



# Vannik

## Developments CC

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# EngMod2T

The Multi-Cylinder Two-Stroke  
Engine Simulator

# EngMod2T

EngMod2T is a Two-Stroke Engine Simulator that simulates the gas-dynamic processes, the thermodynamic processes and the mechanical processes of an engine. It allows the following engine types and variants:

1. Reed valve engines.
2. Inlet piston port engines.
3. Rotary disc valve engines.
4. 1 to 8 cylinder engines.
5. Inline, Boxer and V-engines.

## Major Modelling Assumptions

EngMod2T uses the GPB-method to simulate the one-dimensional gasdynamics in the pipes and ducts. It uses Cd-maps for all the ports, pipe ends and pipe discontinuities like restrictions, steps and throttles.

The combustion model is a typical two-zone model as described in numerous publications. The burn rate is described using a Wiebe function.

The scavenging model is based on the model as developed by Prof. GP Blair with the added capability that no empirical factor has to be added to separate the burnt zone from the fresh mixture zone. The software handles the thermodynamics. The user has to choose the type of scavenge model.

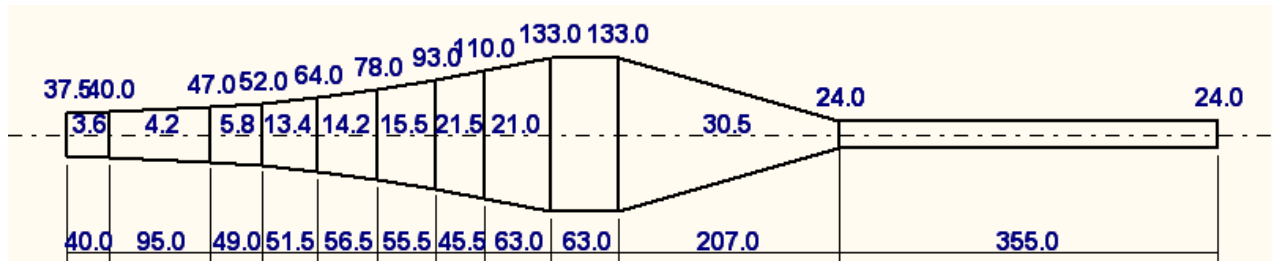
## Types of Exhaust Pipes

A range of exhaust pipe configurations is available, depending on the type of engine. Each pipe can be divided into 11 segments. The following lists some of the available configurations:

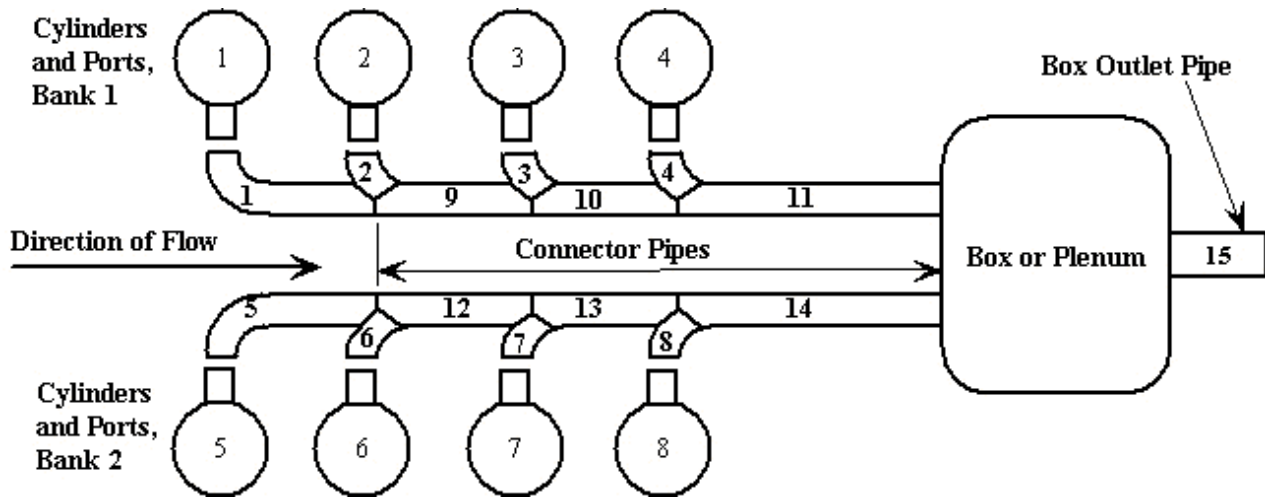
1. Tuned pipe (expansion chamber, expansion box) for each cylinder.
2. Open pipe for each cylinder (the user specifies the layout).
3. Box pipe where the pipe ends in a box with outlet – individual boxes or a common box.
4. Ninto1 pipes from N=2 to N=8, with the collector pipe an open, tuned or box pipe.
5. Log manifolds as is typical on outboard engines ending in an open, tuned or box pipe.

