

Gunson's

Testune

Silicon-chip Electrical Test and Tune-up Meter

For 6 or 12 volt battery/coil or electrical ignition equipped engines.
4 wire.

INSTRUCTIONS FOR USE



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DESCRIPTION

Gunson's Testune offers a comprehensive range of features for electrical testing. These instructions give a description of the methods of use in the early sections followed by useful notes and information in a separate section. The principles illustrated in the information section can be applied to electrical circuits in general and are not confined to the examples given. You will therefore be able to apply these principles to many more tests than it is possible to list here.

The scale window has been treated with anti-static solution — excessive polishing should be avoided — to clean, when necessary, use a damp cloth lightly.

IMPORTANT. Before connecting the instrument check that the needle is reading zero on the scale. Adjust if necessary using the slotted screw situated between the scale and Function switch. The meter and circuit are well protected against overload but frequent or continuous overload due to incorrect use should be avoided. Care should therefore be taken when switching between High and Low ranges and also when using the Points and Ohms scales (See section 1.4. and 1.5.). At the end of any testing, disconnect the meter and return the Range switch to HIGH position, as an extra precaution do not leave the Function switch pointing to Points, Ohms or Amps after use. Ensure that the pair of leads not in use during any particular test are isolated and are not allowed to come into contact with the vehicle body or other electrical contact and also that all leads are kept clear of rotating engine parts and the exhaust system.

NEVER CONNECT THE BLUE/GREEN AND THE RED/BLACK PAIRS OF LEADS AT THE SAME TIME.

If Testune is to be stored for an appreciable period, or if the battery is not in good condition, (i.e. resistance scale zero is not stable), it should be removed to avoid damage due to leakage. Such damage is not covered by the guarantee.

If your Testune should require service or repair at any time see details on the back cover of these instructions.

Each test in section 1 is listed with a separate procedure but Tachometer and Dwell tests can both be conducted by switching between these functions (with the range switch set to High) without stopping the engine.

The engine must be stationary in order to test points condition (see section 1.4.).

If a complete engine service is being undertaken it is suggested that the following order be followed:

(Replace plugs, change oil, filters and adjust tappets etc., as required).

1. Test and replace points as necessary and adjust dwell.
2. Adjust ignition timing.
3. Adjust mixture and engine idle speed — with engine at normal operating temperature.

A good service manual complete with wiring diagram for your vehicle is a good investment and will enable you to get the full benefits of this instrument.

6 VOLT SYSTEMS

The battery must be charging with a voltage of 6.8V minimum otherwise errors on the R.P.M. or Dwell Scales will occur at low engine speeds.

TYPICAL VALUES

Battery Voltage

12.6 volts under no or light load
13.1 volts if recently charged, drops quickly to 12.6 volts under light load (side lights).
13.7 – 14.7 volts with engine at 1500 r.p.m. plus, electrical accessories off, battery well charged.
At 2000 r.p.m. with all electrical accessories on, voltage should not fall below 12.6 volts.
10 volts when cranking on starter (hot) minimum.
9 volts when cranking on starter (cold) possibly less at sub-zero temperatures.

Coil supply voltage (ballast resistor type) 6–8 volts, points closed.

Charging current

When battery is well charged and electrical accessories are off current may drop to 1½ amp approx.

When battery is below 12.6 volts and all electrical accessories are on, alternator current should be 30–45 amps (typical 1–2½ litre engine at 2500 r.p.m.).

A generator would give approx 30% less current at this speed.

Resistance

Spark plug leads (suppressed type).

Approx 4 k ohms per foot length. 6 k ohms per foot on some coil/distributors leads.

Ignition Coil (ballast resistor type).
(ballast resistor type).

Primary resistance, + & – contacts, 1.5 ohms approx.
Secondary resistance, centre HT to + terminal, 10 k ohms approx.

(12 volt supply type)

Primary resistance 3.5 ohms approx.
Secondary resistance 7.5 k ohms approx.

Ballast resistor value

1.5 ohms approx.

Alternator diodes

Should give a very high resistance in one direction and a much lower reading when the clips are reversed.

C. VOLTS, AMPS AND OHMS SCALE — continued

Therefore to check if the ballast resistor circuit is functioning check the voltage between the battery live terminal (Red clip on negative earth) and the coil live terminal during cranking. This should be less than ½ volt indicating that the coil is receiving full battery voltage.

