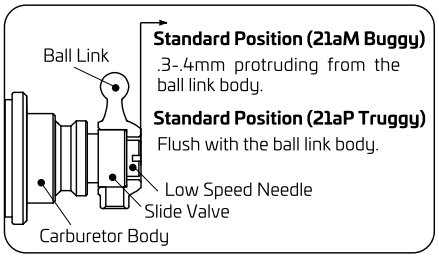


Standard Position (21aM Buggy)
3 turns opened from the fully closed position.
Standard Position (21aP Truggy)
3 and 1/4 turns opened from the fully closed position.
Fully closed position (Both)
Turn the needle-valve clockwise until it stops.
This is the fully closed position.
Do not force it to turn further.

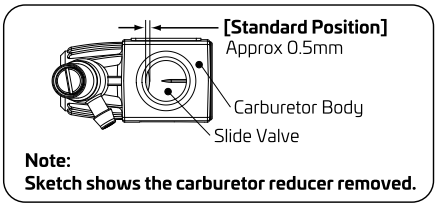
- **The Mid-Range Needle:**
  For adjusting acceleration feeling.
  (Adjusting range should be within ±1 turn.)



- **The Low Speed Needle:**
  For adjusting idle and acceleration feeling.



- **The Idle Screw:**
  For setting the minimum idle speed:



Note:
Sketch shows the carburetor reducer removed.

■ STARTING THE ENGINE & RUNNING-IN ('Breaking-in)

Running- in is a procedure for an engine to come close to actual running conditions (fuel, r.p.m., engine temperature, etc.).
Excessively rich running and prolonged low speed running should be avoided. Prolonged low speed running and low temperature running may result in the oil in the fuel becoming gelled and the piston/liner becoming stuck together.

PRESSURIZED FUEL SYSTEM

- It is recommended that a muffler pressurized fuel feed system be used so that the fuel may be consistently fed to the carburetor.

The following procedure is suitable when a fuel containing 30% nitro-methane is used.

1. Preheat the engine to 200°F before starting.

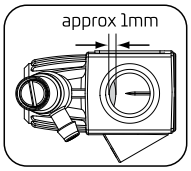
2. Set the carburetor controls to the standard positions (positions when the engine leaves the factory.)

3. Switch the transmitter on and make sure that the linkages move correctly and freely.

4. Make sure the rotating direction of the starter box is correct (counter-clockwise seen from the front edge of the crankshaft), and turn the engine with the starter box to draw fuel into the engine.

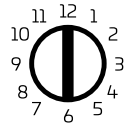
5. Connect glowplug battery lead to heat the plug and start the engine with the starter box.
   When the engine does not start or stops right after being started, try the following.

   - Close the high speed needle approx. 90° from the standard position.
   - Set the idle opening a little wider (approx. 1mm) than the standard setting by adjusting the Idle Screw.



6. When the engine starts, warm it up by repeatedly increasing the rpm to medium speed and back again to a fast idle with the mixture set very rich, glowplug connected, and the driving wheels clear of the ground. The rich mixture will provide adequate lubrication and cooling, indicated by profuse exhaust smoke.

NEEDLE ADJUSTMENT



When adjusting the needles, it is best to imagine the groove in the needle as the dial of a clock. When turning the needles 1 full hour, that would be the same as the hand of a clock moving one full hour.

Attention:
If the engine is allowed to run with the throttle too far open under "no-load" conditions (i.e. with the driving wheels not in contact with the ground) it will rapidly over-heat and may be seriously damaged.

7. Repeat steps 1-6 FIVE times. Make sure the engine returns to ambient temperature between repeating.

8. When the engine is warmed up, disconnect the glowplug battery and try running the car on the track. If the engine stops soon after running at around mid speed, the mixture is too rich. Close the High Speed Needle 1/2~1 full hour.
   If the engine still stalls, close the Low Speed Needle 1/2~1 full hour. Run the car on the track until one tank of fuel has been consumed, then close the High Speed Needle very little (within 1/3 hour).

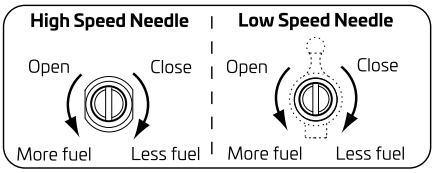
9. Repeat this procedure until approx. 1/2 gallon of fuel has been consumed. Gradually extend full throttle running on the straight as you progress. Carefully observe the exhaust smoke.
   Be sure to run the engine with visible white smoke at all times. If the smoke is not visible, the High Speed Needle is closed too far.

Now the RUNNING-IN (Breaking-in) is completed.

Note:
In the event any of the major parts (e.g. piston cylinder liner assembly) are replaced, the complete running-in proceedure should be repeated.