The tuned pipe allows the modelling of a restrictor at the tail pipe entry. There are also some special pipes for V-engines with cross connectors etc.

The following picture shows a typical tuned pipe configuration.



This is an example of a typical layout of a V8 outboard engine exhaust system.



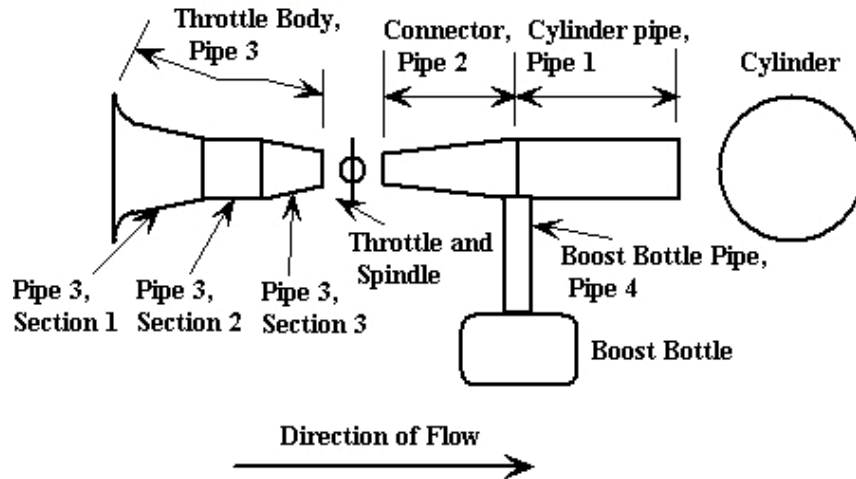
Silencers can also be modelled but requires some advanced knowledge.

## Types of Inlet Pipes

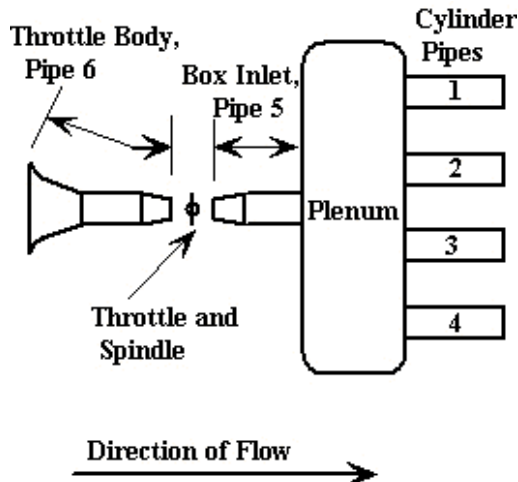
As with the exhaust, a range of inlet pipes is available, depending on the type of engine. The following lists some of them:

1. Plain open inlet pipe.
2. Inlet pipe with a throttle.
3. Inlet pipe with a boost bottle.
4. Inlet pipe with a throttle and boost bottle.
5. Ninto1 collector inlet with cylinder pipe throttles.
6. Ninto1 collector with collector throttle.
7. All the above with airbox/es.

The next figure shows a typical inlet with a throttle and a boost bottle.



