

# Gunson®

## Advance Xenon Timing Light

Part No. 77008

**Handbook**





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## Safety Precaution

Using this timing light necessarily involves working under the bonnet while the engine is running. This is a potentially hazardous situation, and the user should take every precaution to avoid any possibility of injury. The following guidance should always be followed:

- Never wear loose clothing, particularly ties, long sleeves etc that can catch in moving engine parts, and always tie-up or cover long hair.
- Ensure that the car is on firm level ground, and is out of gear and the handbrake firmly applied at all times.
- If for any reason the car is jacked up or the wheels removed, always ensure that the car is well supported, and never rely on a car jack alone, always use ramps or axle stands. Be wary of axle stands and jacks sinking into soft ground, and remember that asphalt surfaces may appear firm, but may give way under the concentrated load of a jack or axle stand.
- Do as much of the work as possible with the engine not running.
- Always route cables well away from hot or moving parts, (particularly the exhaust pipe and cooling fan) and check that cables are in a safe position before starting the engine.
- Always guard against getting the timing light or fingers too close to moving, hot or electrical parts. Be especially wary of the fan, fan belt, fan belt pulley, exhaust manifold, exhaust pipe, and HT parts of the ignition system. Remember that thermostatically controlled fans may suddenly start with no warning.
- Take care to avoid placing metal tools where they may cause an electrical short, such as near the car battery.
- Take care not to place tools etc where they may be dislodged by engine vibration.
- Treat High Tension components with respect, remembering that electrical shocks can cause involuntary movement which may result in secondary injury. Remember that sparks can jump quite a distance. Also remember that severe unexpected HT shocks can be received from old, worn, damaged or wet components (e.g. HT leads, coil, and distributor).
- Keep all sensitive electronic equipment away from HT voltages, and do not make any electrical connection to HT voltages except as expressly advised by the makers of the electronic equipment.
- Remember that Low Tension Voltage, present on the LT terminal of the ignition coil and at the contact breakers, can also give quite an electrical shock.
- Never ever attempt to use automotive diagnostic equipment intended for 12v applications on domestic AC mains 240V supplies.
- Make all electrical connections with power off, so as to avoid the possibility of electrical sparks, which can ignite fuel vapour or inflammable battery gas emissions.
- Take care not to inhale exhaust gas. Never run the engine inside a garage or in a confined space. When running the engine, always ensure that there is adequate circulation of fresh air. Ensure that there are no leaks in the exhaust system near where you are working.
- Keep children and pets away from the car while work is being carried out.

## What is ignition Timing

Petrol engines operate on the principle of using a spark plug to ignite a compressed mixture of petrol and air in the cylinders of the engine. In practice, each spark plug fires slightly before a piston has reached the top of its compression stroke. This is so that the petrol/air mixture has time to fully ignite before the commencement of the power stroke. The faster that the engine is rotating, the greater is the angle before top dead centre (BTDC) that the spark plug has to fire.

Besides engine speed, the optimum timing of the spark depends on other factors, including the degree of suction in the inlet manifold (manifold vacuum), and whether leaded or unleaded petrol is being used.

If the ignition timing of the engine is not correct, then either the performance or the economy of the engine will suffer, or both, and the engine exhaust will be high in hydrocarbons (HC), to a degree that might cause the vehicle to fail statutory exhaust emissions tests.

Car manufacturers vary in the amount of service data on ignition timing that they make available information on the user. They also vary on the facilities that they provide on the engine to enable the timing to be measured, and also on the facilities that they provide on the engine to enable the timing to be set or adjusted.

In some modern engines, no service data is provided, and no method is provided for measuring or adjusting the ignition timing.

However, many manufacturers continue to provide data on ignition timing, and provide timing marks on the engine to enable the timing to be measured using timing light, and provide some means by which the timing can be adjusted.