Use the high volts scale, as 6 volts difference will occur when just the ignition is on and the points are closed.

In the above example with the points closed and a current of 4 amps flowing through the coil the resistance of the ballast resistor is the same as that of the coil as each have a voltage drop of 6.3 volts across them. Therefore the resistance = $\frac{6.3}{4} = 1.575$ ohms.

This relationship between volts, amps and ohms has shown the coil current to be 4 amps, voltage to be 6.3 and resistance 1.575 ohms, at high engine speeds however the current may not build up to a full 4 amps before the points open again. In a similar way the resistance of an electric motor which is stationary will have little relationship to the current consumed when running, and a cold 24 watt 12 volt bulb will have a resistance of approx 0.5 ohms. It is only when the filament glows at white heat that the resistance increases to 6 Ohms.

$$\text{CURRENT} = \frac{24 \text{ watt}}{12 \text{ volt}} = 2 \text{ Amps.}$$

$$\text{RESISTANCE} = \frac{12 \text{ volts}}{2 \text{ Amps}} = 6 \text{ Ohms}$$

D. POINTS CONDITION TEST

On some Ford vehicles an earth strap is not fitted between the distributor baseplate and the distributor body. This may cause a high reading when checking the points. To overcome this connect the red clip to the points spring and the black clip to the distributor baseplate with the points closed to give a representative points condition test. The voltage between the points/coil wire and earth can on these systems be up to ½ a volt according to Ford Specification.

For fault finding (tracing high resistance contacts) use the same procedure as outlined under starter circuit tests. See page 12.

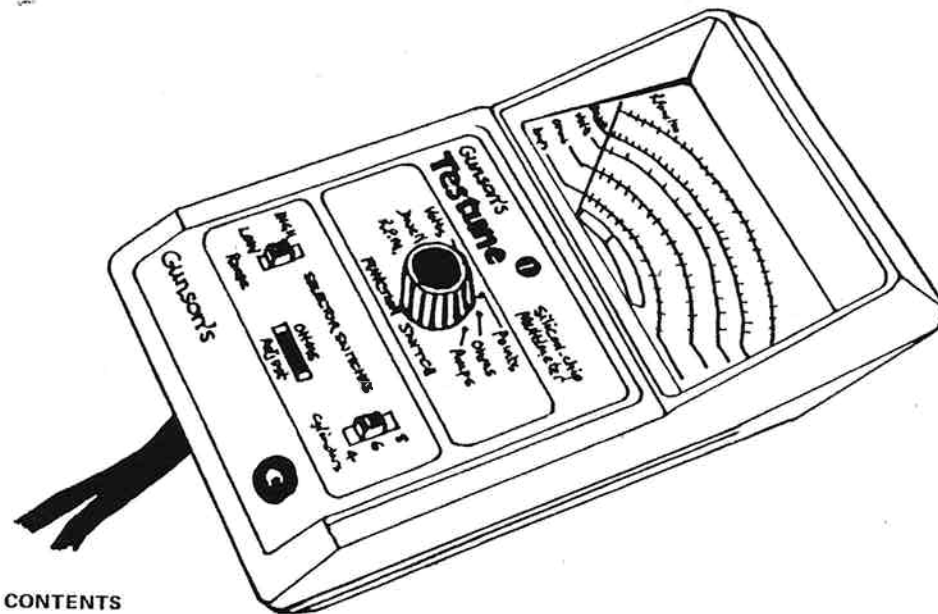
E. RESETTING STATIC IGNITION TIMING

Connect as in Fig. 1 (Page 4) with meter set to high volts range.

With ignition turned on and timing marks aligned as in the vehicle handbook, turn the distributor body in the same direction as the rotation of the rotor arm for a few degrees (past the position where the indicating needle drops to 0 volts). Carefully reverse the rotation until the exact position where the indicating needle gives a reading and lock the distributor body in that position.

Following the foregoing procedure exactly will ensure the effect of back-lash in the distributor drive-train is eliminated.

Some electronic systems with magnetic pick up trigger head can not be reliably static timed in which case the system manufacturers instructions should be followed.



CONTENTS

PAGE 2 AND THE RELEVANT PARTS OF SECTION 1 OF THIS MANUAL MUST BE READ BEFORE USING TESTUNE. SECTION 2 CAN BE REFERRED TO FOR INFORMATION AS REQUIRED.

