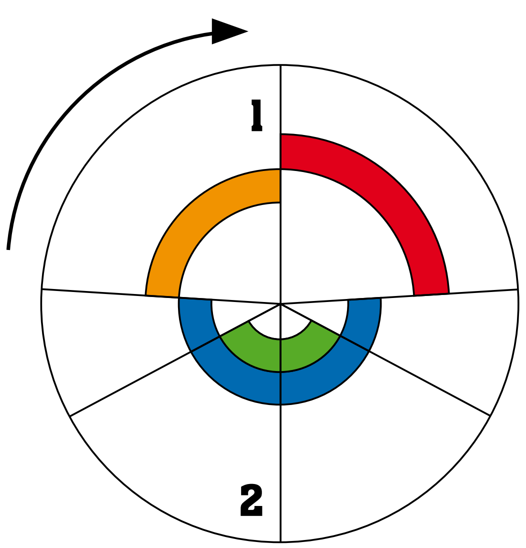
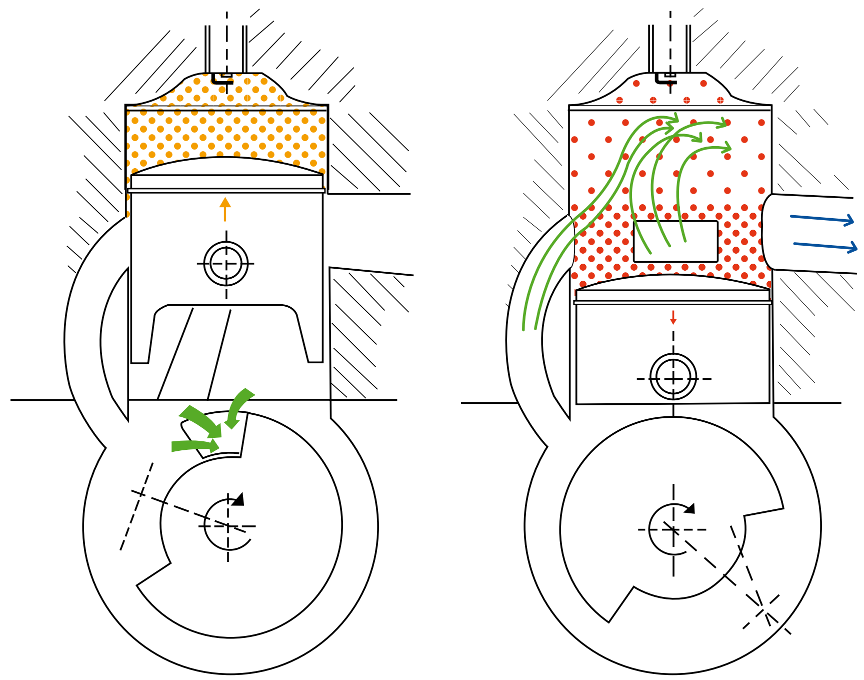
Ports under SPOT-LIGHT