Usually, the data is provided at a particular engine idle RPM (the handbook usually also states whether the vacuum pipe should be connected or disconnected). This is generally referred to as "STATIC" timing. There are often corresponding timing marks on the fan belt pulley or engine flywheel ("STATIC timing marks"), and the STATIC timing can be adjusted by rotating the distributor in its housing.

Such ignition systems are designed so that if the user sets the "static" timing correctly, then the automatic advance mechanisms will take over and ensure that the ignition timing correctly adjusts to other driving conditions.

Manufacturers also commonly provide a Top Dead Centre (TDC) mark in addition to a "static" timing mark. Some manufacturers provide a TDC mark and no "static" timing mark.

Perversely, car manufacturers usually provide no timing marks for engine speeds other than idle, even though timing data may be given for other speeds the workshop manual. It is in such situations that this timing light is very useful, since it can be used to measure the degrees of advance of ignition timing with respect to static timing, or TDC (or with respect to any other timing marks), and hence can be used to check service data where no suitable timing marks are provided on the fan belt pulley or flywheel.

## What is Advance Timing Light?

Before describing advance timing light, it might be useful to describe the principle of operation of an ordinary (non-advance) timing light.

Timing light is a device that works on the stroboscopic principle. That is, a rotating part of an engine is made to appear stationary by being illuminated by a brief flash of light which occurs once per revolution (or multiples of a revolution), at the same rate that the engine is rotating.

The particular part of the engine that is made to appear to be stationary when using timing light is a timing mark (or marks) that the car manufacturer has put on some rotating part of the engine, such as the fan belt pulley or the engine flywheel. There is also always a fixed mark on the engine, close by where the moving mark passes, which is used as a reference position for the moving mark.

Timing light takes its cue from the spark plug of No1 cylinder, and flashes each time that spark plug fires. Non-advance timing light fires at exactly the same instant that the spark plug fires.

The timing mark on the rotating part of the engine therefore appears to be stationary in exactly the position it has at the time of the spark to No 1 cylinder spark plug. From the apparent position of the moving mark in relation to the fixed mark the timing of the engine can be determined.

For example, if the rotating mark represents  $8^\circ$  BTDC, and appears to be exactly opposite the fixed reference mark, then the ignition timing is  $8^\circ$  BTDC.

This is fine if all that the user wishes to do is check that the timing is  $8^\circ$  BTDC. However, maybe the moving mark is not exactly opposite the fixed mark, and the user still wishes to know what the timing is. Maybe he wishes to set the timing to some value for which there is no timing mark. Or maybe he wishes to check the timing at higher RPM, for which the car manufacturer has provided data in the handbook, but has not provided timing marks on the fan belt pulley. For these jobs a simple non-advance timing light is not adequate, and the user needs advance timing light.

Advance timing light includes electronic circuitry which can apply a small but precise delay between the time the spark plug fires, and the time that the timing light flashes. Delaying the flash of the timing light has the same effect on the apparent position of the timing marks as advancing the ignition timing by the same amount. This can be seen to be true by considering that, if two timing marks are brought into conjunction by delaying the timing light flash, then the actual spark from the spark plug must have occurred some time earlier.

The time of the flash is controlled by the advance knob. Rotating this knob fully in an anticlockwise direction applies no delay to the flash, and the timing light will behave as an ordinary non-advance timing light. (The Pointer of the knob lined up with Zero) However, rotating the knob clockwise will advance the timing light flash (cause a delay between the ignition pulse and the flash) by the angle indicated by the pointer on the knob.

To illustrate this by an example, consider the example mentioned above, of a "static" timing mark on a fan belt pulley representing  $8^\circ$  BTDC. This mark would still represent  $8^\circ$  BTDC if the dial on the timing light was 0, but it would represent  $28^\circ$  BTDC if the knob was rotated to show 20. on the dial.