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SECTION 1 – METHODS OF OPERATION

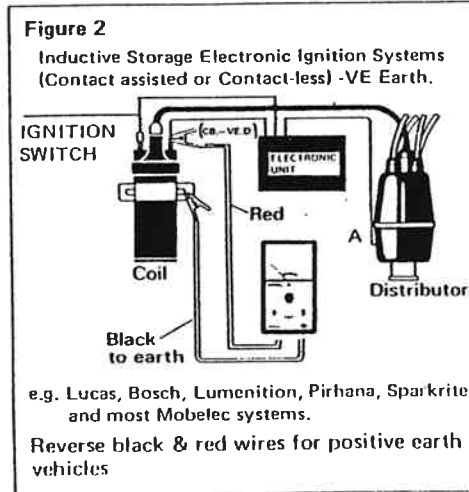
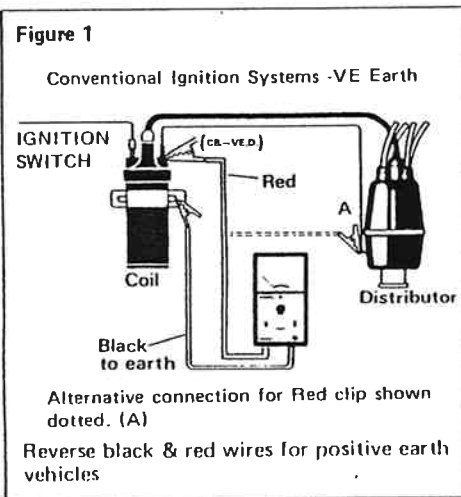
1. TACHOMETER

Use of the Tachometer to measure engine r.p.m.

- Set the function switch to R.P.M., range switch to HIGH and cylinder switch to 4, 6 or 8 cylinders as required.
- Connect the red and black leads as shown below, depending on type of ignition system.
- Start the engine and read engine r.p.m. on the appropriate scale. 0 – 6000 r.p.m.
- If the speed required is below 1600 r.p.m. switch to low range and read on 0 – 1600 r.p.m. scale.
- At the end of the test disconnect the meter and return the range switch to high (if low range has been used).

CONNECTIONS

For the vast majority of original equipment and accessory systems connect Black clip to any earth, Red Clip to coil contact marked CB -VE or D as in Fig 1 & 2.



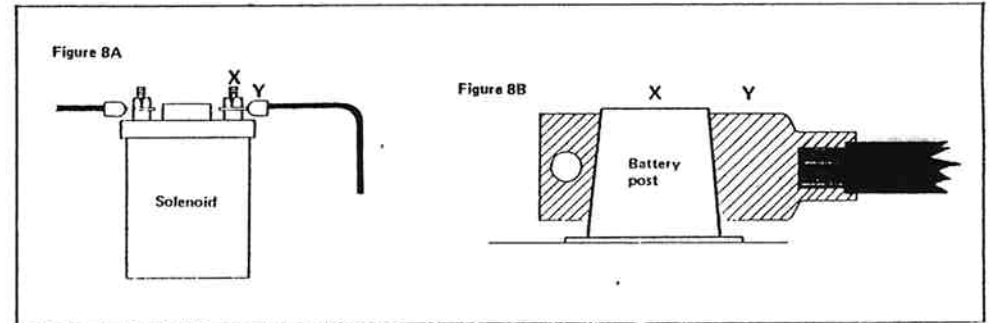
Footnote

Tachometer or Dwell Tests

On vehicles with more or less cylinders than those marked on this switch (see Step 1.a. or 2.a. above or opposite), Testune will give proportionately accurate readings. For example, on a 2 cylinder vehicle with one set of points and the cylinder switch set to 4 cylinders readings will be half actual engine speed or dwell.

This cylinder switch is also marked for the equivalent number of 'rotors' for use on rotary type engines (i.e. Wankel/Mazda, etc.).

C. VOLTS, AMPS AND OHMS SCALE – continued



To check a connection, connect to X and Y while cranking, no reading should be evident if the contact is tight and clean.

If the location of a fault is not found using the above test check the voltage between the starter casing and an earth on the body, any voltage during cranking indicates a poor earth on the starter or engine earthing strap.

Note The volt meter is being used to detect resistance in a circuit in this example because the normal current is very high. The resistance of a poor contact which is carrying 400 amps and has a voltage difference across it of 2 volts is $\frac{2}{400}$ or $\frac{1}{200} = 0.005$ ohms which is too small

to measure on the ohms scale. The high voltage scale should be used because when connected across the solenoid for example and the contacts in the solenoid are not joined, full battery voltage will register on the instrument.

