BIMOTION INTAKE MANUAL

This manual does not explain all theory behind the calculations that is made. It is assumed that the user knows the fundamentals about two stroke engines. Have great fun with your work.
Questions or bug reports are sent to: mail@bimotion.se

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1. Introduction

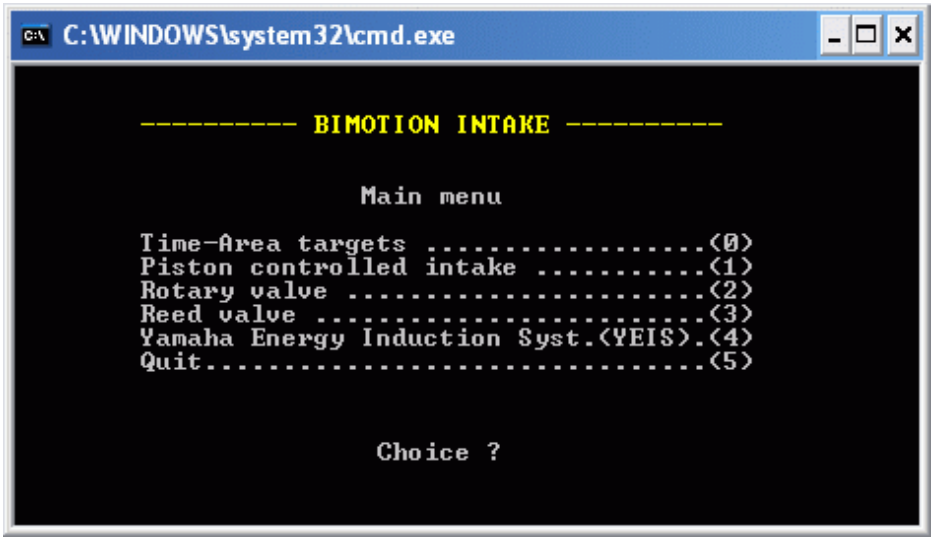
The program gives a clear indication of the state of tune of the engine intake port, and even lets it be compared to itself - with modified porting or with larger bore size. Engine data can be changed rapidly, to see the effects of changing the port width, height, engine speed or any of the basic engine dimensions.
Note: for bridged or multiple ports, do not enter a width value which is greater than the bore; use one half and then double the answer. The program calculates the piston controlled intake port as rectangular so the Port Height Factor will make this shape assumption. (See pg. 10.)
The time-area can be varied with engine speed, or one speed can be selected and the time-area varied as a function of port width, height, etc. Below is a piston skirt length (piston ported) varied:

```
Piston skirt length:  58
Vary time-area by altering skirt length

Maximum skirt length: ? 58
Minimum skirt length: ? 50
Increment:            ? 1

Recommended sp. t-a 15-20 s-sq mm/cc.
Sp. t-a >30 results in bad effect.

Length,mm      s-sq mm       s-sq mm/cc
 58             1.1           18.9  x10^-3
 57             1.14          19.6  x10^-3
 56             1.18          20.2  x10^-3
 55             1.21          20.9  x10^-3
 54             1.25          21.5  x10^-3
 53             1.29          22.2  x10^-3
 52             1.33          22.9  x10^-3
 51             1.37          23.6  x10^-3

Current skirt length is  58 mm.
Enter required value:  _?
```

There are several ways of using the results. One is to take the time-area at peek torque and use the computer to show what size and timing of the ports would be necessary to maintain this time-area at a higher speed. Another way is to compare the engine with a more highly tuned machine and match its time-area. If you that think some output data or recommendations would need more decimals, this is by purpose. The precision in theory should not be better than in practice.

2. General

Start by running Bimotion.bat. If you halt the program (Ctrl+C) for any reason, restart with F2. The caps locks must be active, check this since the program will not take lower case as input except from text strings.



Files are loaded in each sub menu. Example for each menu choice:

```
Continue or (L) to load file
```
→Press “L” …

```
 Type file name without extension, or enter to alter path.
 Path: Current
 ? _
 Syntax: <C:\...path\>
        ? _
```
→ if you enter nothing here...
→ this syntax help will show up...
→ Enter your entire path here as the syntax above.