The use of this timing light is particularly simple where the engine timing marks have an indication for top dead centre (TDC), which many engines have. Using the TDC marks, the ignition timing is simply as shown on the rear panel display. For example, if the TDC mark is opposite the fixed mark when the display shows 00.00, then the timing is TDC, if the display shows 08.00 then the ignition timing is  $8^\circ$  BTDC, if the display shows 20.00, then the ignition timing is  $20^\circ$  BTDC.

NOTE 1: In practice, the scale can never quite reach 0, the lowest reading being typically 0.20.

NB: A timing light cannot apply a retardation to timing marks (i.e. it can not be used to set timing After Top Dead Centre (ATDC), where the timing marks are TDC or BTDC), since this would imply causing the timing light to flash before it received the signal from the spark plug, but there are other ways round this problem, as described later, should it ever be needed.

## Product Description

A lightweight plastic case, with a sturdy handgrip and trigger, and with a soft rubber nose cone which minimizes the danger to the timing light or car from inadvertent contact with moving parts such as the fan, fan belt or pulley.

When the trigger is depressed, the timing light will flash. The timing of the flash is adjusted by turning the advance knob.

A Xenon discharge lamp of very high energy output is provided, combined with a lens which gives a wide beam of brilliant white light, enabling the timing marks to be readily seen even under conditions of high ambient light. Should the lamp ever need replacing, spares can be obtained from The Tool Connection Ltd

### RED and BLACK clips for connecting to the car battery

RED INDUCTIVE PICKUP, for clipping over the spark plug lead of No1 cylinder, for detecting the instant of firing of the spark plug, and also for the measurement of engine RPM. Note that the body of the pickup shows an arrow sign, and the pickup should be attached with this arrow pointing along the HT lead towards the spark plug (connecting it the other way round may result in reduced pickup sensitivity).

### ADVANCE ADJUSTMENT KNOB

This knob is situated on the control panel at the rear of the instrument. It sets the advance angle, which is indicated by the pointer on the knob and the dial scale (0 to 60).

## IGNITION TIMING

1. Ensure that relevant prior service has been carried out on the car. For instance, for contact breaker ignition systems ensure that the points dwell has been correctly set, since adjusting the points can affect ignition timing.
2. Obtain the correct technical ignition timing data for the vehicle from the vehicle's workshop manual. In particular, note at what engine RPM the timing should be checked, and check whether vacuum pipe should be left connected or disconnected. Also from the workshop manual, find where to look for the timing marks (usually on the fan belt pulley or on the engine flywheel), and what the timing marks mean, i.e. whether there is a timing mark for Top Dead Centre (TDC), (this is often indicated by a "0" or "V"), and whether there are other marks, and what angles these marks represent.
3. Find the timing marks on the engine of the vehicle. Preferably, highlight the marks using white paint (typing correction fluid is ideal).
4. Bring the car to its correct operating temperature. Ensure that the car is out of gear, and the handbrake firmly applied.
5. If the handbook says that the vacuum pipe between the carburettor and the distributor should be disconnected, then disconnect it at one end, taking care that the loose pipe is not near hot or rotating machinery. If disconnecting the pipe causes the engine to falter, then it may be necessary to block the open end of pipe.
6. With the engine of the car switched off, make the connections to the car:
  - Connect the RED lead to the battery positive terminal (+),
  - Connect the BLACK lead to the battery negative terminal (-),
  - Attach the INDUCTIVE PICK-UP to the plug lead of No1 Cylinder, with the arrow on the pick-up pointing towards the spark plug. Preferably choose a loop of plug lead that is well separated from other leads, so as to minimize possible interference from nearby HT cables. Note that No1 cylinder is the front one of the engine (i.e. at the fan belt end), unless otherwise stated in the workshop manual.

NB: Take care to not let any leads or clips come into contact with hot or moving components of the engine, and similarly route all leads well clear of hot or moving parts.