Ignition Circuit (Figure 7)

The ignition circuit shown, includes a ballast resistor to improve cold starting. The method of operation is as follows: With the ignition on and the points closed the voltage across the ballast resistor will be for example 6.3 volts and the voltage across the coil 6.3 volts. The voltage across the switch and the points should be virtually zero. When the starter is operated the ballast resistor is ineffective because of the 'by pass' wire. Full battery voltage is applied to the coil to aid starting (9.5 – 10.5 volts).

However the volt meter if connected across the coil during cranking will measure 9.5 – 10 volts when the points are closed and 0 volts with the points open. The meter will read the average of this figure i.e. approx 5 volts (depending on dwell angle).

In the same way if the ammeter were to be connected into the ignition circuit with the points closed a reading of approx 4 amps would be observed. (3 amps on non ballast resistor coils). During cranking a figure of 2 amps approx would register if the voltage were 6.3 volts but as it is increased to 9.5 – 10 volts 3 amps would be typical. (1½ amps on non ballast resistor coils).

C. VOLTS, AMPS AND OHMS SCALE

These three values are inter-dependant in any electrical circuit. For a fixed voltage an increase in resistance (Ohms) will give a corresponding decrease in current (Amps).

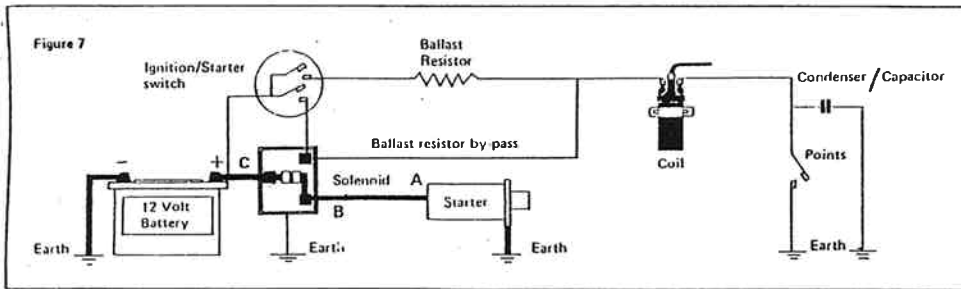
$$\text{Volts} = \text{Amps} \times \text{Ohms}, \text{ Amps} = \frac{\text{Volts}}{\text{Ohms}}, \text{ and Ohms} = \frac{\text{Volts}}{\text{Amps}}$$

The power consumed is equal to the current in Amps multiplied by the potential difference in Volts and is measured in Watts.

It is not necessary to use these expressions in testing the electrical system on a vehicle but they do help to explain certain situations which may be encountered. A list of typical values is given on the back of this manual.

Examples

It will help to examine some practical circuits, e.g. below:—

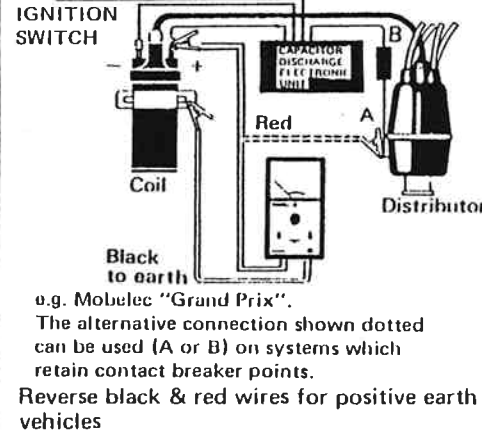


A 12 volt battery has a normal voltage of close to 12.6 volts when no current or a small current is flowing through it. Therefore, if the volt meter is connected across the battery it should register 12.6 volts in the circuit above. If the ignition switch is turned on, 12.6 volts will still register (while the battery remains reasonably charged) as the ignition circuit only draws a small current (4 amps approx). When the ignition switch is turned further this operates the solenoid switch and in turn the starter. As the starter draws a very high current 300 – 500 amps under load the voltage at the battery drops to 10.5 – 9.5 depending on temperature. A cold engine requires more power to turn it over and the battery output (under load) falls as it gets colder.

When the starter is operating, assuming all the electrical contacts in the circuit are good, the voltage between connection A and Earth should be the same as the battery voltage i.e. 9.5 – 10.5 volts. If this is not the case the following procedure will locate the poor contact.