METHOD FOR MEASURING 2-STROKE ENGINE DIAGRAM PHASE

Timing diagram of phases for 2-stroke engines





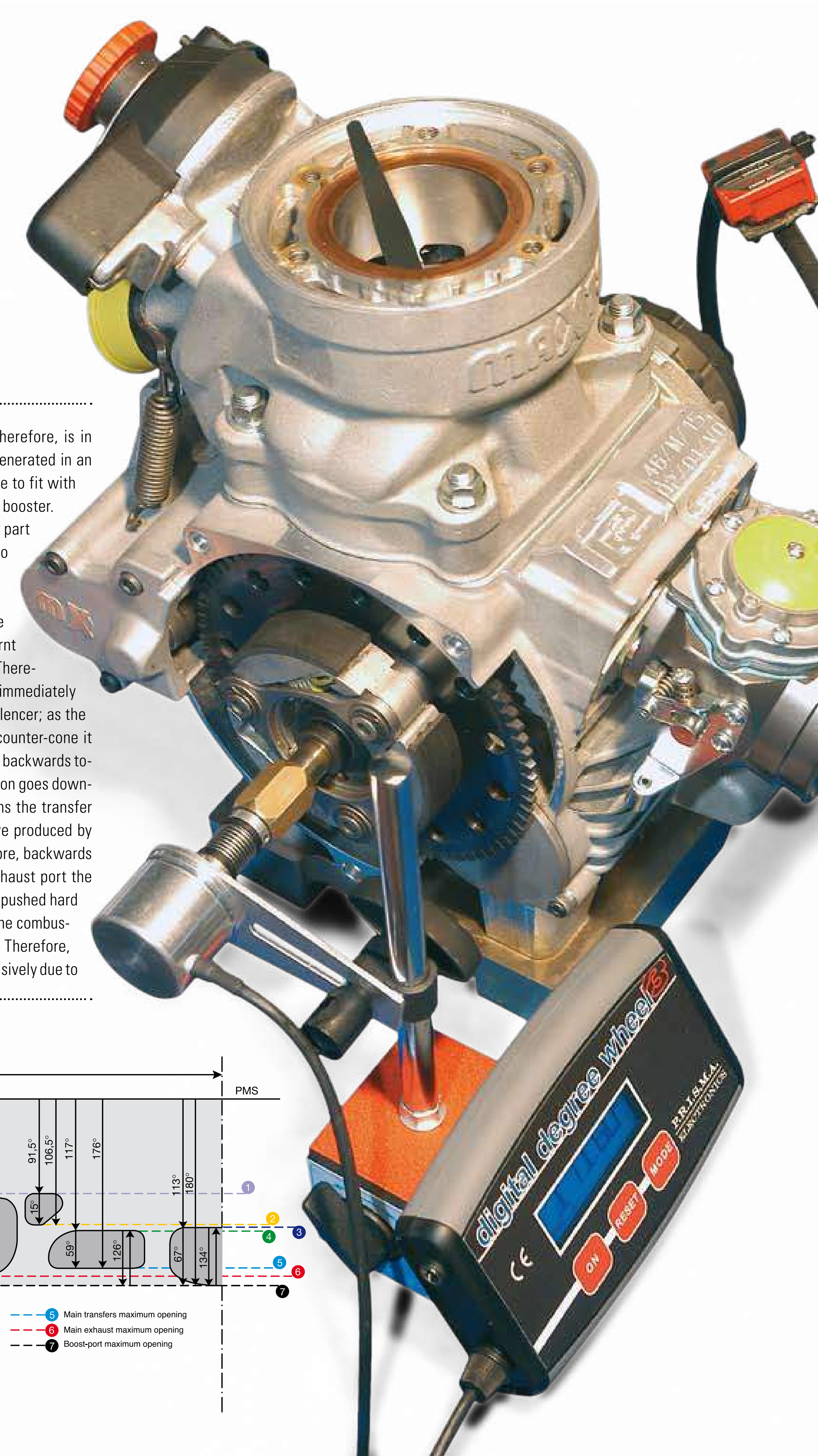
1 PMS
2 PMI
TRANSFER
EXHAUST
COMPRESSION
EXPANSION

REPORT
LEONE MARTELLUCCI

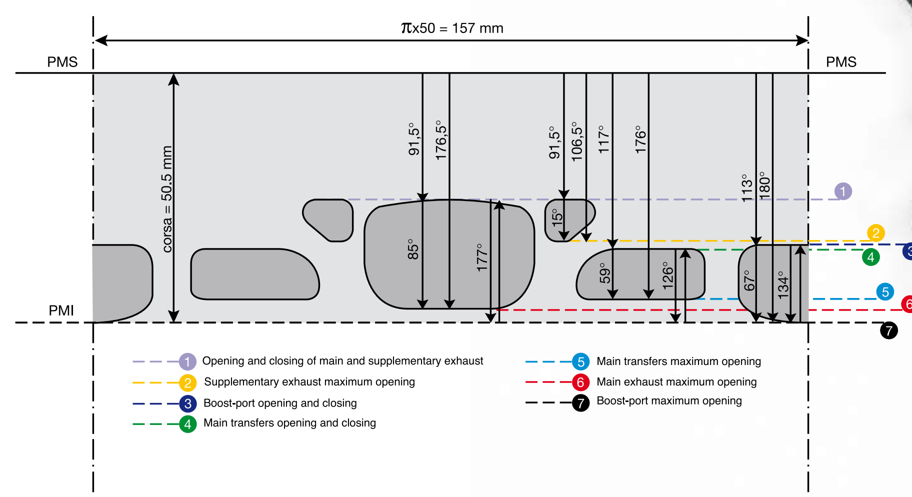
PHOTOS
ARMANDO CINTI

The right 2-stroke engines phase diagram design is one of the most relevant and of most important aspects when trying to improve performance in terms of power. It is even more important than in 4-stroke engines. The phase diagram of exhaust and transfer (see picture) can change the entire character of an engine and enables you to carry out studies for maximum power and elasticity in function, as you wish.
A good tuner can adjust exhaust port and transfer ports diagram adequately and after plan the expansion exhaust in its various parts, especially position and shape of converging cone (or counter-cone), so as to improve the filling coefficient, that is, the engine's ability to draw fresh fuel load in.
The correct exhaust and transfer "joint" allows you to make the most of pressure waves generated, which spread in the exhaust with a double aim; first to help fresh fuel enter thanks to the vacuum in cylinder (respect to pressure in the transfers), and secondly to stop fresh fuel loss at exhaust with following overpressure that act as a fluid mechanics cap.

