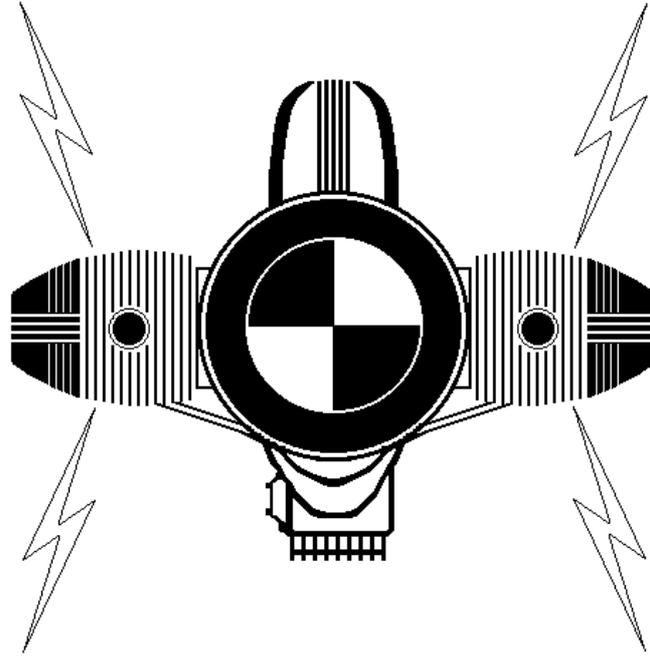


OWNERS GUIDE TO THE DUAL PLUG IGNITION SYSTEM



by
TOM CUTTER

FORWARD

This guide would not have come about without the impetus and encouragement of many people, but the greatest creative force has been supplied by one man who will not realize a penny of profit from his endeavors in the field of Dual Plug Ignition for the BMW motorcycles. Therefore, it only seems fitting to dedicate this book to Orlando Obediah (Oak) Okleshen, former Technical Editor of the *BMW NEWS*.

Also a special note of thanks goes to Udo Gietl for his years of patience and wisdom, given generously and freely, and for his special insight into things mechanical.

Tom Cutter
May 8, 1981
105 W. Hamilton Avenue
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Foreword to the 2003 Reprint

This document is a reprint of the original booklet which was published in 1981.

My original intent for that booklet was to help riders understand the associated problems and procedures for dual plugging etc.

Much of the information is now OBSOLETE and in some places INCORRECT. Nonetheless I understand that there are people who still want a copy for historical purposes.

Readers are permitted to make one copy of this document for their personal use and also to distribute it FREE to anyone else who wants it. No reselling it. No republishing it without prior permission, please.

Tom Cutter
May 2003

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OWNER'S GUIDE TO THE DUAL PLUG IGNITION SYSTEM

CONGRATULATIONS on your decision to convert your BMW motorcycle to the Dual Plug Ignition System (DPIS). This conversion will enhance your enjoyment of your BMW by allowing you to use Regular-Grade fuel, reducing maintenance, and increasing the resale value of your motorcycle.

This guide is intended as an "Owner's Manual" for the System, to assist you in maintaining and fine-tuning the System to your needs and riding style. It is not intended to be a technical treatise on the subject, since this material is available from other sources, including the manufacturers of the various components used in the System. A valuable reference source on the System as applied to the BMW motorcycle is the *BMW NEWS*, the monthly newsletter of the BMW Motorcycle Owners of America.

The System is discussed in an easy-to-read format in the November and December, 1980, and May, 1981 issues of this publication. Reprints of these articles, and membership information can be obtained from *BMW NEWS*, 2902 Eastwood, Iowa City, Iowa 52240. It is highly recommended that you obtain and read these articles in conjunction with this guide, to familiarize yourself with the basic function of the System, as well as to indicate some of the variations possible with the System.

This guide will deal with the System as described in the above-mentioned articles, although much of the information contained herein is applicable to many of the variant systems now being offered.

For your convenience, a space is included in the back of this guide to record tuning settings and results of variations as they affect performance or fuel economy. This will assist you in obtaining the optimum results for your riding style and machine.

Wish you the best of luck and enjoyment with the System:

A handwritten signature in cursive script, appearing to read "Tom Cutter".

Tom Cutter

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DETONATION AND THE DUAL PLUG IGNITION SYSTEM

An internal combustion engine creates usable power by the combustion (burning) of fuel to create gas pressure. By trapping this pressure and allowing it to work upon the piston, this energy is converted from heat into motion which is fed to the wheel via the power train (Crankshaft, transmission and driveshaft).

The stock BMW engine is limited in its ability to burn the fuel in a controlled and progressive fashion, as is any internal combustion engine. As the fuel mixture burns, the remaining unburnt mixture is subjected to rapidly increasing temperature and resultant pressure. Since an increase in pressure in a closed container will cause a parallel increase in temperature, and vice-versa, a chain reaction develops wherein the fuel mixture would spontaneously self-ignite if it is not first consumed by the orderly flame started at the spark plug. In the BMW motorcycle engine, the spark plug is not centrally located in the combustion chamber, so the flame front must travel a relatively long distance to consume the fuel in the remotest reaches of the chamber. If the speed of this flame travel is too slow, the rising temperature and pressure in the cylinder head will cause the mixture to self-ignite in an explosive fashion. This condition is known as "detonation", and is commonly called "ping", or "knock". These names are derived from the sound that emanates from the engine, similar to the sound of two metal objects being struck together.

In the most extreme cases, detonation can lead to severe engine damage from shock and overheating. In less severe cases, loss of performance and fuel economy will occur because the energy released by the burning fuel is not controlled to work upon the piston, and is lost as heat.

To prevent detonation from occurring, oil companies add ingredients to gasoline to retard the progress of the chain reaction of increasing temperature and pressure. Fuels are tested in specially-designed test engines to measure their resistance to detonation. By making a quantitative comparison of the test fuel against a standardized fuel called iso-octane, the detonation resistance of the fuel can be expressed as an octane rating. The octane rating of currently-available automotive fuels ranges from 85 to 96 PON (Pump Octane Number). By U.S. law, this number will be displayed on the pump when the fuel is offered for sale.

For various reasons, high-octane fuel is being phased out of existence in the U.S. This situation has created a serious problem for owners of BMW motorcycles produced between 1970 and 1979, since these models were designed to be operated on a steady diet of 94 octane (PON) premium-grade fuel. In an effort to attract performance-oriented buyers, BMW opted to use high compression ratios which required high-octane fuel. Now, however, the owners of these high-compression motorcycles are faced with the dilemma of not being able to find ready sources of high-octane fuel, especially when travelling. This problem has led many BMW owners to seek alternatives to high-octane fuel for their motorcycles.