1. Connect the volt meter (high range) between positive battery terminal and A.
2. Crank the engine — during cranking if the contacts were good then the voltage at these two connections would be equal i.e. no appreciable resistance, but a poor contact or resistance will cause a difference in voltage to exist and a reading of 2 volts for example will be seen
3. To locate the exact position of the poor contact the negative (black) clip should be moved progressively along the circuit to B and C. If the meter shows 2 volts when connected to B, and 0 ½ volts at C during cranking, there is a volt drop of 1½ – 2 volts across the solenoid or the connections to it.

Figure 3
Capacitor Discharge Electronic Ignition Systems
-VE Earth.



e.g. Mobelec "Grand Prix".

The alternative connection shown dotted can be used (A or B) on systems which retain contact breaker points.

Reverse black & red wires for positive earth vehicles

A reliable R.P.M. indication is given on most Capacitor Discharge systems. If however a very erratic reading is observed use the alternative connection shown dotted only on systems which retain contact breaker points.

On some very uncommon systems an adaptor may be required as an extra from the ignition system manufacturer (voltage impulse type).

SEE SECTION 2 FOR USES AND EXAMPLES

2. DWELL

Use of the Dwell scale to measure contact breaker points dwell angle.

- a. Set function switch to Dwell (range switch is inoperative in this test) and cylinder switch to 4, 6 or 8 cylinders as required.
- b. Connect the red and black lead as in figure 1, 2 (as previous test or at 3.A or B for contact-assisted capacitor discharge).
- c. Start the engine and let it idle.
- d. Read the dwell angle on the appropriate scale.
- e. Check also at higher r.p.m. if required (see Page 11).

SEE SECTION 2 FOR CORRECTION PROCEDURE AND EXAMPLES

3. VOLTAGE

Use of the Voltage scale for electrical circuit testing.

- a. Set the function switch to Volts, range switch to high (cylinder switch is inoperative in this test).
- b. Connect to the circuit being tested, with the black clip on the negative side and red clip to positive.
- c. Read voltage on 0 – 16V scale. If the voltage is less than 4 volts and very accurate readings are required switch to low range and read on 0 – 4V scale.
- d. At the end of the test disconnect the meter and return the range switch to high (if low range has been used).

SEE SECTION 2 FOR USES AND EXAMPLES

These purely Capacitor Discharge systems are far less common than the previous types. Connect Black clip to any earth, Red clip to the + coil terminal.

POINTS CONDITION

Use of the Points scale to check contact breaker condition.

- a. Set the function switch initially to VOLTS, range switch to high. (cylinder switch is inoperative for this test)
- b. Connect the black lead to earth and the red clip to A in fig. 1, 2 or 3 (connections to the coil end of this lead may give erroneous readings if coil/distributor wiring or connections are poor.
If there is not an external distributor connection remove the distributor cap and attach red clip to the internal connection or to the contact breaker spring).
- c. Turn the ignition on and ensure the voltage reading is less than 1 volt indicating that the points are closed. If the reading is not below 1 volt, inch the engine over on the starter to close the points.
- d. Move the function switch to Points position and check that the reading is within the green zone.
- e. At the end of the test disconnect the meter and return the function switch to Volts as subsequent connection to a 12 volt supply will cause an overload and possible damage.

SEE SECTION 2 FOR CORRECTION PROCEDURE AND EXAMPLES

5. RESISTANCE

Use of the Ohms scale to measure resistance for component or circuit testing.

A 1.5 volt battery (HP7/AA type) is required to fit in the rear of unit, -VE battery end to the coil spring contact.

To remove the cover press firmly and move in direction of the arrow.

IMPORTANT

This test uses the internal 1.5 volt battery and if it is required to check components in position on the vehicle it is advisable to ensure that none of the connection points are 'live', by disconnecting the earth terminal on the battery. Otherwise an overload condition could occur which may cause damage.

- a. Set the function switch to Ohms and the range switch to the desired range i.e. high 0 – 50,000 ohms low 0 – 500 ohms. (The markings on the top end of the scale are 10,000, 25,000, 50,000 and infinity and 100, 250, 500 and infinity respectively).
- b. Connect the red and black lead together and operate the ohms adjustment until a reading of zero is obtained on the ohms scale.
- c. Connect the component or circuit to be tested between the red and black clip and read the resistance value on the appropriate scale. (connections must be clean if accurate results are to be obtained).
- d. If the resistance measured is not a convenient value for reading on the scale selected, switch to the other (high or low) scale and return to instruction b. (To achieve maximum accuracy the meter should be recalibrated on the scale in use).
- e. At the end of the test disconnect the meter and return the range switch to high and the function switch to volts. This avoids battery drain and the possibility of damage if the meter is subsequently connected to a 12 volt supply.