Ports aren't just bores in a cylinder that allow gaseous fluid to pass: the accurate position is very important for delivery characteristics and power of an engine.



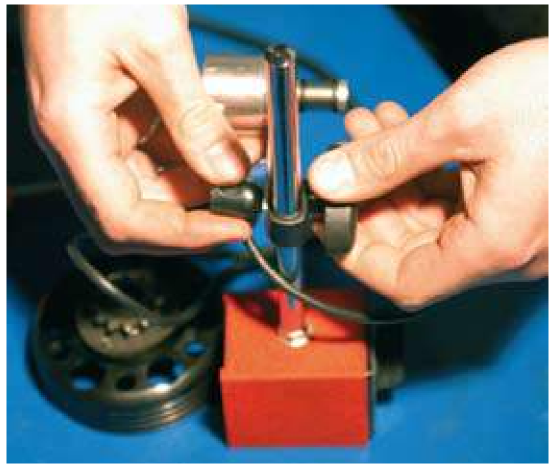
The basic concept that guides the procedure, therefore, is in making the most of pressure waves, which are generated in an expansion exhaust and, if well designed and made to fit with the engine, the exhaust acts as a perfect dynamic booster.
An expansion exhaust is usually made up of a first part known as manifold, which is connected directly to the engine, then there's a sprayer and a counter-cone or converging cone, with the end tube and silencer. When the exhaust port opens, due to the overpressure in the combustion chamber, the burnt gasses start making their way towards the exit. Therefore, when the exhaust opens a pressure wave is immediately generated, and this makes its way towards the silencer; as the pressure wave goes along, when it reaches the counter-cone it produces a reflected pressure wave, which travels backwards towards the exhaust port. In the meanwhile, the piston goes downwards towards the bottom dead centre and opens the transfer and induction starts. The reflected pressure wave produced by the counter-cone in the exhaust continues therefore, backwards towards the engine and, when is reaches the exhaust port the fresh fuel mixture that had entered the exhaust is pushed hard into the exhaust hard and forced to go back into the combustion chamber. This all helps the filling coefficient. Therefore, you get a definite dynamic supercharging and exclusively due to

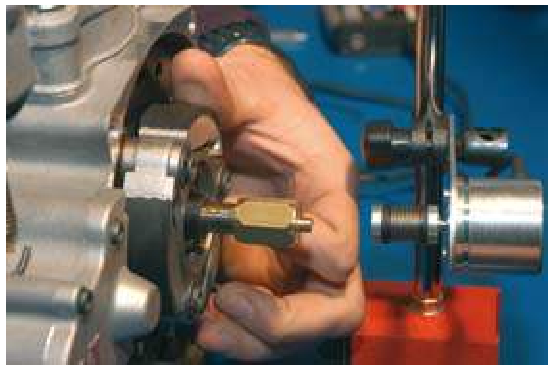


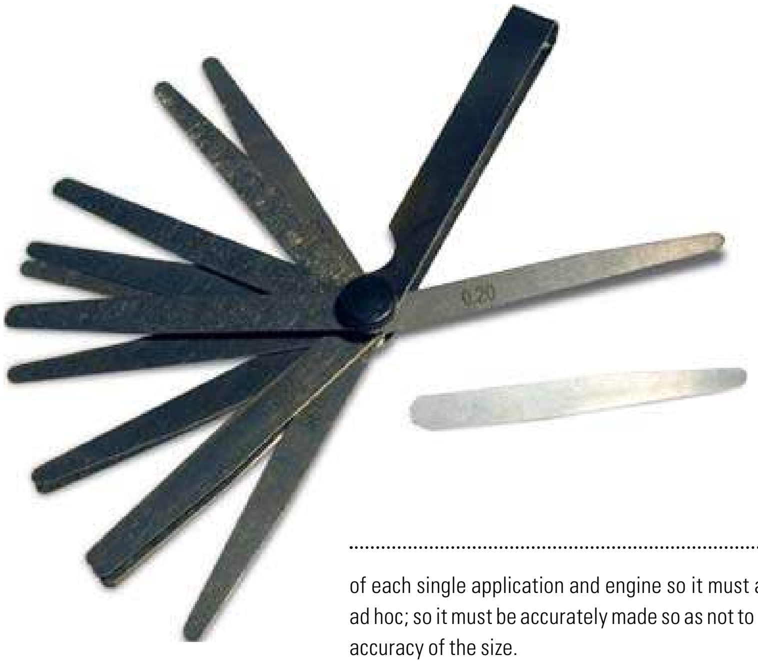
▼ **Like their shape and position, port measurement too is carried out with accuracy. Today digital instruments, which make it easier for a tuner to check if they've done their job properly and technical commissioners can check if set limits have been respected, are used.. Above, the new instruments designed by Pascal Cardinale and made by Prisma Electronics. You can find more information on technical characteristics clicking on: www.prismaelectronics.com**