The program remembers last loaded path used. **Important ! This path must not contain folders longer than 8 characters/folder.**
The program also shows the previous stored files, in this case the test file:

```
        <.int> -files in executing dir:
C:\BIMOTION\
TEST    .INT
```

At least one file each must be available in the executing directory, (.int, .rot, .red, .yes) otherwise the program will fail from the file search with a ‘File not found’ statement.

To accept recommended or previous values just enter. (0 omitted if enter nothing)
Tip: You can run 2 programs in the same time if that would help.
Files will be saved as in example: Kawasaki KX250 Original --> kawasako.*.
The first 7 letters are part of the name, the last one is T/O (Tuned/Original).
Just enter (T) or (O). Delete this T/O with (D).
If no option, first 8 letters will be part of the file name. File will be saved when the choice is accepted with ‘enter’.

```
Accept present path <> or
 Enter path to folder (if different from current)?
 C:\TEMP\

 Current name: TEST
 Accept saving as <C:\TEMP\TEST.cyh>

 or enter engine name, (Last file char is T/O),
 or (P) to alter path
    (T) to add 'Tuned'
    (O) to add 'Original'
    (D) to delete T/O info.? _
```

Data as Bore, Stroke, Rod length will only be necessary to enter once if you not quit, they will be carried along in every program part.

(*) depends on what the file contains:

.int	Piston intake
.rot	Rotary valve
.red	Reed valve
.yes	Y.E.I.S (Yamaha Energy Induction System)

Port width in general is measured perpendicular to the flow direction.

3. Time-Area targets

Bore	If not entered before
Stroke	If not entered before
No. of cyl.	
Tuned speed	Speed for maximum power
Enter your targets in…	Press 1,2 or 3. Bmep=Braked mean efficient pressure

```
------ Time-Area target calculation ------

No. of cyl.? 1

Present tuned speed is 12000 rpm.
Enter to accept or type a new tuned speed (rpm)? _

   Target      Bmep(bar)
   ---------------------
   Road racing    11
   Motocross       9
   Enduro          8
   --------------------

   Enter your targets in hp .... (1)
                         kW .... (2)
                         Bmep .. (3)
   Bmep target? _
```

Note! This T-A recommendation is not the same as the general given in accordance to the port dimensioning. ‘Targets’ are based on several tests of ‘real’ engines with various tuning degrees. The general recommendation applies to enduro-road racing tuning. Calculations for exhaust blow down timing is not supported in this program since such recommendations are very much dependent on the expansion chamber used.

Result:

```
07-30-1999
BIMOTION   Time-Area targets

Bore, mm ............................... 54
Stroke, mm ............................. 54
Displacement, cc/cyl ................... 123.67
Average piston speed (m/s) ............. 19.8
No of cylinders ........................ 1
Target in hp ........................... 24.6
          kW ........................... 18.1
        Bmep ........................... 8

Time-Area targets in s-sq mm/cc x10^-3
                intake ................. 12.3
                transfers .............. 7.4
                exhaust ................ 13.3
                exhaust blowdown ....... .8
```

4. Piston controlled intake

When calculating time-area enter max.-min. value. *Increment* is calculated step.

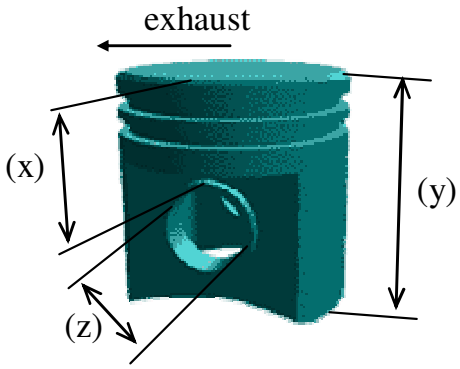
Bore	If not entered before
Stroke	If not entered before
Rod length	If not entered before
Tuned working speed (rpm)	
Intake port height (H)	
Distance square port edge-rounded port…	See pg. 12
Port height shape factor	See pg. 12
Intake port width	Measured perpendicular to the flow direction

```
Answer on 1 of these:
(1/3)   Intake opens mm BTDC   _?
(2/3)   Intake opens deg BTDC  _?
(3/3)   Dist. of bottom edge of port
        from top edge of piston at TDC  _?
```