SEE SECTION 2 FOR USES AND EXAMPLES

B. DWELL SCALE – continued

Remember to smear the points cam with a very small amount of high melting point grease (or oil the felt/foam pad.). This will reduce points heel wear and help maintain the correct Dwell Angle.

After adjusting dwell angle always check ignition timing. Exception – When dwell is set on new points and subsequently re-adjusted to achieve the same dwell after wear has taken place, this should bring ignition timing back to the original setting.

Electronic Ignition Systems

With electronic systems which dispense with the points there is no reason to set dwell angle unless there is a particular recommendation by the electronic system manufacturer. Testune will measure dwell on all except capacitor discharge systems without points (where there is no dwell period as such).

Twin Points Distributors

Two types of twin point installations are in use. One has two individual points, each independently controlling the coil. The other type uses two sets of ignition points in parallel to extend the total dwell period. To identify: the first type will have a distributor cam with only half the distributor cam lobes as there are cylinders, the second type will have the same number of distributor cam lobes as cylinders. To adjust either type: always block open one set of points with a clean piece of smooth card while adjusting the other set. After setting one set, remove the card and move it to the other set and adjust remaining points set. On vehicles with points in parallel, after setting the point dwell for each set, check that the total dwell is also within manufacturers specification, by removing the card and measuring the total dwell.

Dwell Variation

The majority of distributors are designed to maintain a constant dwell angle (type A) exceptions to this rule are those which obtain vacuum advance by moving the pivot point of the points heel separately from the base plate (type B).

When the dwell angle has been set:

1. Remove vacuum advance connection (pipe between carburettor and distributor capsule).
2. Increase engine speed slowly and observe the reading on the dwell scale.
3. Increase engine speed rapidly and observe the reading on the dwell scale.
4. Any change in dwell angle should be less than 2° (or less than the amount specified by the manufacturer). Any change should be gradual when testing as in 2. A sudden decrease in dwell at speeds close to the recommended maximum engine speed indicates a weak points spring (replace points with original equipment). Many test equipment manufacturers recommend that dwell variation be confined to speeds below 1500 r.p.m. With Testune very accurate readings are produced up to 6000 r.p.m. so this limitation can be ignored.
5. Re-connect vacuum advance pipe and re-test as in 2 and 3. Any difference to previous readings is due to the vacuum advance mechanism. Total should be less than 3° (or amount specified by manufacturer) on type A distributors.
On type B distributors dwell variation due to vacuum advance may be up to 6°.

One degree change in dwell angle due to wear will cause 1° error in ignition timing.

A. TACHOMETER – continued

2 Stroke Engines	Switch Position 4 cyl	Switch Position 6 cyl	Switch Position 8 cyl
LOW RANGE	0 – 3200 r.p.m.	0 – 4800 r.p.m.	0 – 6400 r.p.m.
HIGH RANGE	0 – 12,000 r.p.m.		
MULTIPLY READINGS BY	2	3	4

If a range higher than 0 – 6000 r.p.m. is required on car engines of 4 or 6 cylinder see table below:

No. of Cylinders	4	Use 6 Cylinder Switch Position For 0 – 9000 r.p.m. High Range
No. of Cylinders	6	Use 8 Cylinder Switch Position For 0 – 8000 r.p.m. High Range

On 8 cylinder engines with two distributors or two coils use 4 cylinder scale.

3. Timing

The Tachometer can be used when setting ignition timing or when checking the advance mechanism but only in conjunction with a stroboscopic timing light. For Static Timing see Page 14.

WARNING

Never set ignition timing by adjusting the distributor to give highest r.p.m. this will invariably give timing which is too far advanced.

4. Carburettor Fast Idle Adjustment

On carburettors where the fast idle choke mechanism can be operated separately from the mixture enrichment, the fast idle speed can be set to manufacturers specification using the Tachometer.

B. DWELL SCALE (See also Methods of Expressing Dwell on the dwell angle information sheet)

Dwell angle is the period of cam rotation during which the points remain closed. Whenever contact breaker points are fitted on conventional or electronic ignition systems the dwell should be set to the vehicle manufacturer's quoted figure.