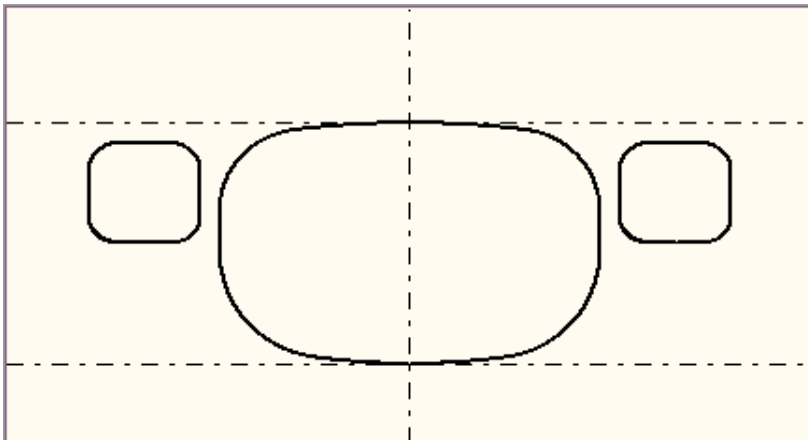
This figure shows a typical inlet system of a racing outboard engine that has a plenum throttle.



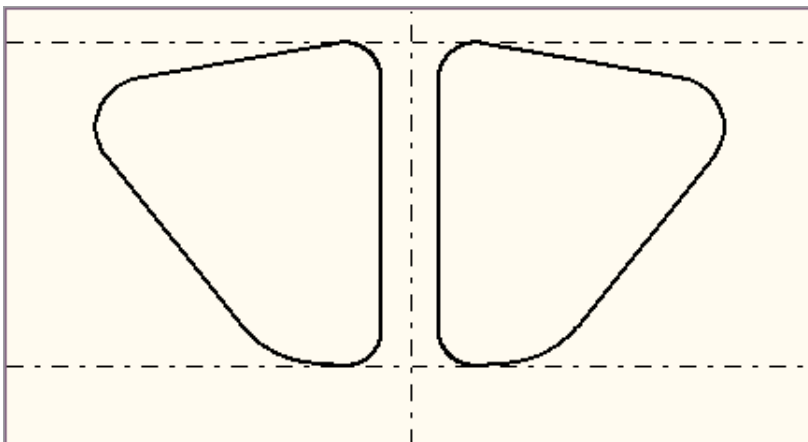
## Exhaust Port Modeling

Two main types of exhaust ports can be modelled, a single type port and a bridged type port. Both types can be modelled with or without auxiliary exhaust ports.

- Single Port. The single port can be used where a single port or the repeat of a symmetrical port is modeled.



- Bridged Port. The bridged port is the classical bridged port as typically used on motocross bikes.



## Inlet Port Modelling

Three types of inlet ports can be modelled:

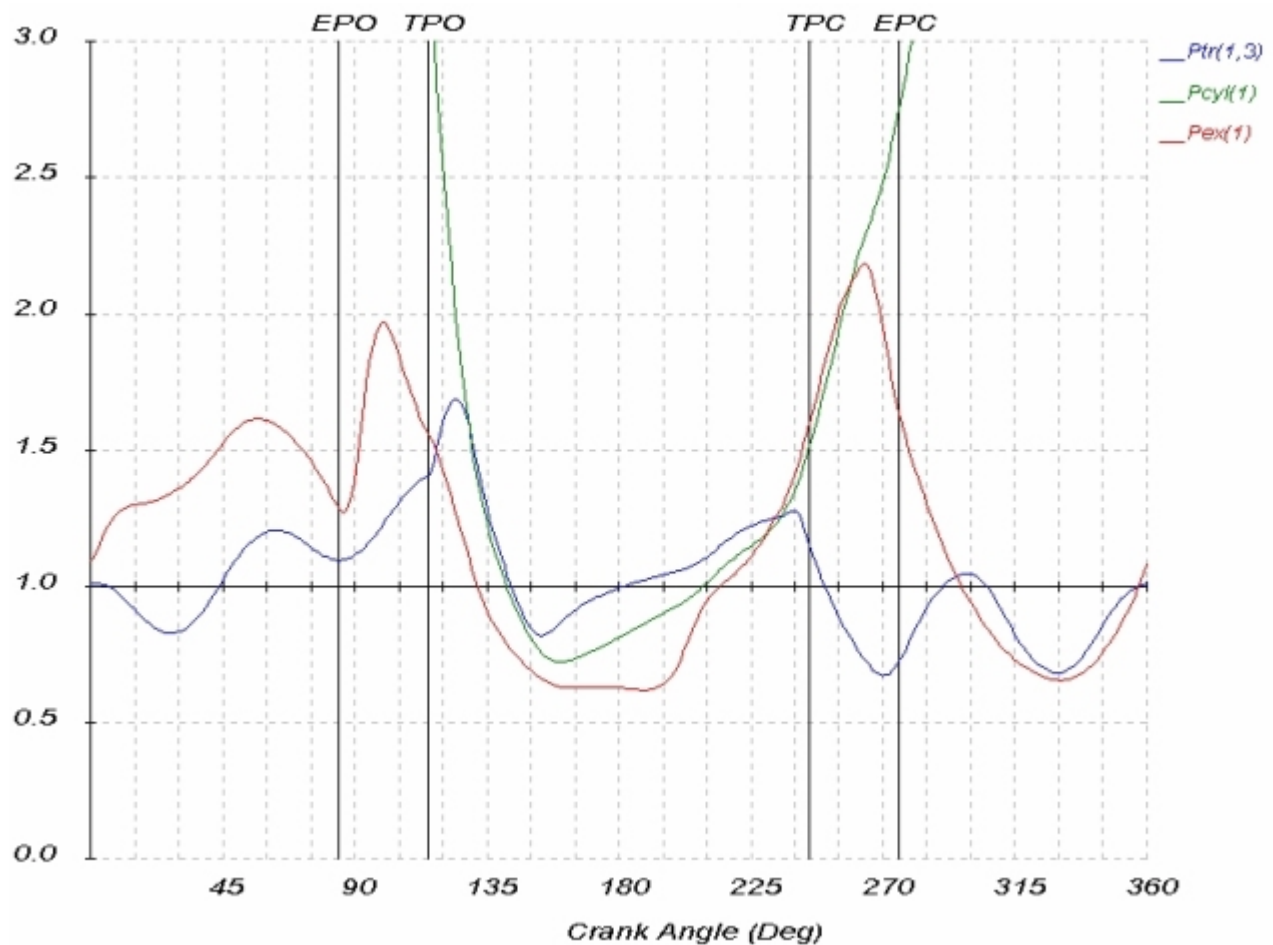
- Reed valve Inlet
- Piston Port Inlet
- Rotary Valve Inlet

## Using EngMod2T

The model is created using a pre-processor called **Dat2T** that is a standalone program. The simulation is then executed using **EngMod2T**. At the completion of the simulation run the post processing is done using **Post2T**. Alternatively, if the user prefers, by something like **Excel**.