Enter first two positions if you wish to input Dist. of bottom edge …

Piston dimensions:

Piston pin bore (z)
Dist. from top edge of pin to edge of crown (x). (Deck height)
Dist. from top of crown to bottom of
skirt at the position of the port (y)



The program recommends a certain intake duration interval dependent on the tuning degree. For RR tuning the crankcase and ports are assumed to be 'state of the art'. The short duration recommendation applies to RR-tuning since it run with stronger pulses.
The long one applies to 'road' tuning. (Weak pulses need more time). There is no recommendation for road tuning at high engine speeds. The carb's area could in advantage be set to 85% of the intake port area.

Working strategy in short: Decide desired duration and adjust time-area by alter port width.

Result :

```
 07-30-1999 TEST
BIMOTION   Piston contr. intake.

Bore, mm ..................................... 42
Stroke, mm ................................... 40
Displacement, cc/cyl ......................  52
Piston area, sq m/cyl ..................... 1194
Rod length, mm ............................... 82
Piston pin bore, mm ........................ 12
Piston skirt length, mm ................... 41.5
Deck height above pin, mm ................. 20
Intake port opens, deg BTDC ............... 92.47
                    mm BTDC................. 24.2
Tuned speed, rpm ........................... 10000

*****  Duration deg  ***** ................ 184.9
Recommended dur.,deg ...................... 176 - 205
Port height shape factor, ................. .89
Port height, mm ............................ 18.2
Port width,  mm ............................ 22
Bottom edge of port,mm BTDC ............... 65.7
```

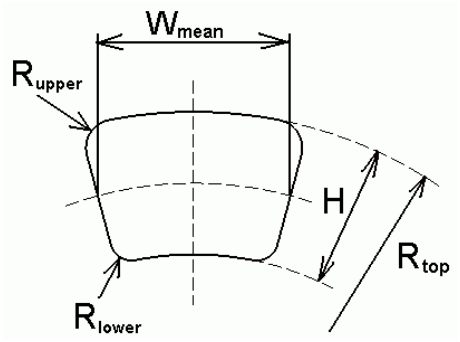
Menu :

```
----------- Intake menu -----------

Time-area targets ..............  (0)
Time-area against.....crank speed (1)
                .......port width (2)
                ....port top edge (3)
                .port bottom edge (4)
              piston skirt length (5)
Current engine specification......(6)
Change piston/port dimensions.....(7)

Menu..............................(8)
Restart ..........................(9)
Load .............................(10)
Save .............................(11)

                Choice ? _
```

5. Rotary valve

Input tuned rpm, Engine, Bore, Stroke, Rod Length and data as requested in the example below. The port opens deg. before TDC and closes deg. after TDC. The example previous values are 0 since it shows the first input.

```
Accept by enter.
---------------------------------
Port top radius, ...  0 _?
Port height, .......  0
Port mean width, ...  0
Port upper radii, ..  0
Port lower radii, ..  0
Disc opens, deg ....  0
Disc closes, deg ...  0
```



Result :

```
07-08-2000 TEST
BIMOTION   Rotary valve intake.

Bore, mm ..................................  54
Stroke, mm ................................  54
Rod length, mm.............................. 111
Displacement, cc/cyl ......................  123.66
Tuned crank speed .........................  12000
Disc opens, deg ...........................  120
Disc closes, deg ..........................  65
Radii upper, mm ...........................  4
      lower, mm ...........................  3
Port radius, mm ...........................  50
     height, mm ...........................  18
     mean width, mm .......................  22
     width angle, deg .....................  31.1
     equiv. dia, mm .......................  22.3
Time-area, s-sq mm/cc .....................  8.1
```