Dwell angle measurements can be made at starter cranking speeds – using the same connections. The distributor cap may be on or off, but the coil H.T. lead should be shorted to earth in either case to prevent tracking.

DWELL ADJUSTMENTS

To increase the Dwell Angle shown on the meter reduce the contact breaker points gap and vice versa.

Setting points against Dwell Angle Information is a more accurate method than by using gap measurement. However, although slight variations on the manufacturer's recommended gap settings are tolerable, the two measurements should nearly coincide.

6. CURRENT

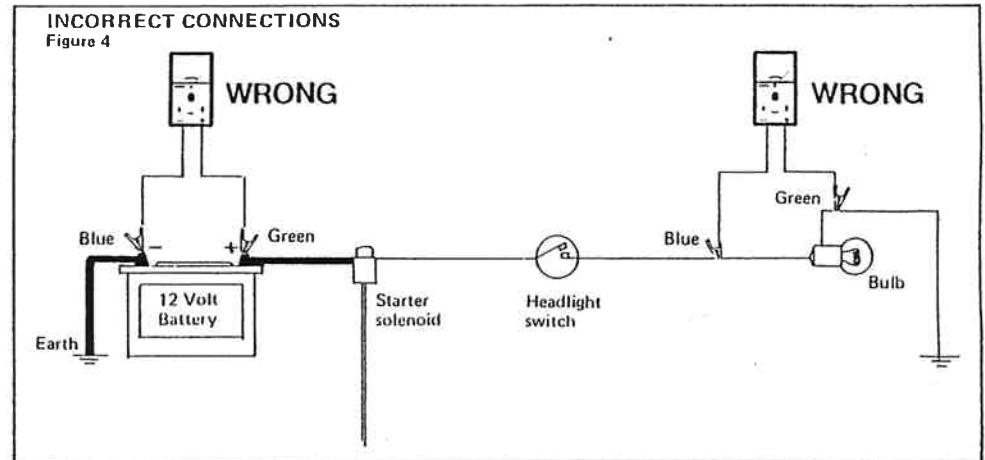
Use of the Amps scale for measurement of current in electrical circuits.

IMPORTANT

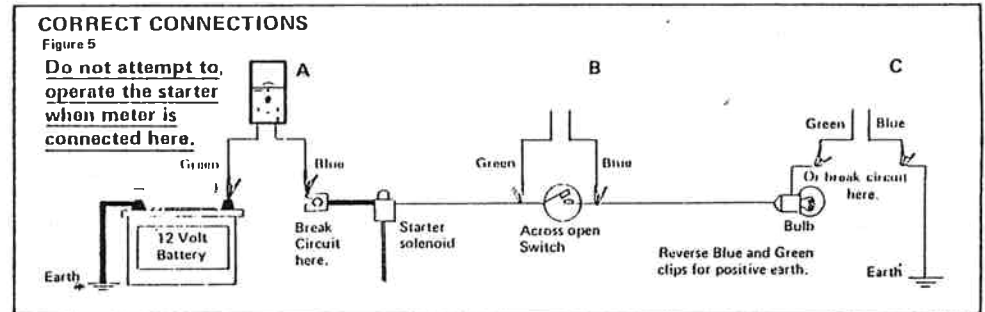
The green and blue clips are used for the Amps scale. These are connected directly into the circuit for measurement up to 10 amp (i) or with the copper shunt for measurement up to 100 amps (ii).

The high range switch position will give a totally incorrect (excessively High) reading if used without the shunt.

Under no circumstances should these clips be connected directly across the battery or the load in an electrical circuit. (See below and Section 2).



Measurement of Current Values up to 10 Amps only.

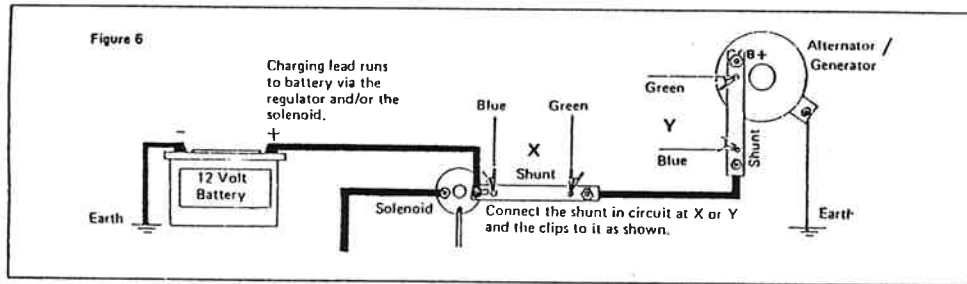


The ammeter leads should be connected in series with a circuit which has a break in it (A or C), or across a switch which is in the off position (the switch will act as a break and connecting the ammeter will switch on the circuit), (B).

