

# Tuning the R/C Engine for Stunt

April 5, 2017

Last year, I started flying my RToucan with EVO60NX engine. This engine is the R/C engine (Evolution PN EVOE0600) and had the compression ratio higher than typical stunt engines. The exhaust timing is also higher (~150 deg.), the crank timing more advanced and the intake and transfer ports geometry differ from typical stunt engines like ST60 or Jett60.

As powerbands RPM range is determined primarily by the port heights and sizes, this engine had too much power for stunt at stable, rather high RPM on large diameter two blade propeller.

Too much power and high RPM translate of course into too fast flying with too much lines tension.

The engine was also noisy. I used my own exhaust deflector that was very small and very light but did not work like the expansion muffler. Consequently, the engine noise level on the ground was 103 dBA measured according to FAI or AMA recommendations.

I partially tamed this engine and it works now better for stunt. I am writing "better" as this kind of engine will never give such "ideal" 2-4-2 break like well tuned ST60 or Jett.

The flights on Nov.15, 2016 with 13x4 MAS propeller and expansion muffler demonstrated that:

1. Launch RPM were stable at ~10,000 range (**this is still too high, 8,300-8,500 is the target**)
2. Lap times are 4.8-4.9 seconds on 61' 1" long (eye-to-eye), 0.018" braided lines
3. Engine has roughly the same RPM in level, inverted, nose up and nose down model positions
4. The noise level was acceptable (93 dBA) using AMA - ref:

<http://www.modelaircraft.org/files/927.pdf> and FAI Sporting Code (excerpt below):

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"The official noise test procedure shall be for a noise meter to be positioned at 3 metres from the longitudinal (fore and aft) centre line of the model aircraft, with the model aircraft placed on the ground (ideally over a concrete or asphalt surface) adjacent to the contest flight circle, and with the inboard wingtip of the model aircraft facing towards the wind (when the model aircraft is set up to fly anti-clockwise). With the motor running at it's normal Take-off power setting, measurement shall be taken at 90 degrees to the flight path of the model aircraft, from the side of the model aircraft which is towards the outside of the model aircraft's flight path, and with the noise meter microphone placed on a stand 30 cm above the ground and in line with the motor/s. No noise-reflecting object shall be nearer than 3 metres from the model aircraft or from the noise meter microphone when measurement is taking place. **If performed on a concrete or asphalt surface the maximum permitted noise level shall be 96 dB(A). If a hard surface is not available then the noise measurement may be taken over grass but in this case the grass shall not exceed 2.5 cm in length. When measuring noise over grass the maximum permitted noise level shall be 94 dB(A).**"

I could not find any MAAC recommendations, rules or suggestions regarding this important issue.

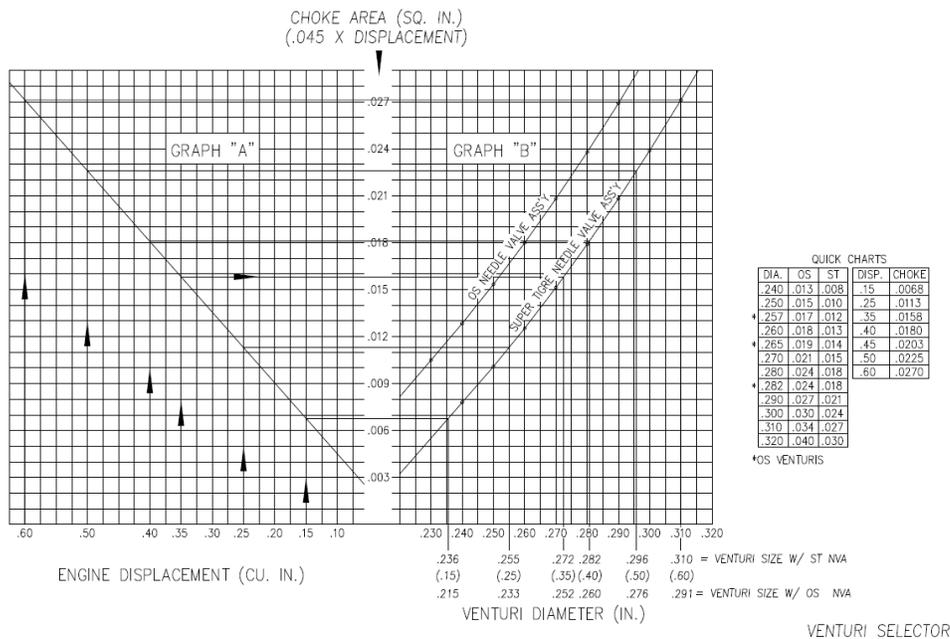
For the RToucan flights on Nov. 15, 2016, EVO60NX had 0.51 mm. of head shims.