Over the last decade, there have been many alternatives offered to the BMW owner to overcome the octane problem. Some of these solutions are; compression reduction, octane boosters and fuel additives, fuel mixing, and, most recently, the Dual Plug Ignition System. Each of these alternatives is discussed below.

BMW has suggested compression ratio reduction as a solution to the octane problem for many years. This is done by adding thick shims at the cylinder base to increase the volume of the combustion chamber and reduce the compression ratio. Since these shims resemble, and serve secondarily as, gaskets, they are commonly referred to as "low-octane gaskets". This solution was readily available to BMW since the company builds many low-compression engines for military, police and other applications in different markets. There are many machines in the U.S. that have been converted in this manner, and if you own a machine that was purchased secondhand, it is possible that it was converted by the previous owner. There are drawbacks to this solution, however, the greatest of which is a loss of power and fuel economy which can range from mild to severe depending on tuning factors and riding style. Also, lower compression engines tend to exhaust at higher temperatures, which lends to increased operating temperatures and reduced efficiency. This combination of effects can lead to rapid carbon buildup in the combustion chamber, which will raise the effective compression ratio and hinder heat transfer, leading to detonation problems after extended operation. For this reason, many low-compression conversions were unsuccessful from the standpoint of octane requirement reduction.

Another commonly-used solution to the octane problem is the mixing of additives or "octane boosters" to the fuel to raise the detonation resistance of the fuel. Due to the high cost of these substances, coupled with the inconvenience and risk inherent in carrying them while touring, their practical application is limited. While these substances will raise the octane of the fuel mixture if mixed correctly, there have been reports of carburetor float saturation and fuel leakage associated with their use in the BMW motorcycle.

It is possible to mix leaded regular-grade fuel with the now-available unleaded premium grades to obtain a mixture whose octane level will be in the vicinity of 92.5 PON. For those BMW's which will run well on this octane level, this is a practical alternative, if the rider is willing to contend with the inconvenience of the mixing chores. Since no modification is required on the machine, the economy factor is favorable as well. This process will not work, however, in some conditions, such as high ambient temperatures, high loads, or excessive carbon buildup in the engine. The R60/5 and R60/6 models will seldom run well on this mix, due to the camshaft grind used on these models, which raises the effective compression ratio and will aggravate the detonation problem.

The Dual Plug Ignition System has its historical roots in aircraft and racing applications, where its ability to control detonation and boost power output have been well proven.

These benefits can also be applied to street riding, now that high-octane fuel is becoming scarce. The System will also offer other benefits, including improved fuel economy, cleaner running with less carbon deposits in the engine, and a modest performance boost. Fuels with octane ratings as low as 87 can be used, even in the R60 models, without detonation. If the system is used for performance reasons, it will permit the use of compression ratios and camshaft grinds that would be otherwise impractical for street use. It is important to note, however, that the System will not cure or cover up other engine maladies, which should be corrected before the modification is performed, or while it is in progress.

There are many vendors offering the System in various forms at this time, and prices and equipment offered can vary tremendously, so the prospective buyer should carefully analyze his needs, and choose accordingly. Shortcuts in the basic conversion will almost certainly result in the loss of some (or all) of the potential benefits of the System.

This guide will address the use of the System primarily for detonation control, and secondarily for improving fuel economy and performance. Only 1970-1979 BMW models are covered, since these are the models most frequently converted. The next chapter will describe the components of the System, and indicate some of the basic functions of each component.

DESCRIPTION OF THE DUAL PLUG IGNITION SYSTEM

As its name suggests, the primary function of the Dual Plug Ignition System is to provide and fire a second spark plug in each combustion chamber. To accomplish this objective, two basic jobs are required. The first is to prepare the cylinder head to accept the additional spark plug, and the second is to modify the ignition system to deliver adequate spark to fire the added plug. Since these two jobs require some disassembly and modification work, they provide an excellent opportunity to improve upon existing parts to realize the maximum benefit from the conversion. Due to the nature of the work involved, it is recommended to leave it to a person who has a solid understanding of engine operation and repair techniques. The machining required to install the additional spark plug should be trusted to a shop that has experience with this modification, since even a small error could ruin the cylinder head. The modification of the ignition system is relatively straight-forward, but it should be done in a professional and workman-like manner to insure reliability.

The System consists of two additional spark plugs located in the "bottom" of the cylinder head, opposite the existing spark plugs, two high-energy, dual-output ignition coils with racing-type copper-core spark wires, and an ignition amplifier which is triggered by the stock points. In addition to these components, it is necessary to re-adjust ignition timing and carburetor

settings to accommodate the change. Some experimentation with these settings will help you to tailor the System to your needs. Initial settings are included in later chapters. Keep detailed notes on all changes and settings for maximum results.

The following chapters will cover installation and maintenance procedures for each component of the System. It is suggested to use a BMW Repair Manual in conjunction with this guide. If you are hesitant to attempt this modification yourself, this guide should be used by the person who you appoint to perform the modification for you.

*"The only reason some people get lost in thought
is because it's unfamiliar territory" ---Paul Fixx*

PREPARING CYLINDER HEADS FOR DUAL PLUG IGNITION

To permit the installation of the lower spark plug in each cylinder head, it is necessary to remove and disassemble the head. At this time it is recommended to completely recondition the heads to original specification. This will require checking the valves, springs, guides and seats for wear, and replacing or re-grinding to obtain good sealing. The head and piston should be decarbonized and cleaned, and the piston rings should be checked for wear, and replaced if required. On any engine with more than 20,000 miles, it is recommended to replace the lower two rings (nose ring and oil ring). The cylinder should be measured for wear and honed with a Flex-Hone to obtain a 45° crosshatch. All gaskets and seals should be replaced. The cylinder bases should be resealed using 'Hylomar' sealant per BMW recommendations.

The spark plug holes should be machined and tapped by a shop who has experience with this type of work. If the vendor offers a choice between 12mm or 14mm thread holes, specify the 12mm size. I prefer the 12mm size because it requires less material removal from the head in the area of the valve seat, which will lessen the possibility of the seat loosening in operation. Also, using a 12mm lower plug and a 14mm (stock) upper plug totally eliminates the chance of mixing up the plugs. Due to the design of the head where the second plug is installed, it is only possible to obtain 1/2 inch of threads, so you will need to use a 12mm,

1/2 inch reach spark plug, as listed in the spark plug chart "C" If your dealer or vendor has already supplied your cylinder heads with a 14mm, 1/2 inch thread, then you must select your lower plugs from chart "D". Once you have determined which thread size you have, cross out the chart which you don't need to prevent any possibility of getting the wrong plug. If you have 14mm, 1/2 inch reach lower plugs, be very careful when installing the plugs, as the stock upper plug is 14mm, 3/4 inch reach, and if it is inadvertently installed in the lower hole, it will hit and damage the valves and piston.