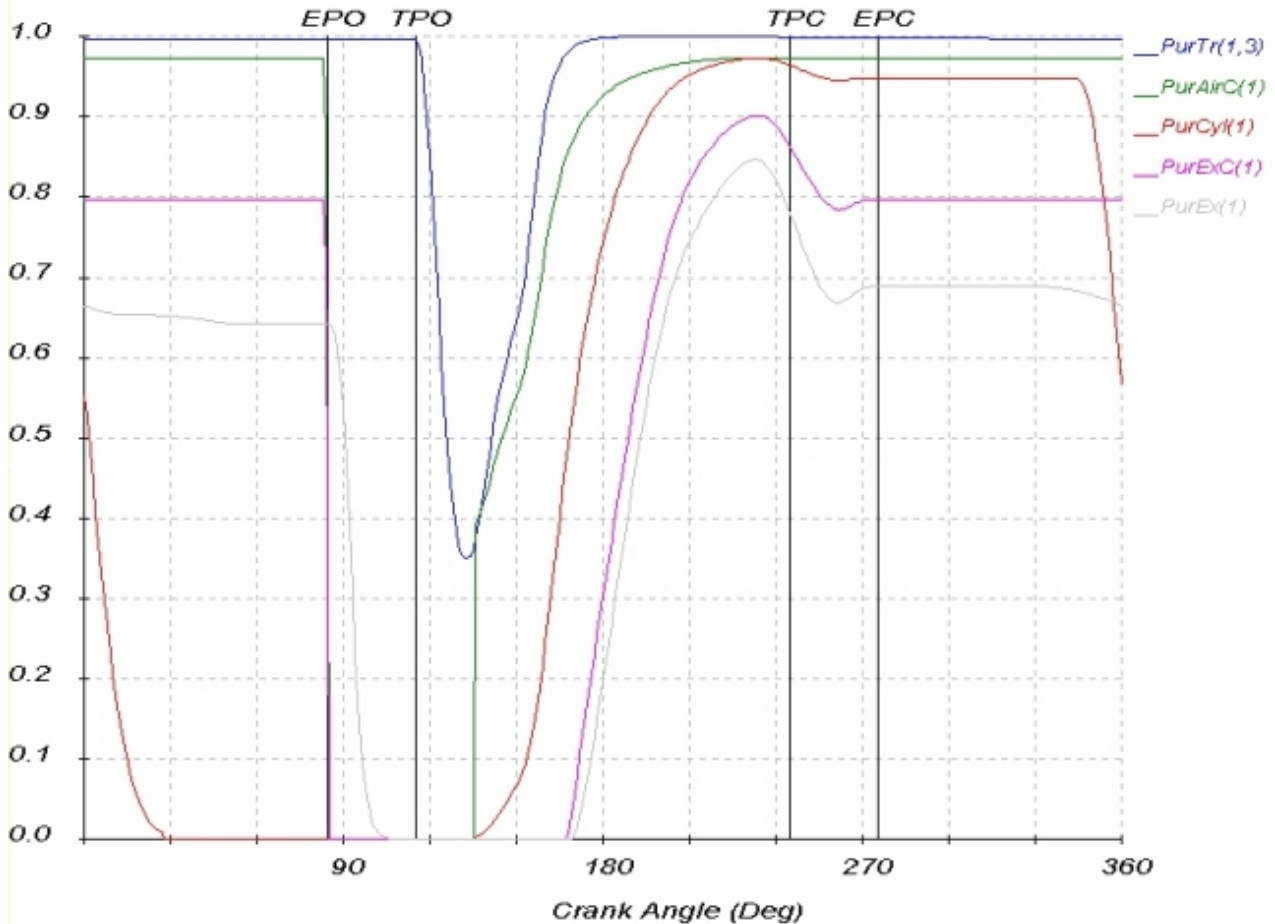
## Output of EngMod2T

The software can produce pressure and temperature traces for any duct, port and plenum including the cylinder, crankcase and boost bottle. The following shows a typical pressure trace of the transfer port, cylinder and exhaust port of a single cylinder:



EngMod2T also outputs the mach indexes of all the ports and ducts, the purity trace of the gas at each port and the pressure trace of the left and right moving wave at each port and duct.