Total number of head shims: 5.

When the engine was purchased, there was only one, 0.20 mm. thick head shim installed.

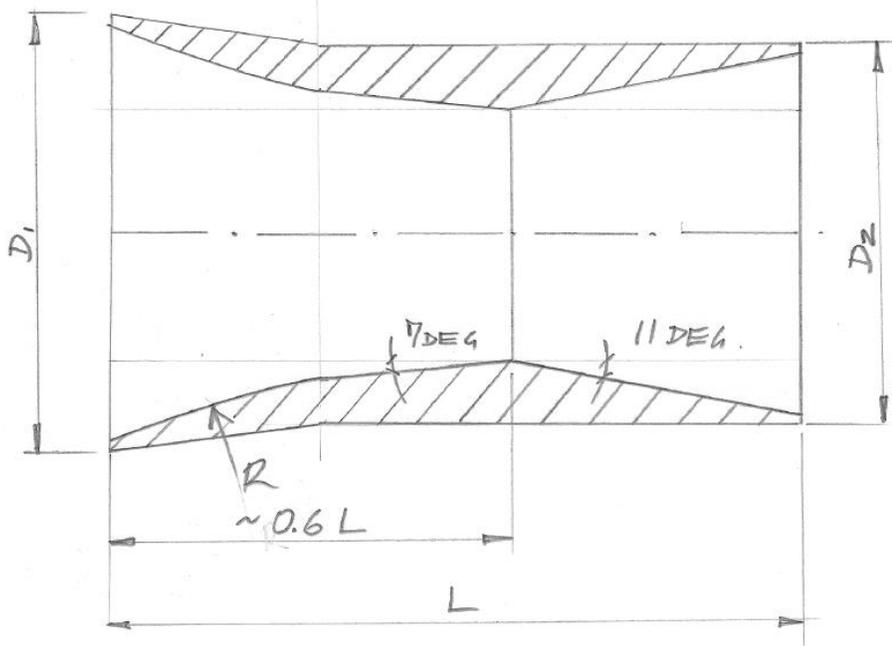
The venturi choke area diameter has been decreased from 0.308" to 0.285".