After re-assembly of the engine and installation of the ignition components, set the ignition timing following the procedure and recommendation in this guide. Leave all carburetor settings in stock position. Break in the engine using light (10W40) oil and light throttle loading. Avoid excessive idling and lugging.

After a 600-mile break-in period, change the oil and retorque the heads. Adjust the valve clearance, check timing and readjust the carburetors. Experimentation with rejetting should only be done after the break-in period.

Careful assembly and break-in of the engine is absolutely critical to the success of the conversion, and will have as much effect on the final results of the project as the actual addition of the second plug. Your BMW dealer should be entrusted with this work unless you are well versed in BMW repair procedures. The one-time expense will be well justified in this case.

SPARK PLUG CROSS REFERENCE CHARTS

To use this guide, first locate the reference letter corresponding to your motorcycle year and model from chart "A". Using this reference letter, go to chart "B" to find the recommended stock upper plug from the manufacturers shown. To find the correct corresponding lower plug, determine which size your motorcycle is tapped for (12mm, 1/2 inch reach, or 14mm, 1/2 inch reach) - and refer to chart "C" or chart "D" for the correct lower plug to use. When you have determined whether chart "C" or chart "D" is correct for your bike, cross out the incorrect chart to avoid confusion.

The cross-reference charts lists standard electrode and gold palladium type plugs from NGK, ND, and Champion. The gold-palladium type plugs offer improved cold weather starting, better resistance to fouling, and wider heat range tolerance, at a high price.

The Champion Resistor Series plugs are listed for riders who use AM/FM or CB radio equipment, and need to reduce radio interference.

For more information on this subject, Champion Spark Plug Company offers a very informative booklet from their technical services department.

SELECT PLUG SIZE AND HEAT RANGE VERY CAREFULLY.

INSTALLATION OF INCORRECT PLUGS COULD LEAD TO ENGINE DAMAGE.

CHART "A" - RECOMMENDED STOCK PLUGS BY YEAR AND MODEL

MODEL	1970 - 1976						
	1970	1971	1972	1973	1974	1975	1976
R50/5	A	A	A	A	-	-	-
R60/5/6	A	A	A	A	A	A	A
R75/5/6	C	C	C	C	C	C	C
R90/6	-	-	-	-	C	C	C
R90S	-	-	-	-	C	C	C

MODEL	1977 - 1979		
	1977	1978	1979
R60/7	B	B	-
R65	-	-	B
R75/7	C	-	-
R80/7	-	D	D
R100/7	C	C	-
R100S	C	B	B
R100T	-	-	B
R100RS	C	B	B
R100RT	-	-	B

NOTE: SOME EARLY PRODUCTION 1970 and 1977 MODELS WERE FITTED DIFFERENTLY. CHECK YOUR OWNER'S MANUAL

CHART "B" - CROSS REFERENCE FOR UPPER PLUG

MANUFACTURER	TYPE ¹	REFERENCE LETTER FROM CHART "A"			
		A	B	C	D
BOSCH (New Number)	STD.	W5D	WSD	W6D	W7D
BOSCH (Old Number)	STD.	W230T30	W225T30	W200T30	W175T30
CHAMPION	STD.	N6Y	N6Y	N7Y	N9Y
CHAMPION	RESISTOR	RN6Y	RN6Y	RN7Y	RN9Y
CHAMPION	GOLD	N3G	N3G	N4G	N4G
NGK	STD.	BP-8ES	BP-7ES	BP-6ES	BP-6ES
NGK	GOLD	BP-8EV	BP-7EV	BP-6EV	BP-6EV
ND- "HOT U"	STD.	W24EP-U	W22EP-U	W20EP-U	W20EP-U
ND- "HOT U"	GOLD	W24ES-GU	W22ES-GU	W20ES-GU	W20ES-GU

¹ 'STD' = Steel electrode, non-resistor.

'RESISTOR' = Steel electrode with resistor for radio interference suppression.

'GOLD' = Gold palladium center electrode (see text).

CHART "C" 1/2" REACH, 12mm. PLUG FOR LOWER LOCATION IN DPIS

MANUFACTURER	TYPE	A	B	C	D
BOSCH	STD.	X2A	X2A	X4A	X4A
CHAMPION	STD.	P7	P7	P8Y	P8Y
CHAMPION	RESISTOR	-	-	-	-
CHAMPION	GOLD	P7G	P7G	P8G	P8G
NGK	STD.	D-8HS	D-8HS	D-6HS	D-6HS
NGK	GOLD	D-8HV	D-8HV	D-6HV	D-6HV
ND- "HOT U"	STD.	X24FS-U	X24FS-U	X-20FS-U	X20FS-U
ND- "HOT U"	GOLD	X24FS-GU	X24FS-GU	XZ0FS-GU	X20FS-GU

CHART "D" - 1/2" REACH, 14mm, PLUG FOR LOWER LOCATION IN DPIS

MANUFACTURER	TYPE	A	B	C	D
BOSCH	STD.	W5B1	W5B	W6,B	W7B
CHAMPION	STD.	L82Y	L82Y	L87Y	L92Y
CHAMPION	RESISTOR			RL87Y	
CHAMPION	GOLD	L6G	L6G	L9G	L9G
NGK	STD.	BP-7HS	BP-7HS	BP-6HS	BP-6HS
NGK	GOLD	BP-7EV	BP-7EV	BP-6EV	BP-6EV
ND- "HOT U"	STD.	W22FP-U	W22FP-U	W20FP-U	W20FP-U
ND- "HOT U"	GOLD	W22FP-GU	W22FP-GU	W20FP-GU	W20FP-GU

A handy spacer can be made for emergency use (when the short reach plugs are unavailable) that will allow you to use 3/4" reach plugs in the lower location. If you use the 14mm. lower plugs, the spacer will allow you to use the stock upper plug in the lower hole. If you use the 12mm. lower plugs, you will be able to substitute 3/4" reach, 12mm. plugs in the lower location. These plugs are readily available from any Honda dealer. The spacer dimensions are: Length 1/4", O.D. 1", I.D. 12.2mm, or 14.2mm, depending on which plug you are using. Make the spacer from hard aluminum or stainless steel.

Use a gasket on each side of the spacer, and tighten per specification. Do not use these spacers for continuous operation, as they can affect the plug heat range. The spacer should be considered as an emergency item for use while travelling.

SERVICING THE DUAL PLUG IGNITION SYSTEM

A.) INSTALLING AND SERVICING SPARK PLUGS

FOLLOW THESE SIMPLE STEPS FOR CONSISTENT SPARK PLUG PERFORMANCE.