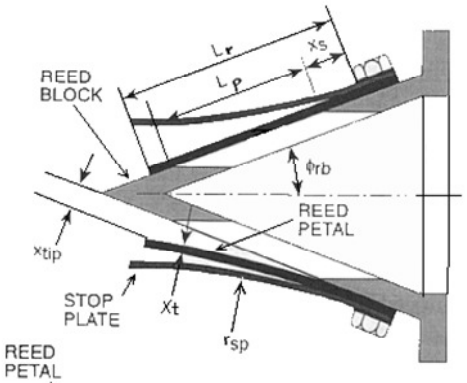
Menu:

```
--------- Rotary valve menu ----------


Time Area Targets ................. (0)
Alter dimensions .................. (1)
Present dimensions ................ (2)

Menu............................... (3)
Save............................... (4)
Load............................... (5)



                Choice ?
```

6. Reed valve

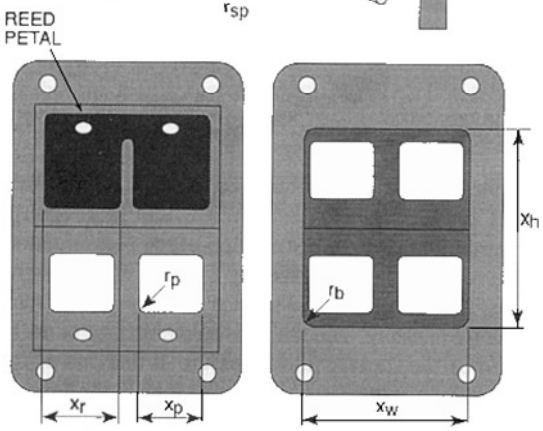
Input *Tuned rpm, Engine, Bore, Stroke, Rod Length* if not entered before as usual.
Input equivalent exhaust port dia., that is exhaust port area equalized to the corresponding dia. of a circular area. ($d0=\sqrt{\frac{4*A}{\pi}}$)
Bmep= Braked mean efficient pressure.
Crank case compression ratio, for example 1.35:1=1.35

```
Accept by enter.
-------------------------------------
Eqv. exh. port dia, d0 ...  0    ?
Bmep ....................  0
Cr.case compr.ratio (>1)..  0
```




```
Accept by enter.

Block dimensions.
-----------------------------
No of ports ......  0    ?
Width, ........ Xp  0
Length, ....... Lp  0
Radii, ........ Rp  0
Angle, ..... Fi_Rb  0
```

Reed petal variables:




```
Accept by enter.

Reed petal dimensions
-----------------------------
Width, mm ..... Xr  0    ?
Length, mm .... Lr  0
Mount distance, Xs  0
Thickness, mm . Xt  0
Reed mtrl, (C)Carbon
           (G)Glass
           (S)Steel
Duration (170-210), Default 200  0
xtip/Lr max, % .... Default 30%  0
```

The program throws warnings when necessary. These are:

```
Warning!

Tip lift is higher than stop plate height.     Warning (1)
Reed plate is close to natural freq.( 18 %)    Warning (2)
Short reed plate, 1 mm tip sealing.            Warning (3)   See next
Port area too small.                           Warning (4)   page.
Reed area too small.                           Warning (5)

A to alter, any key to continue.
```

Warning (1) : If the reed plate is too thin it will smash the stop plate and cause reed flutter as is the case at (**) below. Change material or dimensions.

Warning (2) : If the reed petal natural frequency is closer than 20% to crank rpm the petal is subject to fatigue damage. The life time is much dependent on the time spent within this rpm interval. A race engine can withstand closer critical rpm or to pass it often due to frequent services.

Warning (3) : Reed plate tip sealing less than 2 mm will cause this warning. plate-port over run, mm =Lr-Lp-Xs. (See reed case fig.)

Warning (4) : Increase the area in the block to match the flow requirement.

Warning (5) : Increase the reed lift to match the flow requirement by making it longer, less width, thinner, change material etc.