7. Start the engine and set the engine speed to the correct RPM as recommended in the workshop manual.  
Rotate the ADVANCE CONTROL KNOB fully anticlockwise. Press the trigger; the light should start to flash.  
Direct the timing light at the timing marks of the engine (taking care not to touch any rotating parts with the timing light).  
Rotate the advance control knob slowly clockwise until a moving timing mark comes in line with the fixed mark.  
If the marks that are in line represent Top Dead Centre (TDC), then the ignition timing of the car is the number of degrees shown on the dial scale.  
For instance if the pointer points to 8, then the timing is 8° BTDC.  
If the timing marks represent some other timing advance angle, then add this to the angle shown on the scale. For instance, if the timing marks represent 8° BTDC and the scale shows 0, the ignition advance is 8° BTDC; if the display shows 2 the timing is 10° BTDC, etc.

## a. 6 /24 VOLT VEHICLES:

A separate 12 volt battery should be used to power the instrument.

## b. MAGNETO IGNITION SYSTEMS:

Operation should be satisfactory, but see opposite

## c. ROTARY ENGINES

The Timing Light can be used for Rotary engines. Follow the manufacturer's specific instructions and specifications.

Typical instructions for a Mazda Twin Rotor engine

- Connect Red and Black clamps to the battery
- Connect wire with the spark plug adaptor to the leading spark plug on the front of the rotor housing
- Start the engine and run at idle
- Air the timing light at the timing indicator pin on the front cover
- Loosen the distributor locking nuts and rotate the leading side distributor body until the timing mark on the eccentric shaft pulley is in line with the timing indicator pin. Tighten the locking nuts and recheck the timing.  
Repeat the above stop for setting the trailing side distributor timing with the timing light connected to the trailing spark plug

## d. UNSTEADY READING:

If the illuminated moving mark is not steady, but jumps around, then this indicates that the inductive pick-up is not detecting a clean indication of the ignition spark. Either it is missing sparks, or detecting extra ones. Check that the inductive pick-up is not broken and is correctly attached. Try moving the pick-up to a different position on the HT lead. Ensure that the HT leads are well separated so that one lead is not picking up a signal from an adjacent lead. Check for faults in the vehicle's ignition system. Check the plug gap. This problem is more likely to be encountered on engines in which the electrical polarity of the spark alternates, i.e. a (+) spark followed by a (-) spark, etc. In this case, increase the spark plug gap slightly to cause a stronger signal.

## e. RETARDED IGNITION

One relatively common problem is that an engine has only a mark for static timing, but the user needs to set more retarded timing than this for use with unleaded petrol.

A similar problem is where the user has only a static timing mark, but the data for higher RPM is with reference to TDC, and the user wishes to avoid continual mental arithmetic in making the conversion (i.e. adding the static timing to the measured timing).

The solution to these problems is to paint a TDC mark onto the fan belt pulley or flywheel (using white paint or typing correction fluid), or on the casing of the engine, using a protractor scale as a guide, and use this TDC mark as a reference in further timing measurement.

## Some useful Diagnostic tests using Timing Light

### a. TESTING CENTRIFUGAL ADVANCE MECHANISM

This mechanism should cause the ignition timing to advance with increase in engine speed.

The instructions are as follows:

- Remove vacuum advance/retard connections.
- Observe the timing marks with the engine running at idle.
- Gradually increase the engine speed. The timing mark should remain aligned initially, and then begin to move in the opposite direction to the pulley/flywheel rotation, and then stop. (Centrifugal advance usually begins between 500 & 1500 R.P.M. and ends between 4500 & 5500 RPM).

If excessive ignition advance with increase in RPM is observed, the cause is usually due to wear or broken advance springs.

If the ignition advance is too low, the cause is usually sticking or wear at the pivot point of the rotating weights.

### b. TESTING VACUUM ADVANCE

- Re-connect vacuum advance connection only.
- Observe the timing marks with the engine running at idle.
- Gradually increase the engine speed. Vacuum advance should operate smoothly from around 800 RPM, reaching a maximum at about 2500 RPM.

This increase in ignition advance will be in addition to that due to the centrifugal advance.

