USER'S MANUAL

MT148OA

Gasoline & Diesel Engine Tach/Timing Meter

The MT1480A LUMY/MAG II is designed to monitor ignition timing and rpm on four-stroke-cycle diesel engines that have combustion chamber access and a magnetic pick-up receptacle, and four-stroke-cycle gasoline engines with accessible spark plug wires and a magnetic pick-up receptacle.

Safety Tips

1. Be sure to read complete instruction manual before using the MT1480A.
2. **Always insure that everyone within close proximity to the test vehicle is wearing approved eye protection before proceeding with any tests.**
3. Route vehicle exhaust outside if test area is not well ventilated, as exhaust gas contains deadly poison.
4. Gases produced by a battery are highly explosive.

   Do not smoke, allow open flame or sparks near battery.

   When connecting power leads to battery, first connect positive lead (red) to positive (+) terminal and then negative lead (black) to negative (-) terminal. When disconnecting leads, disconnect negative lead first.

   Do not create an electrical connection between battery terminals through jumper cables, tools, etc.
5. Always use extreme care when working around high voltage spark plugs and coil terminals.
6. Keep hands, clothing and test equipment clear of all moving engine components; such as fan blades, drive belts, pulleys, etc.
7. Do not touch or allow test equipment near hot engine parts, exhaust manifolds, etc.
8. Do not place test equipment on fenders or other places where it could slip or fall.
9. Make sure to use the correct luminosity probe for the engine being tested. (See "Operator Tips".)
10. If engine is being operated with air cleaner removed, install a suitable cover.
11. Unless otherwise instructed, test vehicle parking brake should be set and the gear selector in neutral (standard transmission) or park (automatic transmission) and the drive wheels blocked before performing a test with the engine running.

Contents

Snap-on MT1480A LUMY/MAG II

The original LUMY/MAG (MT1480) revolutionized modern diesel engine timing. It used specially designed sensors — a luminosity probe with an optical pick-up, and a magnetic pick-up — to detect ignition (the start of combustion in a combustion chamber), crankshaft revolutions (rpm) and crankshaft position (piston position in relation to TDC). The meter processed this data and simultaneously displayed the timing angle in crankshaft degrees and the engine speed in rpm. The LUMY/MAG provided an alternative to time consuming "static" timing check procedures prescribed by some diesel engine manufacturers. It also meant that it was no longer necessary to rely on the accuracy of manufacturer's witness (timing) marks etched into injection pumps, pump adaptors, etc. This becomes increasingly important as mechanical components begin to wear. The LUMY/MAG offered automotive technicians a fast, easy and professional method of monitoring diesel engine timing under actual operating conditions - "dynamic" timing.

The LUMY/MAG II (MT1480A) does everything the original LYMY/MAG could do . . . and more. The most significant advance is that the LUMY/MAG II is both a diesel and gasoline engine tachometer and timing meter. The addition of an interchangeable ignition sensor, the inductive pick-up, that monitors ignition on gasoline engines added this new dimension.

The "ENTER OFFSET" feature of the LUMY/MAG II added several more dimensions:

1. *The LUMY/MAG II can be programed to monitorm timing on any engine that has compatible pick-up receptacles, regardless of the position of the engine's magnetic pick-up receptacle in relation to TDC.*

2. *The LUMY/MAG II can monitor engine timing using any cylinder. This allows a more convenient cylinder to be used if access to a given cylinder is restricted. It also enables you to time engines using the "average method of timing" recommended by some automobile manufacturers (see page 12).*

The LUMY/MAG II features large digital displays (LED) which are much easier to read than pointer-type calibrated meter scales. It also has wide meter scale ranges to provide more testing capability, such as "cranking rpm" tests.

Read the following instructions thoroughly and familiarize yourself with the LUMY/MAG II and its components. Then with just a little hands-on experience you should find it quite simple to make the precision timing adjustments required for today's engines.

READ THIS INSTRUCTION MANUAL THOROUGHLY BEFORE USING THE MT1480A LUMY/MAG II GASOLINE AND DIESEL ENGINE TACH-TIMING METER

The LUMY/MAG II . . . *Functional Description*

POWER LEADS — Have color-coded clip boots. Red lead is connected to positive (+) terminal of 12 volt battery, and black to negative (-) terminal or a good vehicle ground.

MAGNETIC PICK-UP LEAD — This lead features the male half of a "quick disconnect" coupling which attaches to either of the two magnetic pick-up assemblies included with the MT1480A - the MT89 and the MT88A.