■ CARBURETOR ADJUSTMENT

Carburetor adjustment should be carried out only after the running-in has been completed.



1. HIGH SPEED NEEDLE ADJUSTMENT

Run the vehicle (with throttle fully open) over the longest available straight course a few times to observe the model's speed. Return the vehicle to the starting point and close the High Speed Needle 1/2 hour and repeat the run again, taking note of the improvement in performance.

Continue with further runs, gradually reduce the High Speed Needle setting, aiming to achieve the highest straight-line speed (optimum position).
Remember, however, if the High Speed Needle is closed too far, the engine will overheat, accompanied by visibly diminished exhaust smoke and the model will lose speed. At this point, you should throttle down immediately, stop the vehicle and reopen the High Speed Needle 1~1 & 1/4 hours.

2. LOW SPEED NEEDLE ADJUSTMENT

After setting the High Speed Needle to optimum position, run the vehicle a few times at the straight line.
With the engine running, close the throttle and allow it idle for about five seconds, then reopen the throttle fully.
If, at this point, the engine puffs out an excessive amount of smoke and the vehicle does not accelerate smoothly and rapidly or even stops, it is probable that the idle mixture is too rich. In this case, turn the Low Speed Needle clockwise 1/2~1 full hour.
If, on the other hand, the engine tends to speed up momentarily and then cut out abruptly when the throttle is opened, the idle mixture is too lean. In this case, turn the Low Speed Needle counter-clockwise 1/2~1 full hour.

3. IDLE SCREW ADJUSTMENT

If the engine runs too fast with the throttle closed, the Idle Screw should be turned counter-clockwise to allow the throttle opening to be reduced.

■ OPTIMUM MID-RANGE NEEDLE POSITION

With the optimum Mid-Range Needle position, light smoke is visible during high speed running and the engine rpm increases smoothly during acceleration. Carry out adjustment 1.~3. patiently until the engine responds quickly and positively to the throttle control.

Remember that, if the engine is operated with the fuel/air mixture slightly too lean, it will overheat and run unevenly. As with all engines, it is advisable to set both the High Speed and Low Speed Needles slightly on the rich side of the best rpm setting, as a safety measure.

Finally, beyond the normal break-in period, a slight readjustment toward a leaner needle setting may be required to maintain maximum performance.

Note:
Please regard the standard positions in the instruction manual as just a guideline. Positions will vary due to the fuel and muffler used. In general, if a fuel containing less nitromenthane is used, the high speed needle will need to be closed further. Remember, closing the high speed needle too far can cause rusting and damage to the engine.

■ CARE AND MAINTENANCE

1. The minute particles of foreign matter that are present in any fuel, may accumulate and partially obstruct fuel flow, causing engine performance to become erratic and unreliable. It is recommended that a good in-line filter be installed between the tank and carburetor.

2. Do not forget to clean the filters regularly to remove dirt and lint that accumulate on the filter screens. Also, clean the carburetor itself occasionally.

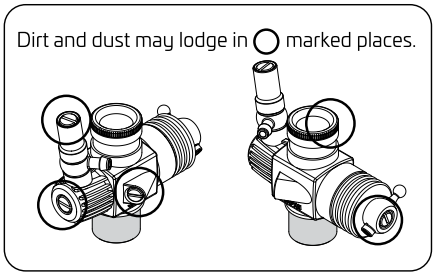
3. At the end of each operating session, drain out any fuel that may remain in the fuel tank.

   Long Term Storage
   Energize the glow-plug and try to restart the engine, to burn off any fuel that may remain inside the engine. Repeat this procedure until the engine fails to fire. Do this while the engine is still warm.

   Then, inject some after-run oil into the engine, and rotate the engine with an electric starter for 4 to 5 seconds to distribute the oil to all the working parts.

Note:
Do not inject after-run oil into the carburetor as this may cause the O-rings inside the carburetor to deteriorate. These procedures will reduce the risks of starting difficulties or corrosion after a period of storage.

4. Finally, when cleaning the exterior of the engine, use methanol or a household cleaning agent. Do not use gasoline, kerosene, or any petroleum based chemical which can damage silicone fuel tubing.



■ REMOVING DIRT/STAIN

Dirt and stains stuck on the engine and muffler/manifold cause heat dissipation. When dirt and stains are detected, remove the engine from the chassis and clean it thoroughly with alcohol.

■ INSTALLING DUST CAPS

When storing the engine, install the cap on the exhaust port, carburetor, etc. to prevent dust from entering the engine.