Result:

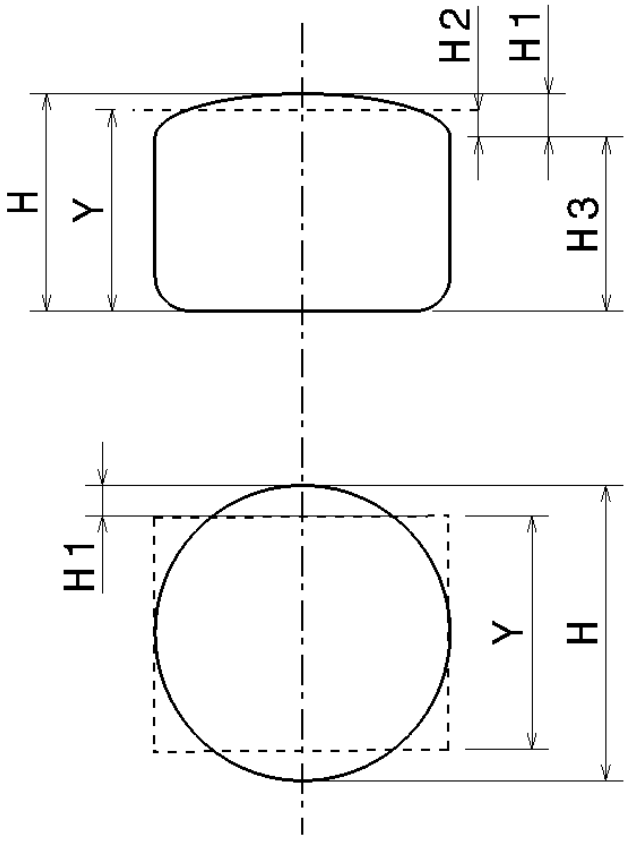
```
07-08-2000 TEST
BIMOTION   Reed valve intake.

Bore, mm ..................................  56
Stroke, mm ................................  50.6
Displacement, cc/cyl ......................  124.63
Tuned crank speed .........................  11740
Bmep ......................................  11
Crank case compr.ratio.....................  1.35
Eqviv. exhaust port dia, mm ...............  37.5
Block width  xp, mm .......................  19.6
      length Lp, mm .......................  32
      radii  rp, mm .......................  1
      angle  rb, deg ......................  23.5
Reed  material ............................  Glass
      thickness xt, mm ....................  .42
      width  xr, mm .......................  22.7
      length Lr, mm .......................  38
      mount distance xt, mm ...............  4
      duration, deg .......................  200
      no. of ports ........................  6


 07-08-2000 TEST
 BIMOTION   Reed valve intake.

 Reed tip/Lr, % ............................  33  } (**)
              % (max) ......................  30  }
     plate-port over run, mm ..............  1
 Stop plate radius, mm .....................  58
 Required area, mm^2 .......................  1421
 Reed area, mm^2 ...........................  1474
 Port area, mm^2 ...........................  1499
 Carb dia, mm ..............................  39.9
 RPM critical ..............................  9610
 Margin, % .................................  18
```

Menu :

```
          ---------- Reed valve menu -----------

          Time Area Targets ................. (0)
          Alter port,bmep,crank case ........ (1)
                block....................... (2)
                reed petal ................. (3)
          Present dimensions................. (4)

          Menu............................... (5)
          Save............................... (6)
          Load............................... (7)


                          Choice ?
```

7. Port Height Shape Factor (HSF)

The program calculates efficient port area, so the port height needs to be adjusted to a squared port area. (H) is port height to enter. The bottom of the intake port is most important concerning HSF.



HSF=Y/H
Y=H3+H2

H1=(H-Y)/2
Y=0.8*H
HSF=Y/H

8. Y.E.I.S

Bore	
Stroke	
Rod length	Don't care
Carb. dia.	
Crank speed to improve	your flat spot rpm

Result :

```
07-30-1999 TEST
BIMOTION   Y.E.I.S

Carb dia., ..................................... 22
Box volume, cc ................................. 125
Min-max branch pipe dia, mm .................. 8 - 16
Present branch pipe dia, mm .................. 12
               pipe length, mm ............... 462
Resonance crank speed, rpm ................... 4500
```

Menu:

```
------------ Y.E.I.S menu -----------

Vary pipe length with pipe dia.......(1)
     box volume with pipe length ....(2)
     pipe length with crank speed ...(3)
Restart .............................(4)
Present dimensions ..................(5)

Menu ................................(6)
Save ................................(7)
Load ................................(8)

                Choice ? _
```

9. Printouts

Data can be printed by Cut and Paste the graphs in windows mode. Right click on the windows frame and choose ‘Edit; Mark’. Mark the area and right click on the frame again, Edit;Copy or just press Enter. Paste into a text editor.