MAGNETIC PICK-UPS — The MT88A pick-up, with convenient handle and flexible extension, is designed for general use; while the MT89 is intended for use on vehicles with restricted access to the magnetic pick-up receptacle. Magnetic pick-ups are used with both diesel and gasoline engines equipped with compatible pick-up receptacles. The magnetic pick-up senses a groove or protrusion on a harmonic balancer, flywheel or crankshaft pulley and provides precise crankshaft or piston position and rpm data to the meter. Magnetic pick-ups are carefully calibrated to detect proper grooves or protrusions and to reject minor surface imperfections that may cause improper meter readings. However, if an improper rpm reading occurs, use the optical or inductive pick-up to obtain the proper rpm reading.

OPTICAL/INDUCTIVE PICK-UP LEAD — Either the optical pick-up or inductive pick-up is connected to this lead at the locking coupling. The optical pick-up is used when working on diesel engines and the inductive pick-up is used with gasoline engines. The pick-ups perform the same basic function; they monitor the start of combustion within an engine cylinder.

LUMINOSITY PROBE — The luminosity probe is installed in a diesel engine glow plug hole. The probe has a quartz core which serves as a "window" to the cylinder. Light pulses, caused by combustion in the cylinder, pass through the "window" and are detected by the optical pick-up.

The luminosity probe can also be used with the Snap-on MT250 Optical Cable (not included with the MT1480A). The MT250 allows visual analysis of combustion within a cylinder.

Two luminosity probes are included with the MT1480A - the MT160 (chrome finish) and MT161 (black finish). They are used for testing the most common domestic automobile and light truck diesels. Other probes are available.

OPTICAL PICK-UP — The optical pick-up connects to the luminosity probe. A photo detector inside the pick-up senses light pulses that pass through the probe and changes the light pulses to electrical signals.

INDUCTIVE PICK-UP — The inductive pick-up clamps over a spark plug wire on a gasoline engine. It monitors the high-voltage surges supplied to a spark plug, which provides the spark that ignites the compressed air/fuel mixture in the engine cylinder.

RPM LED DISPLAY — The MT1480A has an RPM range of 40 to 8000 RPM and displays in increments of 10 RPM. Just one pick-up connection is required if only an rpm reading is desired. For a diesel engine rpm reading either the magnetic or optical pick-up can be used, and for a gasoline engine either the magnetic or inductive pick-up.

Diesel and gasoline engine "cranking rpm" tests are performed using the magnetic pick-up. For user convenience, the rpm display will hold the "cranking rpm" reading for about five seconds after cranking is stopped.

DEGREES LED DISPLAY — The MT1480A displays engine timing to within 99° (in increments of .5°) of engine offset settings of 0° to 359.5°. This allows timing to be performed from any engine cylinder.

The luminosity probe, optical pick-up and magnetic pick-up are used for diesel engine timing. The inductive pick-up and magnetic pick-up are used for timing gasoline engines.

CONTROL PANEL — The MT1480A features a touch control panel with ten digits (0 - 9), a decimal point (.) and two function controls - ENTER OFFSET and CHECK OFFSET.

The ten digits, decimal point, and enter offset controls are used to enter the desired degrees of offset. Offsets of .5° - 359.5° may be entered in .5° (1/2 degree) increments, such as: 1, 1.5, 2, 2.5, etc. This is termed a "valid" offset. Offsets entered that are greater than 359.5° or not in .5° increments are "invalid" and will be rejected by the meter (refer to "OFFS Err" on page 5).

The offset setting entered for timing an engine is determined by the position of the magnetic pick-up receptacle in relation to TDC, the number of engine cylinders, the cylinder used for testing, the engine's firing order, and the crankshaft throw angle (firing interval). Manufacturer's manuals and other service manuals, such as Mitchell or Chilton, will usually provide much of the above information. A chart containing the timing