- 1.) Lightly coat spark plug threads with an Anti-seize or Molybdenum disulfide (MOS₂) compound to prevent thread siezing or galling.
- 2.) Set plug electrode gap at .030" (.75mm) using a wire-type feeler gauge. Avoid scratching or overbending the electrodes.
- 3.) Thread the spark plug into the cylinder head by hand until the gasket is seated. Torque 14mm. plugs to 17 foot/pounds, 12mm. plugs to 12.5 foot/pounds.
- 4.) Install and tighten the small sleeve nut onto the spark plug.
- 5.) Push the spark wire cap fully onto the plug and twist it back and forth to seat it. Failure to fully seat the cap can cause arcing which will ruin the cap.
- 6.) If plugs are subsequently cleaned with an abrasive particle blaster, thoroughly clean the particles off the electrodes, insulator and threads before re-installing.
- 7.) Keep the outer ceramic portion of the plug clean and dry to prevent spark tracking and misfiring.
- 8.) Never re-use the spark plug gasket. Renew it every time the plug is removed. This is especially critical on the 12mm. size plugs.
- 9.) Inspect used plugs for signs of engine malfunction such as oil consumption, detonation, rich or lean carburetion or weak ignition spark. Many spark plug manufacturers supply charts with photographs and diagnostic tips for this purpose.

SERVICING THE DUAL PLUG IGNITION SYSTEM

B.) INSTALLING AND SETTING IGNITION POINTS

Since the Dual Plug Ignition System uses the original BMW ignition points and condenser, installation procedures are identical to those suggested in your owner's manual. In order to achieve the required range of timing adjustment, however, it is necessary to modify the points and baseplate slightly. Refer to the diagram in Section H. (Wiring Diagrams) for the exact location of the required filing and grinding. It is necessary to elongate the baseplate mounting holes to allow additional clockwise rotation of the baseplate. This can be done with a small round file or with a Dremel tool and a small grinding bit. Carefully de-burr the plate after filing or grinding, and take care not to bend or distort the plate while making the modifications. Once the base-plate is modified, there should be no reason to change it. The ignition points will have to be modified also, as the lower baseplate screw will hit the points assembly when the plate is turned clockwise. Thus it is necessary to grind a small amount of material from the points assembly at the bottom edge. The diagram will indicate where to grind. The job can be done on a bench grinder and an extra set of points should be modified and carried while travelling to avoid any possibility of difficulty in the event of points failure.

Setting the points involves adjusting the point gap and setting the timing of the spark. Timing is covered in detail in the following section of this guide. Setting the point gap can be done three different ways. The first method is accomplished with the aid of a feeler gauge to measure the point opening by "feel". While this method is certainly adequate for field repairs, it should be avoided in the shop because it is inaccurate, and because the feeler gauge can scratch the thin tungsten coating on the points, which will lead to arcing and corrosion of the electrical contacts. This method is described in the owner's manual in detail, and should be practiced to prepare for any potential emergency situation. The easiest and most accurate method of setting the point gap is with the use of a Dwell Meter. These meters are readily available at a reasonable cost. It is important to note, however, that it may be necessary to bypass the Ignition Amplifier in order to obtain an accurate Dwell Meter reading. This procedure is covered under section E. (Ignition Amplifier).

Connect the Dwell Meter according to the manufacturer's instructions, and set it on the "4 CYLINDER" scale. (While meters for 2 cylinder engines are available, the 4-6-8 cylinder variety are more common and generally less expensive, with no appreciable loss of accuracy.) Check the number stamped on the face of the centrifugal advance unit and compare it to the chart on the following page to determine the correct dwell setting for your motorcycle. Compare this to the reading from the meter and adjust the point gap to obtain the correct dwell setting.

CHART "E" - DWELL SPECIFICATIONS

NUMBER FOUND ON ADVANCE UNIT- (LAST 3 DIGITS)	FACTORY DWELL ANGLE SPEC.	CORRECT READING ON 4-CYL. SCALE
---	------------------------------	------------------------------------

005		
007 (1972 /5 Models)	110°	55°
007 (1973 /5 Models)	78°	39°
010		
012		
1979-1980 Models with Canister-Type Ignition	120°	60°

To set dwell angle, connect dwell meter per manufacturers instructions. Set meter on "4 Cyl." scale. Remove upper spark plugs and re-install in wires. Lay the connected plug on the cylinder fins. Switch on the ignition and crank the electric starter while observing the meter reading. Switch off the ignition and adjust point gap to obtain correct dwell. (Opening points gap reduces dwell angle.) Do not attempt to set the dwell with the engine turning except on 1979-1980 models.

Remember to re-connect the Ignition Amplifier for ordinary running before starting the engine.

The point opening can also be adjusted with a dial indicator set to measure the travel on the movable contact point. Use a solid mounting fixture and make sure that the indicator pointer is set in the direction of point travel. Rotate the engine with an allen wrench fitted in the alternator bolt, and adjust the point opening to .016" as specified by BMW.

The above method will also show any runout in the camshaft tip, which is the cause of the "double image" seen when using a strobe timing light on the flywheel marks. If the point opening is set to .016" on one side, and the other side does not open the same amount, the runout should be corrected. To do this, remove the centrifugal advance unit and place the dial indicator on the cam tip to find the "high spot". Using a small plastic mallet, tap the shaft (NOT the threaded portion!) to straighten it. Proceed slowly and gently until there is .001" or less runout.

When reinstalling the advance unit, locate the unit on the flat spot ground on the cam, then hold it counterclockwise gently with an adjustable wrench fitted on the rectangular portion, while gently tightening the retaining nut. The nut should be torqued to 5.5 foot/pounds. Use extreme care in this entire operation, as a heavy hand can cause some very expensive damage. Once the runout is minimized at the cam tip, there is little else that can be done to correct any remaining timing variation. maximum allowable variation is 3°, or the distance between the "S" marks on the flywheel.

As you can see, each of the three methods of adjusting the point gap is useful in different situations, so it is recommended that you become proficient at all of the methods.

SERVICING THE DUAL PLUG IGNITION SYSTEM

C.) SETTING IGNITION TIMING FOR THE DUAL PLUG IGNITION SYSTEM

Ignition timing must be set so that the spark occurs in time to allow the mixture to reach its full energy output as the piston begins its downward travel. Since the Dual Plug Ignition System allows the flame propagation rate to be greatly increased, the time required to burn the fuel mixture is reduced. For this reason, it is necessary to readjust the ignition timing to have the spark occur later. The exact amount of change varies depending on bore size, ignition spark energy, fuel mixture strength, and engine temperature and RPM.