■ CHECKING THE ENGINE

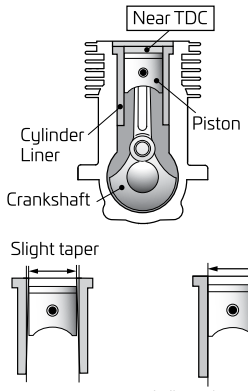
If the engine does not develop normal performance after running for a long time due to worn out parts, it is suggested to replace any necessary parts when the following symptoms are detected.

- Engine sound changes and easily overheats.
- Power has dropped extremely.
- Idle is unstable and/or engine tends to stop at idle.

In most cases, ball bearings, cylinder/piston assembly, connecting rod and/or crankcase have become worn. Check the parts carefully and replace them if necessary.

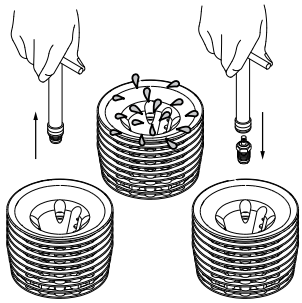
ENGINE CONSTRUCTION

With this engine, the piston will feel tight at the top of its stroke (TDC) when the engine is cold. This is normal. The cylinder bore has a slight taper. The piston and cylinder are designed to achieve a perfect running clearance when they reach operating temperature.



NOTES WHEN APPLYING AN ELECTRIC STARTER

Do not over-prime. This could cause a hydraulic lock and damage the engine on application of the electric starter.
If over-primed, remove glowplug, close needle-valve and apply starter to pump out surplus fuel. Cover the head with a rag to prevent any pumped out fuel from getting into your eyes.



■ ABOUT THE ENGINE

Standard included accessories

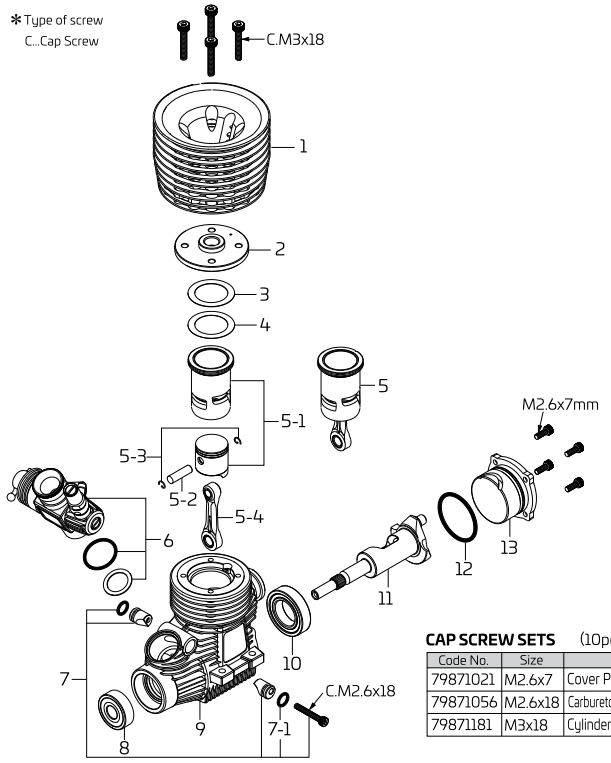
- Glow Plug P3 T-type head (Turbo head) 1piece (Hot Type)

- Exhaust Seal Ring 1piece

- Carburetor Reducer
  Blue - 6 & 6.5mm (21aM Buggy)
  Black - 6.5 & 7mm (21aP Truggy)
  (w/ "O" Ring)

- Dust Cap ø3, ø16, ø18 1piece each

■ ENGINE EXPLODED VIEW



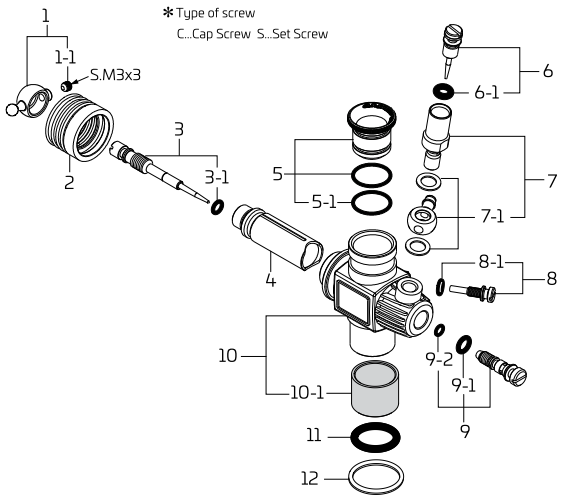
CAP SCREW SETS (10pcs./set)

Code No.	Size	Pcs. used in an engine
79871021	M2.6x7	Cover Plate Retaining Screw (4pcs.)
79871056	M2.6x18	Carburetor Retainer Retaining Screw (1pc.)
79871181	M3x18	Cylinder Head Retaining Screw (4pcs.)