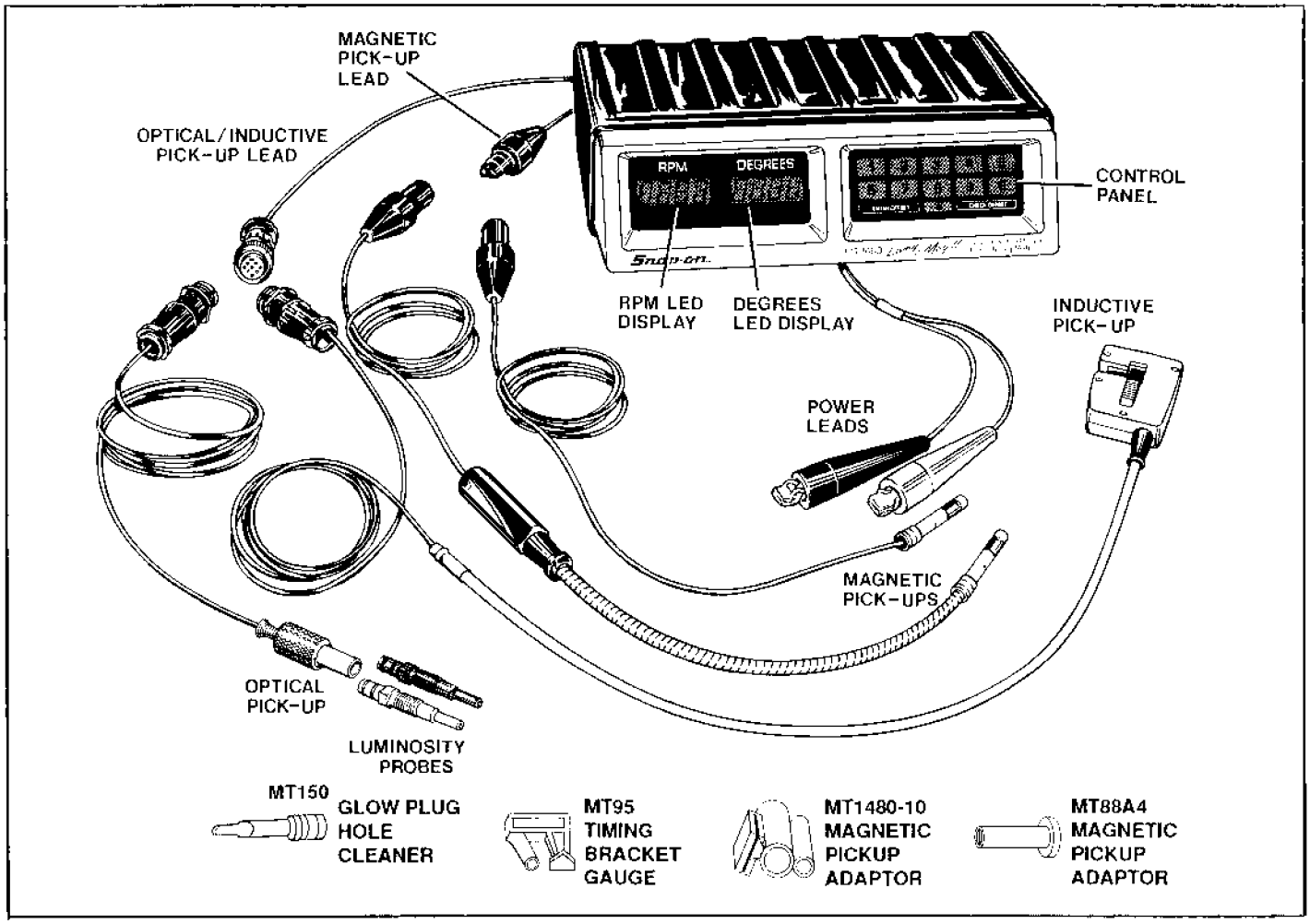


Fig. 1 — MT1480 Meter, Leads, Pick-ups, and Probes

offset settings covering the more common engines that can be timed using the MT1480A has been provided for your convenience on page 14. Refer to "How to Calculate Enter Offset Settings" when timing an engine not included in the offset chart.

CHECK OFFSET is used to verify the degrees of offset entered. The degrees entered are displayed by touching CHECK OFFSET.

ACCESSORIES

Included with the MT1480A:

MT95 Timing Bracket Gauge — The MT95 is used to check and align the position of Chevrolet 6.2L diesel engine magnetic pick-up receptacles. Instructions are packaged with the MT95.

MT150 Glow Plug Hole Cleaner — The MT150 is used to remove carbon build-up from around glow plug holes on diesel engines that use the MT160 and MT161 Luminosity Probes. It is inserted into a glow plug hole and hand turned. A 1/4" drive handle or extension may be used with the MT150.

MT88A4 Magnetic Pick-up Adaptor — The MT88A4 is inserted into the magnetic pick-up receptacle on Chyrsler Corp. engines to adapt it for use with *Snap-on* magnetic pick-ups.

MT1480-10 Magnetic Pick-up Adaptor — The MT1480-10 is used on Chrysler Corp. V-type engines that have four grooves spaced 90° apart on the harmonic balancer. The groove for monitoring TDC for #1 cylinder or its companion cylinder runs the full width of the balancer, whereas the other three taper upwards towards the rear of the balancer. The adaptor positions the magnetic pick-up towards the rear of the balancer to help eliminate improper TDC signals that can be caused by the other three grooves. Install the adaptor by sliding its center portion over and into the vehicle's magnetic pick-up receptacle, and its squared slotted end over the vertical portion of the receptacle's sheet metal bracket.

Optional Accessories (not shown):

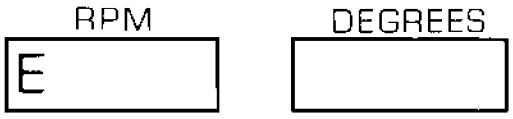
MT162 Luminosity Probe — The MT162 is designed for use on Volkswagen diesel engines. It is used in the same manner as the MT160 and MT161 included with the MT1480A.