On the BMW motorcycle the ignition timing is adjusted to varying engine RPM by means of a centrifugal advance unit. Since 1970, BMW has changed the characteristics of this unit several times for various reasons, as evidenced by the chart "E" on page 20. For adjustment to suit the combustion behavior of the Dual Plug Ignition System, the early unit used on 1970 and 1971 /5 models, marked "005" is not suitable and should be replaced with the latest 1978 unit marked "012" (BMW part number 12 11 1 357 626). All of the later units are adaptable to the System, with proper adjustment.

For street use with the Dual Plug Ignition System, we need to

have the spark occur at 21-25° BTDC, at full advance. This setting will offer a good compromise for easy starting, mid-range power, and good fuel mileage. Since the BMW centrifugal advance unit has a total control range of 25° (26° on 1979 and 1980 models), setting the timing (static) on the "OT" mark will give the proper full advance curve. The larger bore engines (900 and 1000cc.) tend to prefer a slightly more retarded setting, 2-3° ATDC. The R65 engine, having a shorter stroke, and consequently different flame propagation characteristics, runs well when the static timing is set at 3° BTDC.

As mentioned previously, it may be necessary to modify the points and baseplate to obtain these settings. Refer to the diagrams in Section "H" for exact details of this modification. The chart on the following page will indicate recommended initial settings to try, based on engine size. Once you have completed the break-in of your engine, try slightly advanced settings from these initial ones, to obtain maximum midrange power and fuel economy. The diagrams below indicate how the marks will look in the window at idle.

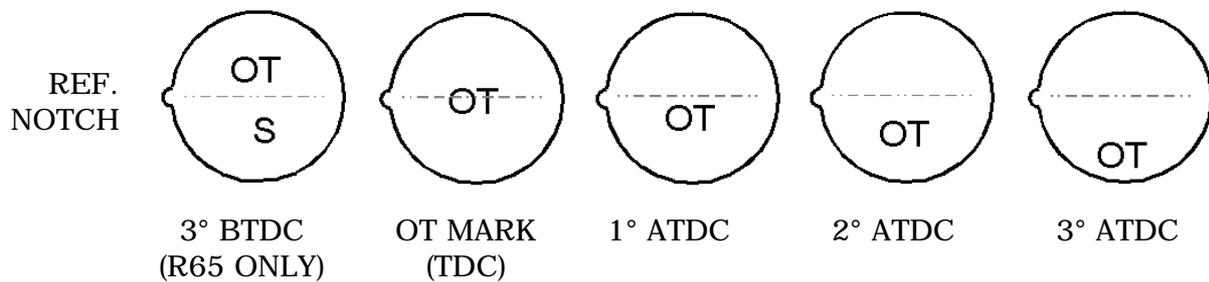


CHART F - IGNITION TIMING FOR DUAL PLUG IGNITION

ENGINE SIZE (CC.)	STATIC SETTING	FULL ADVANCE
500-----	OT MARK (TDC)-----	25° BTDC
600-----	OT MARK (TDC)-----	25° BTDC
650 (R65) -----	3° BTDC-----	29° BTDC*
750-----	1° ATDC-----	24° BTDC
800-----	1° ATDC-----	24° BTDC*
900-----	2° ATDC-----	23° BTDC
1000-----	3° ATDC-----	22° BTDC*

* NOTE 1979 and 1980 models have total range of 26° therefore, add 1° to full advance stated in chart.

In many cases a blurred or double image will appear when using a timing light to observe the timing marks. Refer to Section B, page 21, for instructions to minimize this timing variation. If some variation exists, use the UPPER mark for all settings as per the above recommendations.

Once you have located the optimum settings for your motorcycle, use white paint to re-mark the flywheel timing marks. To make a new "F" mark for checking full advance, use a degree wheel on the alternator and zero it on the "OT" mark. Then rotate the engine until the correct full advance setting is reached as per Chart F, and make a paint dot opposite the reference notch in the engine housing.

D.) SERVICING THE IGNITION COILS AND WIRES

The ignition coils and wires will require little maintenance. Periodically check the wire connections for looseness or corrosion, and clean the coils and wires annually. Inspect the caps for any signs of burning caused by spark leakage. When installing the spark caps onto the spark plugs, press them on firmly and twist them back and forth to work the rubber down over the plug insulator, to obtain a watertight seal. This is especially critical on the lower plugs since they operate in an inverted position.

E.) SERVICING THE ACCEL IGNITION AMPLIFIER

The Accel ignition amplifier is used in conjunction with the stock points to reduce the current flow to the points while delivering enough current to the coils for maximum spark output. The amplifier is a sealed, non-serviceable unit. In the event that you suspect that the amplifier has failed, it can be bypassed for testing, or for emergency operation, although this will very likely cause rapid deterioration of the ignition points. In this case, replace the points and amplifier at the same time.

As mentioned in Section B, it may be necessary to bypass the amplifier when using some dwell meters. To serve this purpose, ACCEL has provided two bullet-type connectors, in the red and green wires, which can be unplugged and cross-connected (red to green, green to red). This will allow current flow directly from the coils to the points.

IN NO EVENT SHOULD THE IGNITION BE LEFT "ON" WHEN THE ENGINE IS NOT RUNNING, AS THIS CAN CAUSE FAILURE OF THE COILS, POINTS, OR AMPLIFIER!

Some BMW models made after 1978 with the electronic tachometer will exhibit severe tachometer instability when the amplifier and Andrews coil are used. This can be easily corrected by attaching a second condenser at the coil terminal with the green wire from the amplifier. The condenser must be solidly mounted and grounded. The capacitance value of the condenser in this application is not critical, and an old used condenser will serve this purpose very well. As an added benefit, the added condenser will increase spark voltage slightly. Refer to the wiring diagram in section H for the location of the added condenser.