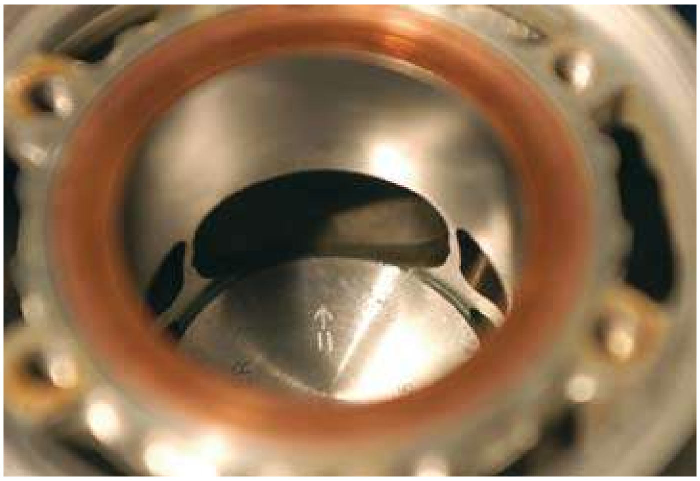
the fluid mechanics of the engine, and not to external organs. Time taken for all this to happen depends on both the number of revs and the size of the various ducts, especially length; therefore, it is evident that you can allow different expansion exhaust geometry to correspond and therefore change time taken, frequency, that is, number of revs where you get the effect of supercharging. The distance between the counter-cone and the engine is very important; longer distances move the supercharging effect towards low revs. Taper ratio too, is important because marked tapering makes the reflected wave stronger and shorter, at the same time it gets more power but the engine has less proof stress. An interesting animation showing this is found in Wikipedia:
http://it.wikipedia.org/wiki/File:Arbeitsweise_Zweitakt.gif

So, it is very important to measure the phase of a 2-stroke engine properly in order to be able to carry out engine tuning successfully.
At the POMOS laboratory, Polo per la Mobilità Sostenibile at the University "La Sapienza" in Rome, we used an electronic system, made by Prisma Electronics, for measuring phase. The instrument is made up of a digital display with resolution to the hundredth, an encoder to be applied to driving shaft by means of a threaded bush and a magnetic base for an accurate and quick encoder and driving shaft alignment. Furthermore, there is a very important metal joint between the treaded bush and encoder, which allows to get rid of any minor dis-alignment between the driving shaft and the encoder. Tests were carried out on a Maxter KF2 125cc engine, for which a coupling has been made between the driving shaft and best instrument. Notice that this coupling is particular









of each single application and engine so it must always be made ad hoc; so it must be accurately made so as not to compromise the accuracy of the size.

To start the tests, besides the measuring instruments we used a spessimetro, that by regulations is 0.2 mm thick and 10 mm wide. These are stated by the international regulations as the surface of the exhaust and transfer duct shutters is curved; different thickness and width value would give rise to a different size. The spessimetro is placed between piston crown and the start of the exhaust port; it acts as reference point for the start and finish of the width.

We therefore carried out a series of tests. First of all you fix the initial reference point by nterposing the spessometro between the piston and the exhaust port (exhaust shut) and taking the digital display to zero. Then you turn the driving shaft to enable the piston to carry out its stroke that will bring it back to the initial position. Once the piston has carried out the entire stroke that brings it to the initial position, read the value on the display and check that the shaft rotation is within the 190° according to norms for this engine. (for other classes of engines the reference values are logically different). In the test we did, as usual we always saw different size in order to the tenth influenced by the imperfect coupling between bush and drive shaft.

In any case, all operations are very quick and easy with the correct coupling and let us have accurate measurements, correct to the tenth, in hardly any time, and this is useful reference for tuners and technical marshals. Don't forget that regulations state ±2° on the size of exhaust port.

The instrument therefore, has proved to be efficient, precise and easy to use. It is useful for tuners both for its simplicity in use and also to be used on the field to check regulating norms. Obviously, you must make sure that regulations allow for this sort of control even with the normal protractor goniometro graduato, which logically is not so accurate as this digital instrument, that is it could bring up awkward errors due to the existing differences between the two measuring systems. Prisma Electronics carries out continuous research to find new solutions to make these measurements simpler, more accurate and quicker.

▼ **To stop piston from running near the border of the ports, when measuring port opening, use the appropriate thickness gauge. By norm these should be 0.2 , and 10 mm wide**