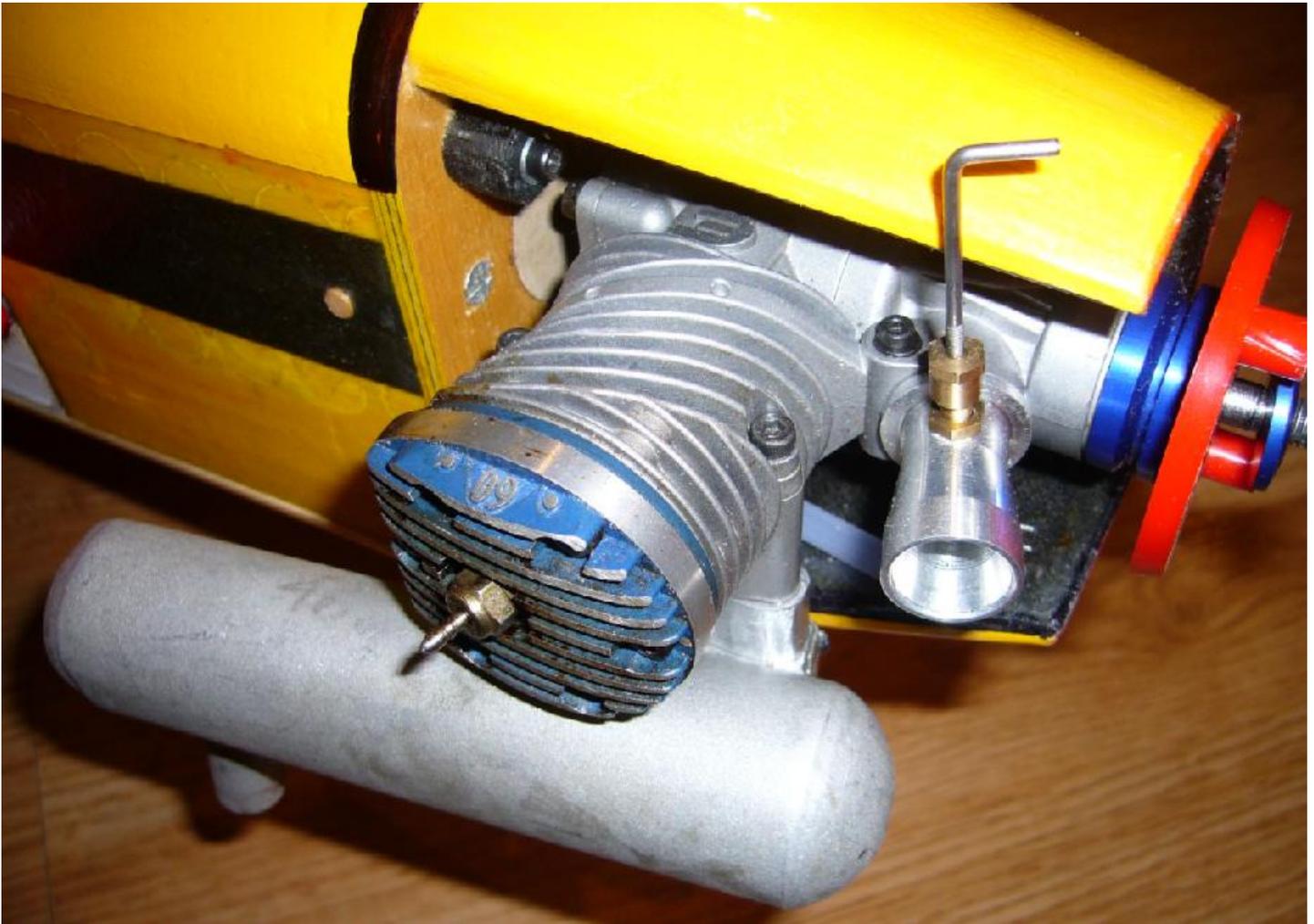
A very useful graph below allows to select the venturi diameter w/r to the engine displacement. **This graph is only valid for the NVA installed along the diameter of the venturi.**



The custom machined venturi ( below) has Super Tigre 60 NVA located at 0.6L level.

L for EVO60NX = 1.45". 7 and 11 degrees are typical for converging and diverging parts of the stunt venturis. R=1.5".





EVO60NX, ST60 NVA, venturi and 6.5:1 expansion ratio muffer.

More work is expected during 2017 outdoor season to bring the launch RPM to stable~8,300-8,500.

I will be experimenting with low or no nitro content and venturi choke area diameter.

I already know that this engine will not work well and effectively in 2-4-2 regime and, when tuned properly, will stay in the so called 2-2 break with minimal variation of RPM in maneuvers.

After shortening and rebuilding of the entire front part of the fuselage to stiffen and strengthen it, adding the expansion muffer, partial cowl and spinner, RToucan weights now 1942 grams (68.5 oz.).

This RTF dry weight gives the wings loading 15.2 oz./ft.<sup>2</sup>. what is 15% higher than typical, good stunt planes. I hope to find a reasonable compromise between the launch RPM, lines tension and lap times.

To be continued.....