SERVICING THE DUAL PLUG IGNITION SYSTEM

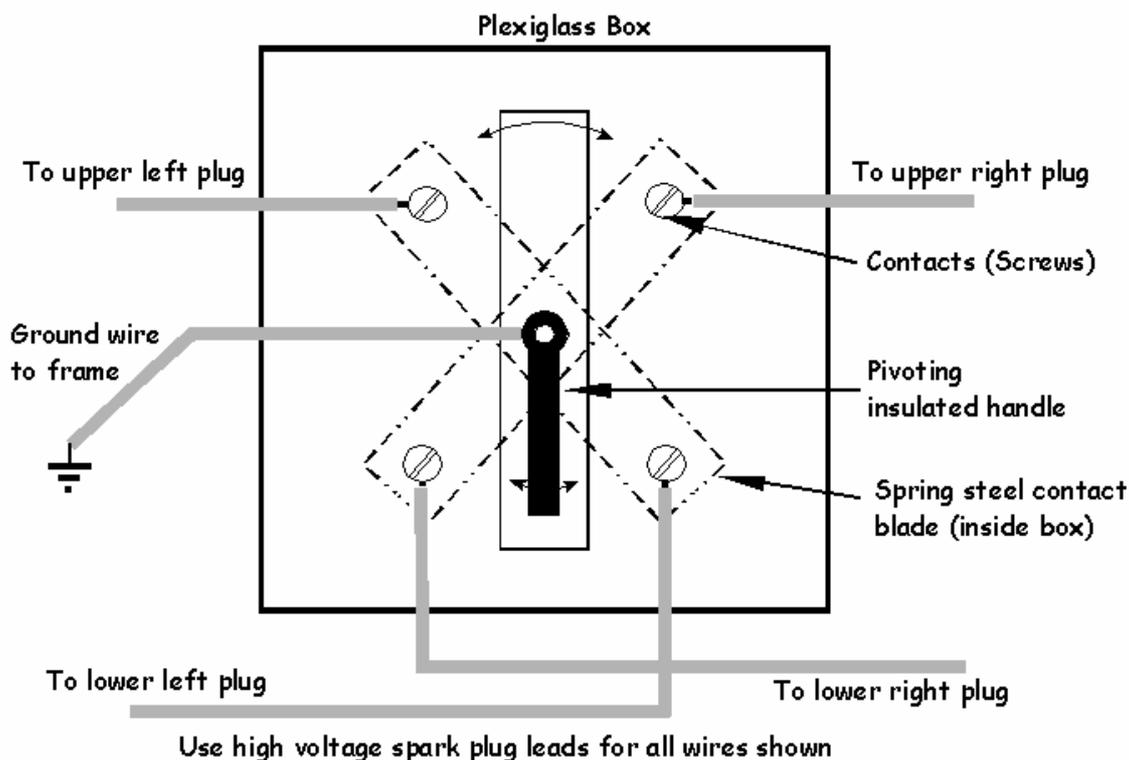
F.) CARBURETOR ADJUSTMENT

Carburetor adjustment is the final step in engine tuning. All other adjustments, i.e., valves, point gap, timing, plug gap and oil change should be done before any attempt is made to adjust the carburetors. Be sure that the carburetors are clean, i.e., free of water, dirt or stale fuel, and that the choke is fully off. The engine should be at normal operating temperature, after a 5-10 minute ride, and cooling air should be provided to the cylinders and heads by means of a fan.

To adjust the carburetors, it is necessary to be able to shut off the spark to one cylinder at a time. Do not pull off the spark caps for this purpose, as damage could result to the coils and wires. Also, this method poses the hazard of possible electrocution to the adjuster. The spark must be grounded by means of a switch such as the Equalizer. This device can be homemade by following the sketch below, or an Equalizer for dual plug systems can be purchased from: ABC Enterprises, Box 18016, Rochester, N.Y. 14618. Once you have a device to short out the spark, you can proceed with the actual adjustment. Refer to your BMW owner's manual for clarification of this procedure.

Set the throttle at the idle position and shut out the right cylinder. Working on the left carburetor, adjust the idle mixture screw to obtain the strongest running. Lower the idle speed with the idle speed screw and re-check the mixture adjustment. Repeat this adjustment until the left cylinder runs strongly at 450 - 550 RPM.

Now shut out the left cylinder and repeat the adjustment on the right carburetor to obtain the same idle speed. With both cylinders running, idle speed should be steady between 950 and 1050 RPM. By alternately shutting out each cylinder, check that they are running at the same speed. The idle adjustment is now set and should not be changed. To synchronize the throttle cables, adjust the cable adjusters to provide 1-2mm free play in each cable, then shut out the left cylinder. With just the right cylinder running, lock the throttle at a steady 1500 RPM. Leave the throttle in this position and switch the left cylinder on, and adjust the cable to obtain 1500 RPM, and lock the adjuster nut. Switch each cylinder on and off alternately to check that they are both pulling the same RPM. To double check, bring the RPM up to 3500 on one cylinder and alternately check that both still pull the same speed. If there is a gross difference at this RPM level, suspect a kinked cable or ruptured diaphragm as the culprit. Correct this condition and repeat the adjustment procedure. The entire procedure should not take more than ten minutes, to avoid possible engine overheating.



SERVICING THE DUAL PLUG IGNITION SYSTEM

G.) CARBURETOR JETTING

One of the many benefits of dual plug ignition is that the engine will run well on leaner-than-stock fuel mixtures, which will give improved economy and performance and reduce carbon deposits in the engine. In order to take advantage of this benefit, it is necessary to re-jet the carburetors. Re-jetting should not be attempted until the engine is fully broken in and any other problems are sorted out and corrected. Keep accurate records of your stock jetting as well as any changes you make, and of resultant changes in performance and fuel mileage.

There are three jetting circuits in BMW carburetors, that control fuel metering at different throttle openings. The idle circuit controls mixture from idle to 1/4 throttle. The needle jet and jet needle work together to control midrange from 1/4 to 3/4 throttle. Above 3/4 throttle, the main jet controls fuel flow, although changes in jet needle position can have some effect even at full throttle opening. In order to determine which circuit you are using at any given time, it is handy to place a strip of white tape on the handlebar and twist grip, and make clear marks for 1/4, 1/2, 3/4 and full open throttle.

If the mixture in a given range is correct, the motorcycle will accelerate and cruise smoothly in that range, without surging or stumbling. If it is too lean, the engine will "stumble" on acceleration, and surge while cruising. An overly rich mixture will give poor throttle control, and the exhaust note will be "blubbery". Obviously these are over-simplifications of these conditions, but they will give you an idea which direction to pursue in jetting. Spark plug readings will give accurate indications for fine tuning, if done correctly and methodically. New plugs of the correct heat range should be used, and the motorcycle must be fully warmed-up and ridden at least two miles at steady throttle in top gear. The engine then must be switched off, and the motorcycle coasted to a stop. Reading is done by examining the insulator at the center electrode with a magnifying glass. A white, blistered insulator indicates a lean mixture. A sooty or dark brown color indicates a rich condition. Tiny spots (like pepper) on a white-grey insulator indicate detonation that may not be detectable to the ear. For normal street riding and touring, a light tan-brown color indicates correct jetting. Since jetting is affected by air density and ambient temperature, these factors should be taken into consideration when making jetting adjustments. Normally a richer mixture is required for cold weather or humid climates, so avoid jetting too lean on a warm day, because the same settings may prove too lean in cooler weather. When checking jetting, proceed systematically, beginning with the idle circuit and progressing toward the main jet circuit. You will most likely find the idle jetting to be correct as delivered by BMW, as there is a wide range of adjustability

