FACTORY TUNED ENGINE
(21aM BUGGY) & (21aP TRUGGY)

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.

WARNING

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.

NOTES ON OPERATION

While Operating

• Please do not run on a public street, this could cause serious accidents, personal injuries and/or property 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.

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 refer to the running-in procedures 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.

TOOLS, ACCESSORIES, etc.

The following items are necessary for operating the engine.

• Items necessary for starting

FUEL

GLOWPLUG IGNITER

STARTER BOX

• Install an effective silencer (muffler). Frequent close exposure to a noisy exhaust (especially, in the case of the more powerful high-speed 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 tightening the loose screws and nuts often causes the parts breakage that is capable of harming you.

• To stop the engine, fully retract 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 whereby it is just possible for the engine to abruptly restart if it is rotated over compression WITHOUT the glowplug battery being reconnected.

BASIC ENGINE PARTS

Outer Head
Carburetor
Cover Plate
Exhaust
Mounting Lugs
Crankcase
Crankshaft Bearing (Front)
Crankshaft

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 over-tighten 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.

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

2. **Idle Screw**
   - For setting the minimum idle speed.

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

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

5. **Carburetor Body**
   - Do not allow bottom of crankcase to touch chassis.

6. **Chamfer inside edges of bearings.**

### CARBURETOR CONTROLS - STANDARD POSITIONS
(POSITIONS WHEN THE ENGINE LEAVES THE FACTORY)
Four adjustable controls are provided on this carburetor.

- **High Speed Needle**
  - Close (Clockwise) when adjusting the high speed needle.
  - Open (Counter-clockwise) when adjusting the low speed needle.

- **Idle Screw**
  - For setting the minimum idle speed.

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

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

### 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) as seen from the front edge of the crankshaft, then 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.
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.

### 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.

### 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 procedure should be repeated.
**CARBURETOR ADJUSTMENT**

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

- **High Speed Needle**
  - Open
  - Close

- **Low Speed Needle**
  - Open
  - Close

- **More fuel**
- **Less fuel**

**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 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 set too high, 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 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 stop, 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 nitromethane 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 bank 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.

4. 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.

**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-prime, 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.

**Standard included accessories**

- Glow Plug P9 T-Type head (Turbo head) 1 piece (Hot Type)
- Exhaust Seal Ring 1 piece
- Carburetor Reducer Blue - 6 & 6.5mm (21A) Buggy
  Black - 6.5 & 7mm (21A) Truggy
  (w/ "O" Ring)
- Dust Cap P3, P16, P18 1 piece each