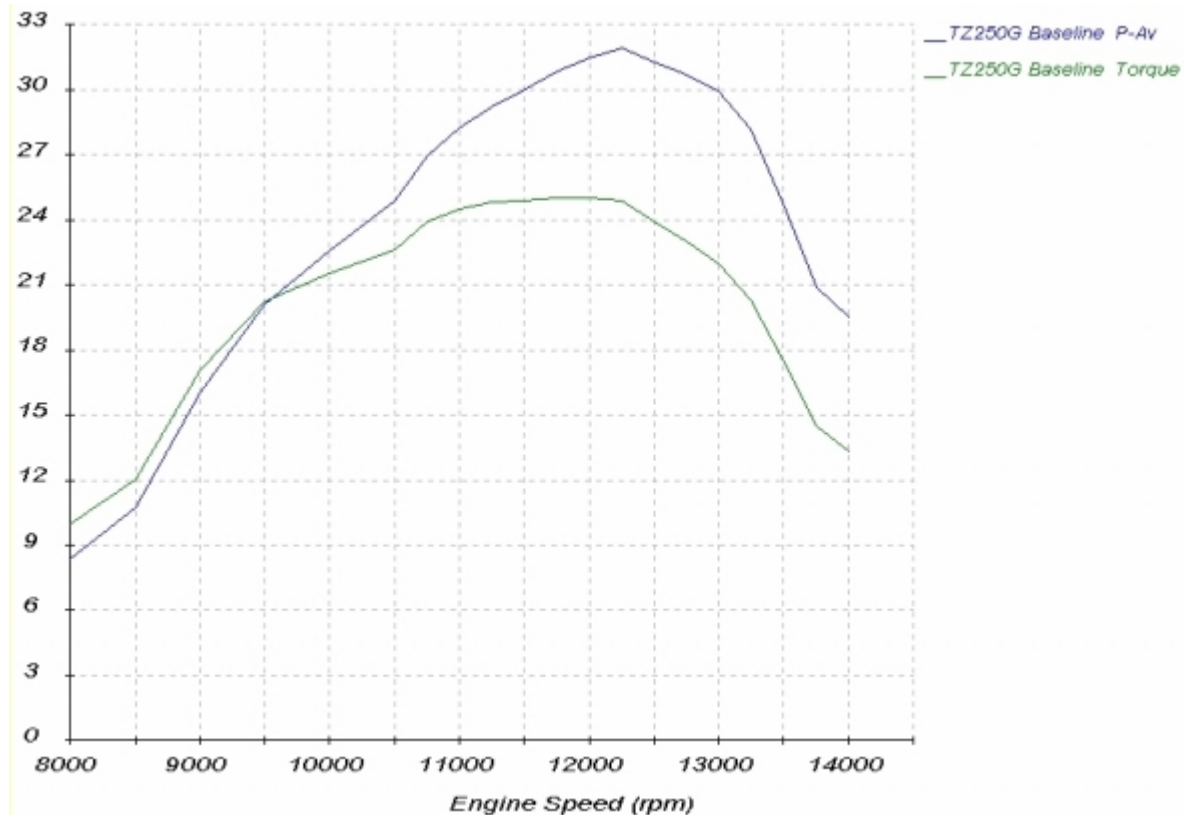
For each cylinder the purities, efficiencies and temperatures of each zone during scavenging is available. The next figure shows the purities in the transfer port, of the fresh charge, overall cylinder purity, of the burnt gas and of the gas in the exhaust port.



Other than the output during a single cycle the output for a complete run can also be displayed. This includes values such as power output and torque values, delivery ratio, scavenging efficiency, trapping efficiency, charging efficiency, IMEP, BMEP, FMEP and PMEP as well as maximum cylinder temperature and pressure etc.

The next figure shows the power curve and torque curve for a Yamaha TZ250G engine. Although it is a twin cylinder engine only one cylinder was simulated as the inlet, crankcase and exhaust systems are separate and not interconnected. As can be seen in the graph legends these curves are for the baseline engine. As modifications are simulated their curves

can be added to the same graph. It is also possible to plot the curves from other engines on the same graph.



## Obtaining the EngMod2T suite of programs

The software price is \$400.00. To purchase it email Neels van Niekerk at [vannik@mweb.co.za](mailto:vannik@mweb.co.za) with a request. The software will then be emailed to you after which you install it on your PC. The pre and post processors together with all the help files should then work. **EngMod2T** requires a licence file to run. A one month evaluation license can be provided. If after reading the help files you should decide to purchase the software contact Neels van Niekerk to obtain banking details. Once proof of payment has been received the licence file will be sent to you. The licence is for one computer only.

## Note

The software was written with the more experienced user in mind that cannot afford the more sophisticated programs but still wants the ability to simulate multi-cylinder engines and/or have some control over the temperatures and combustion processes.