CURRENT – continued

- (i) **Measurement of Current Values up to 10 Amps Only.**
 - a. Set the function switch to Amps and the range switch to Low as required (cylinder switch is inoperative in this test).
 - b. Break the circuit and connect the blue (to -) and green (to +) leads so as to join the circuit at the point where current measurements are to be made.
 - c. Close any switch which is in the circuit (unless connected across the switch as in B).
 - d. Read the current from the Low scale.
 - e. At the end of the test disconnect the meter and return the range switch to high (if low range has been used) and the function switch to volts.
- (ii) **Measurement of Current Values Exceeding 10 Amps**
e.g. Alternator/Generator output.

Identify the alternator/generator charging lead, this will be the heavy lead usually marked B+ (on negative earth vehicles). It is connected between the alternator/generator and the battery (or the regulator when an external regulator is fitted). (An earth lead of similar heavy section may also be connected to the alternator.) The copper shunt can be connected in, at either end of this charging lead, as shown at X or Y in Figure 6.



Do not allow the shunt to touch earth when connected into a circuit. (It is advisable to disconnect the battery earth lead while fitting the shunt).

- a. Connect the shunt into the circuit where the current is to be measured **ensuring the shunt is insulated from the vehicle body.**
- b. Select High on the range switch and Amps on the function switch.
- c. Connect blue and green leads to the terminal posts on the shunt.
- d. Start the engine and run at 2,500 r.p.m. (or manufacturers recommended speed if data is available) – for typical value of current see page 15.

IMPORTANT

Do not attempt to measure starter current under load, this can be 300–500 Amps. The no load current can be measured off the vehicle (40–60 Amps) but the starter should be held firmly as it will tend to jump as rotation begins. (See manufacturers specification for exact values).

SECTION 2 – GENERAL INFORMATION

Adjustments, fault finding and correction procedures.

A. TACHOMETER

Many accessory manufacturers suggest the use of a Tachometer:—

- a. For mixture setting by adjustment until highest r.p.m. is observed.
- b. To detect a dirty air cleaner.
- c. To detect the faulty operation of the distributor centrifugal advance.
- d. To detect a faulty crank case ventilation system.

Such tests can be misleading and are not recommended.

1. Individual Cylinder Check

In order to perform this test accurately and without causing damage due to tracking (if plug leads are removed) we recommend the following method:—

Place a thin piece of uninsulated wire (e.g. fuse wire) under each plug lead contact at its junction with the distributor, leaving a short length exposed.

These can be shorted to earth in turn either with a long screwdriver (Place against the engine block first before contacting the wire.) or using a jumper lead (This can be handled with safety once one end is well earthed.).

Remember to keep your hands clear of the other copper wires emerging from the distributor cap.

- a. Set the engine speed to 1000 r.p.m.
- b. Connect each spark plug cable in turn to earth on the engine block.
- c. Note the engine r.p.m. each time a plug lead is earthed. Readings should be within 50 r.p.m. of each other. Any cylinder which produces less of a drop in speed than the remainder is suspect as less power is being produced by that cylinder. Likely causes are faulty sparking plug, compression leakage past piston rings, burnt valves, tight tappet adjustment or air leak at manifold flange causing weak mixture on the affected cylinder.

2. Motorcycles and Other Engines.

Where one coil and one set of points per cylinder are fitted the Tachometer ranges will be as follows:

4 Stroke Engines	Switch Position 4 cyl	Switch Position 6 cyl	Switch Position 8 cyl
LOW RANGE	0 – 6400 r.p.m.	0 – 9600 r.p.m.	0 – 12800 r.p.m.
MULTIPLY READINGS BY	4	6	8

4 Stroke engines which have the points cam rotating at engine speed have one spark per rev (i.e. one spark out of two is wasted) and will give Tachometer readings as a 2 stroke. This also applies to those where one coil feeds two spark plugs (in different cylinders) connected in series.