■ ENGINE PARTS LIST

	No.	Code No.	Description
*	1	2B704000	Outer Head (21aM Buggy)
*	1	2B704001	Outer Head (21aP Truggy)
*	2	22424105	Inner Head
	3	22014161	Head Gasket (0.2mm)
	4	22014171	Head Gasket (0.1mm)
	3/4	22014166	Head Gasket Set (0.1mm & 0.2mm)
*	5	22423111	Built-up Parts Set
*	5-1	22423101	Cylinder & Piston Assembly
	5-2	22016001	Piston Pin
	5-3	21817001	Piston Pin Retainer (2pcs.)
*	5-4	22425001	Connecting Rod
*	6	2B781000	Carburetor Complete (21aM Buggy)
*	6	2B781001	Carburetor Complete (21aP Truggy)
	7	23981741	Carburetor Retainer Assembly
	7-1	24881824	"O" Ring (2pcs.)
	8	23731021	Crankshaft Ball Bearing (Front)
*	9	2B701000	Crankcase
	10	23730021	Crankshaft Ball Bearing (Rear)
	11	22422031	Crankshaft
	12	23107101	Cover Gasket
	13	22427101	Cover Plate
		71641321	Glow Plug P3
		22826141	Exhaust Seal Ring
		22615001	"O" Ring (1pc.)
		22884251	Dust Cap Set (3mm, 16mm, 18mm)

■ CARBURETOR EXPLODED VIEW



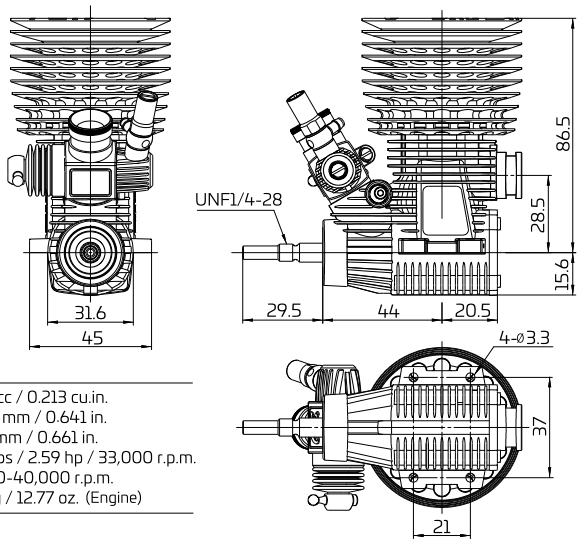
*** marked parts are available only for limited period (one year after finishing the production).**

■ CARBURETOR PARTS LIST

No.	Code No.	Description
1	23781401	Ball Link No.3
1-1	26381502	Retaining Screw
2	23981521	Dust Cover
3	2A381501	Metering Needle Assembly (21aM Buggy)
3	23818341	Metering Needle Assembly (21aP Truggy)
3-1	27881821	"O" Ring (2pcs.)
4	2A381201	Slide Valve (21aM Buggy)
4	22848211	Slide Valve (21aP Truggy)
5	71534360	Carburetor Reducer 6.0mm (Blue/21aM Buggy)
5	71534465	Carburetor Reducer 6.5mm (Blue/21aM Buggy)
5	71533565	Carburetor Reducer 6.5mm (Black/21aP Truggy)
5	71533570	Carburetor Reducer 7.0mm (Black/21aP Truggy)
5-1	22615001	"O" Ring
6	23618198	Needle Assembly
6-1	46066320	"O" Ring (2pcs.)
7	22082941	Needle Holder Assembly
7-1	22082951	Fuel Inlet (No.15)
8	2A381621	Throttle Stop Screw
8-1	27881821	"O" Ring (2pcs.)
9	23781601	Mixture Control Valve Assembly
9-1	46066320	"O" Ring (L) (2pcs.)
9-2	22781801	"O" Ring (S) (2pcs.)
10	2B781100	Carburetor Body (21aM Buggy)
10	2B781101	Carburetor Body (21aP Truggy)
10-1	2AN81102	Thermo Insulator
11	29015020	Carburetor Rubber Gasket
12	23818191	Carburetor Sealing Washer

■ THREE VIEW DRAWING

Dimensions (mm)



SPECIFICATIONS

■ Displacement	3.49 cc / 0.213 cu.in.
■ Bore	16.27 mm / 0.641 in.
■ Stroke	16.8 mm / 0.661 in.
■ Output	2.55 ps / 2.59 hp / 33,000 r.p.m.
■ Practical R.P.M.	4,000-40,000 r.p.m.
■ Weight	362 g / 12.77 oz. (Engine)

The specifications are subject to alteration for improvement without notice.