NB: If the throttle is opened rapidly the vacuum advance will operate and return quickly as use of the throttle affects the vacuum).

If vacuum advance is operating at idle this may be due to incorrect carburettor setting on Solex/Weber carburettors which have both throttle "bypass" and "throttle stop" adjustment; or this may be due to incorrect air balance on twin carburettors.

If the vacuum advance is too low, the cause is usually due to sticking contact breaker base plate, punctured diaphragm or blocked vacuum pipe.

If the vacuum advance is too high, the cause may be due to incorrect carburettor adjustment.

NB: Some distributors are adjustable for vacuum advance (examine the area around the vacuum advance or retard operating rod).

### c. TESTING VACUUM RETARD

This feature may be fitted for emission control, and only operates at idle and during deceleration.

- Observe the timing mark with the engine running at idle.
- Re-connect the vacuum retard connection.
- Observe the difference in timing.
- The timing mark should move in the same direction as pulley/flywheel rotation.

### d. DETECTION OF DISTRIBUTOR WEAR OR INACCURACY

Most engines are timed on No 1 cylinder, but other cylinders (No 4 on a 4 cylinder engine) should also fire when the timing marks are aligned. By connecting to the opposite lead to No 1 on the distributor cap the difference can be checked.

Alternatively connection can be made to the king lead (the input HT leads to the distributor) which will give flashes as each cylinder fires. The difference between various cylinders can then be observed.

These methods can also be used to synchronise double points - stop the engine and adjust the position of the moveable points with the engine stationary, until the timing is consistent on appropriate cylinders.

To check other cylinders (2 & 3 on 4 cylinder engines) accurate marking of the pulley at 180° is required.

A regular error (of more than 2-3 degrees) in the ignition timing between separate cylinders indicates distributor cam error or wear, bent or worn distributor shaft or large error in points setting.

Erratic errors in ignition timing on all cylinders indicates wear in distributor drive, shaft or points base plate. A very erratic idle speed or pitted contact breaker points will also cause ignition timing "scatter".

### e. EFFECTS OF INCORRECT IGNITION TIMING

Ignition that is too advanced may cause audible "pinking" or detonation and engine damage, and also causes increased emission of hydrocarbons (HC) in the vehicle's exhaust. Ignition is too retarded causes engine overheating, poor economy and performance, and burnt exhaust valves.

## GENERAL WARNINGS

This equipment has been designed to operate in the harsh environment close to spark ignition engines but the user should be aware of the following:

- Spark ignition engines and related electronics can emit high levels of interference which could effect test and maintenance equipment together with other electrical items such as radio or television receivers, computers etc.
- Any interference emitted from the engine area could be increased by:
  - Opening the engine compartment cover.
  - Making electrical connections to the vehicle wiring loom or the vehicle battery.
  - Any faulty components particularly those associated with the ignition system.
- If this equipment has any display which behaves in an erratic nature the user is advised to refer to the advice given in the detailed instructions to minimise the possibility of interference. In cases of difficulty the user is advised to check for the following:
  - A faulty vehicle battery or poor connections to it.
  - Poor ground connection to engine or other electrical equipment
  - Faulty ignition components particularly rotor arms, ignition coils or HT leads with an internal break or with a resistance outside vehicle manufacturers limits.
- The user is therefore advised, due to the potential emitting of interference, that vehicle maintenance and testing should be undertaken with due care and not in an area close to sensitive electronic equipment.

## GUARANTEE

The Tool Connection has made every effort to ensure that this product is of the highest quality and value to the customer. However, The Tool Connection accepts no responsibility for any damage arising from the use of this product.

All technical enquiries regarding this product should be made to:  
The Technical Department on 01926 818181

Please note that The Tool Connection cannot provide technical advice or information on motor cars.

This Warranty does not affect the Statutory Rights of the user.

If this product should require service or repair, it should be returned to:

**The Tool Connection Limited**

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When sending goods for service or repair, please give full details of faults requiring attention.