offered by the idle mixture screw. If the engine stumbles just off idle, try adjusting the idle mixture screw to a richer setting. On the R50 and R60 models, this condition can indicate a malfunction of the accelerator pump device fitted inside the needle jet holder. This should be checked and corrected before the jetting is changed. On the R90S model with Dell'orto carburetors, the accelerator pump should be adjusted to deliver 6cc. of fuel per 20 strokes, which will give good acceleration and prevent plug fouling. Your BMW dealer will be familiar with the details of this delicate adjustment. For the Dual Plug Ignition System, the large majority of jetting changed is in the 1/4 to 3/4 throttle range, where the needle jet and jet needle meter the fuel flow. The needle position can be changed to lean out or richen the mixture, although this is a somewhat gross adjustment. One change in needle position equals roughly four jet sizes, so this should only be used for large initial adjustments. For reference, the top or leanest setting of the needle is always referred to as the number 1 position, and the notches are counted down from there. Start with the stock jet and lower the needle one step. If this setting is too lean, return the needle to the stock position and reduce the jet size one step at a time until the lean limit is reached. Raise the jet size by one step and you should have good acceleration and economy.

To test the main jet circuit, it is necessary to run the motorcycle at full throttle over a flat, straight highway at least one mile in both directions. Note the indicated top speed each way, and average them to eliminate error caused by wind. Try changing the main jet one size at a time to obtain the highest top speed. When the jetting is correct, the spark plugs should be almost white, with just a trace of tan color. There should be no sign of detonation present. Obviously this test involves a certain amount of hazard, and should only be attempted by an experienced rider on a deserted, safe roadway.

If you find the jetting to be too lean or too rich at all throttle settings, check the float level in both carburetors. On all post-1970 BMW's, the correct float level is obtained when the float needle is seated as the molding seam on the float is level with the float bowl gasket surface. On the 32mm Bing CV carbs, this will yield 20-22mm of fuel in the bowl. On the slide-type Bing carb, this will yield 25-26.5mm of fuel, and on the Dell'orto, there should be 55cc. of fuel released from the bowl when the plug is removed. Repeat each measurement twice to insure consistency. If full throttle leanness persists despite increases in the main jet size, check the fuel output of each petcock. Minimum flow rate is 300cc per minute.

Difficulty in obtaining precise idle mixture adjustment can often be traced to leaking choke housing gaskets or chokes not fully seated. If this condition persists despite carburetor inspection and repair, check for leaking or sticking intake or exhaust valves. Slide-type carburetors may be difficult to adjust and jet due to wear at the throttle slide allowing air leakage around the slide.

Replacement of the worn slides will usually yield excellent results. Carburetor jetting must be undertaken in an orderly and methodical manner if it is to be successful. Dirty or worn carburetors and components cannot be corrected or overcome by re-jetting or adjustment. If you encounter jetting difficulty, revert back to the stock settings and test the machine again. If the problem persists, there may be dirt or damage to the carburetor or some other engine or ignition component.

The chart on the following pages lists the original BMW settings for all models from 1970 to 1980, while there were some variations in production, most machines imported into the United States were delivered with the settings shown here.

CHART G - FACTORY RECOMMENDED CARBURETOR JETTING, 1970-1980

YEAR	MODEL	CARB (1) TYPE	MAIN JET	NEEDLE JET	NEEDLE TYPE	NEEDLE (2) POSITION	IDLE JET
1970 to	R50/5	A	135	2.68	4	3	35
1973 (5)	R60/5	A	140	2.68	4	2	40
	R75/5	C	135	2.70	46-241	3	50
1974 to	R60/6	B	140	2.68	4	2	40
1976	R75/6	C	145	2.66	46-241	3	50
	R90/6	C	150	2.68	46-241	2	45
	R90S	E	155	2.60	K-4	3	60
1977	R60/7	B	140	2.68	4	2	40
	R75/7	C	145	2.66	46-241	3	50
	R100/7	C	150	2.68	46-241	3	50
	R100S	F	170	2.66	46-341	3	45
	R100RS (6)	F	170	2.68	46-341	2	45
(3) 1978	R60/7	B	140	2.68	4	2	40
	R80/7	D	145	2.66	46-241	3	50
	R100/7	C	150	2.68	46-241	3	50
	R100S	F	170	2.66	46-341	3	45
	R100RS	F	170	2.66	46-341	3	45
(4) 1978	R80/7	D	145	2.66	46-241	2	45
	R100/7	D	145	2.66	46-241	2	45
	R100S	F	160	2.64	46-341	2	45
	R100RS	F	160	2.64	46-341	2	45

REFER TO PAGE 37 FOR EXPLANATION OF FOOTNOTES.

CHART G. CONTINUED

YEAR	MODEL	CARB TYPE	MAIN JET	NEEDLE JET	NEEDLE TYPE	NEEDLE POSITION	IDLE JET
1979	R65	D	140	2.66	46-241	2 ⁽⁷⁾	45
	R80	D	145	2.66	46-241	2	45
	R100T	F	160	2.64	46-341	2	45
	R100S	F	160	2.64	46-341	2	45
	R100RS	F	160	2.64	46-341	2	45
	R100RT	F	160	2.64	46-341	2	45
1980	R65	C	145	2.66	46-241	3	45
	R80	C	150	2.66	46-241	3	45
	R100T	F	160	2.66	46-341	2	45
	R100S	F	160	2.66	46-341	2	45
	R100RS	F	160	2.66	46-341	2	45
	R100RT	F	160	2.66	46-341	2	45

REFER TO PAGE 37 FOR EXPLANATION OF FOOTNOTES.

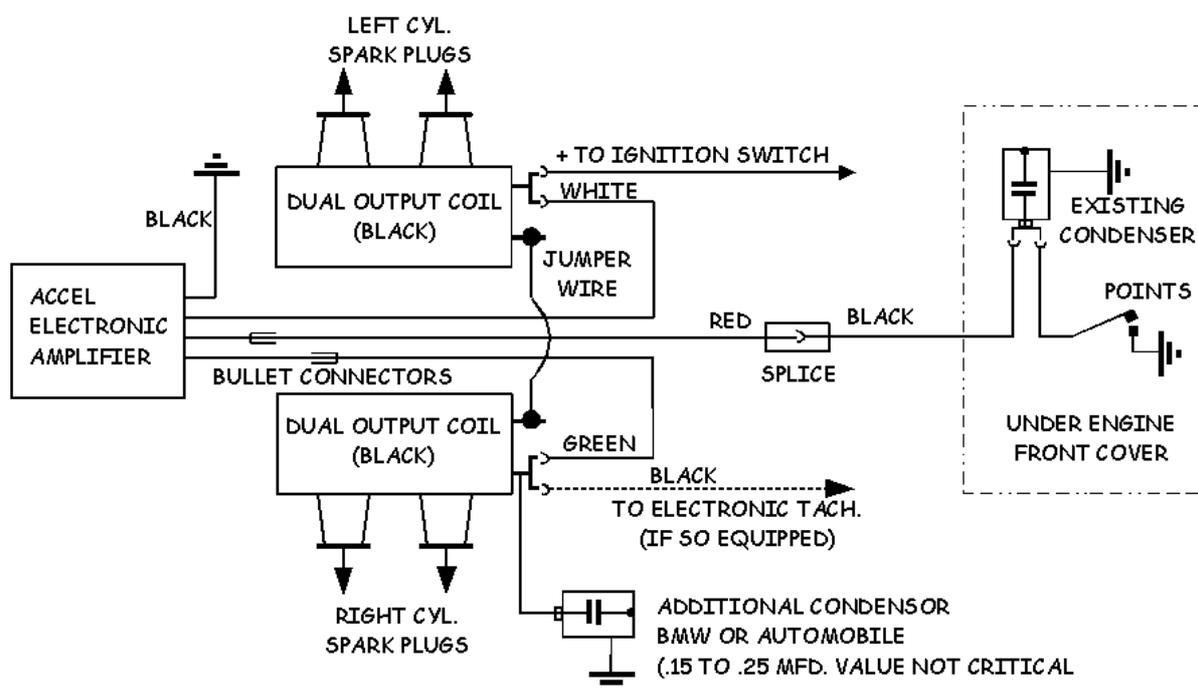
FOOTNOTES - CHART G

1 CARBURETOR TYPES

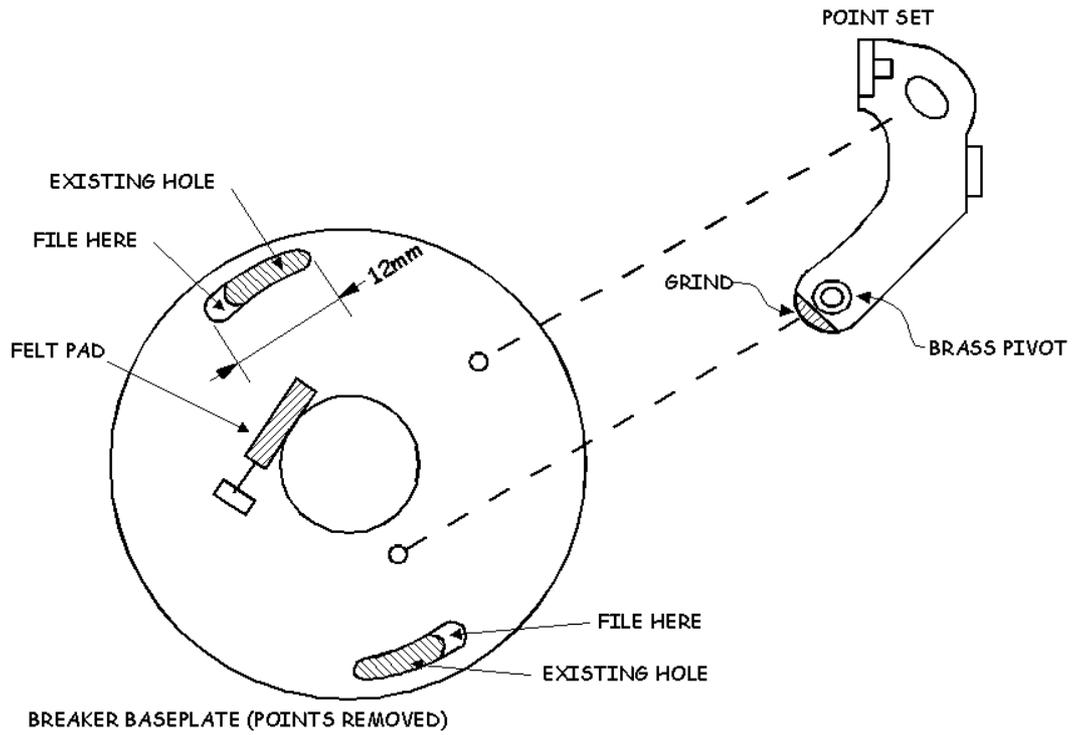
- A - Bing 26mm slide-throttle with acc. pump in needle jet housing and push-button tickler for fuel enrichment.
- B - Bing 26mm slide-throttle type with acc. pump in needle jet housing and cable-operated enrichment device.
- C - Bing 32mm Constant Velocity type with Slide Piston Guide Sleeve in dome.
- D - Bing 32mm Constant Velocity type with flat top (no sleeve)
- E - Dell'orto 38mm slide-throttle type with acc. pump
- F - Bing 40mm Constant Velocity type

- 2 Count needle notches down from top to determine position. Measure length of needle projecting from slide to check setting.
- 3 1978 models produced prior to January 1, 1978 were not subject to E.P.A. emissions regulations.
- 4 1978 models produced after January 1, 1978 subject to E.P.A. Control.
- 5 Early production R50/5 models (up to engine # 2900441) were jetted as follows; Main Jet-145. Needle Jet-2.68. Needle type-4. Needle Position-2. Idle Jet-35.
- 6 This line applies only to 1977 R100RS models fitted with 40mm exhaust system. Models with 38mm exhaust system are jetted identically to 1977 R100S model.
- 7 R65 models were changed to needle position 3 to cure lean running.

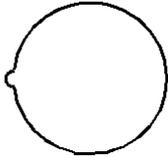
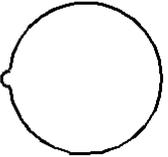
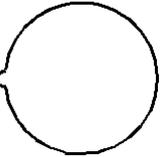
H.) WIRING DIAGRAM FOR THE DUAL PLUG IGNITION SYSTEM
(COURTESY OF WALUS ENGINEERING, BEECHER, ILLINOIS)



MODIFICATION TO THE CONTACT POINTS BREAKER PLATE AND POINTS FOR TIMING ADJUSTMENT (SEE PAGE 18)



RECORD ALL SETTINGS HERE

	ORIGINAL SETTINGS	FIRST CONVERSION	FINAL
<u>CARBURETOR JETTING</u>			
MAIN JET:	_____	_____	_____
NEEDLE JET:	_____	_____	_____
NEEDLE POSITION:	_____	_____	_____
<u>IGNITION TIMING:</u>			
REF. NOTCH -			
<u>FUEL MILEAGE:</u>			
TANK # 1	_____	_____	_____
TANK # 2	_____	_____	_____
TANK # 3	_____	_____	_____