MT93 Magnetic Pick-up Adaptor — The MT93 is inserted into the center hole of the plastic screw-in plug located on top of the bell housing on Volkswagen engines. It can also be used with Audi engines.

Your Snap-on representative can provide you with more information on these accessories and others, and keep you updated as new accessories become available.

Display Codes

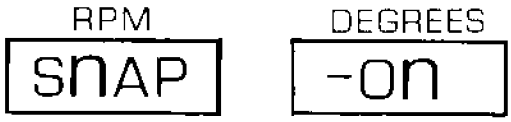
The RPM and DEGREES displays provide valuable meter operation information in addition to rpm and timing read-outs. An understanding of the following display codes is necessary for efficient use of the MT1480A.



"E" will appear when power leads are connected to battery. It indicates that meter is waiting for an offset to be entered.

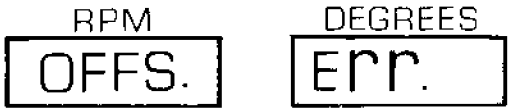
If anything other than "E" is displayed, press ENTER OFFSET to display the "E".

"1480 READY" will move across the displays after a valid offset is entered. It indicates that the meter is ready, but no signals are going to the meter. In other words, the engine has not been started and/or the pick-ups have not been connected.



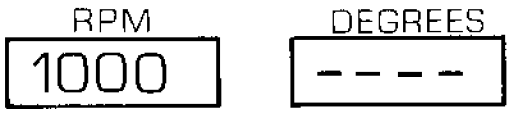
"SNAP-ON" also indicates that the meter is ready and no signals are going to the meter. It will appear after a valid offset is entered if pick-up leads are disconnected and/or engine is shut off.

Cranking rpm tests can not be performed if the displays read "SNAP-ON". A valid offset must be reentered first. See "Cranking RPM Test" on page 12.



"OFFS. Err." (offset error) will be displayed if an invalid offset is entered. If this occurs, press ENTER OFFSET and reenter a valid offset. "OFFS. Err." indicates one of the following entry errors has occurred:

1. An offset greater than 359.5° was entered
2. An offset using a decimal point not followed by a "0" or "5" was entered. Offsets must be entered as whole numbers or in increments of .5° (½ degree).
3. No offset was entered.
4. An offset with more than one number to the right of the decimal point was entered, such as 9.50 or 9.05.
5. A four digit offset was entered, such as 0100. or 0200.
6. An offset was entered using the decimal point, but no number was entered after the decimal point.



Displays show rpm reading, but no timing reading. It indicates that only one pick-up is connected. Only one pick-up connection is required to monitor rpm on a gasoline or diesel engine. Two pick-up connections are necessary to monitor engine timing. The optical and magnetic pick-ups are required for diesel engines, and the inductive and magnetic pick-ups for gasoline engines.

When timing an engine and only an rpm reading is displayed, check for the following potential problems:

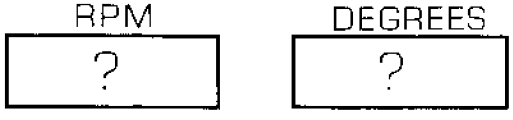
1. No magnetic pick-up signal — Check by disconnecting optical pick-up (diesel engine) or magnetic pick-up (gasoline engine). If rpm reading is still displayed the magnetic pick-up is functioning properly.

2. No optical or inductive pick-up signal — Check by disconnecting the magnetic pick-up. If rpm reading is still displayed the meter is receiving a signal from the optical or inductive pick-up and the pick-up is working properly.

   If the optical pick-up is connected, and no rpm reading is displayed when the magnetic pick-up is disconnected, the problem may be a dirty luminosity probe and not a bad connection or faulty pick-up.

3. Timing of engine is not within ±99° of offset entered — Verify that the offset entered is correct for the engine and engine cylinder being tested. Press CHECK OFFSET and make sure the correct offset degree was entered.

4. RPM is too low — If the rpm reading is less than 400, no timing degrees will be displayed.



If anything other than a tach reading, timing reading, or one of the display codes mentioned appears, press ENTER OFFSET or disconnect and reconnect a battery power lead.

Operator Tips

Familiarize yourself with the following Operator Tips before doing any testing with the LUMY/MAG II. Tips are divided into two sections — Equipment Tips and Testing Tips.

Equipment Tips

1. When installing a luminosity probe in a glow plug hole, take care not to overtighten it. Follow torque specifications in testing sections.
2. Handle the luminosity probe with care. Dropping it may fracture the quartz. Do not use a damaged probe.
3. Use a wet toothpick or wooden matchstick to remove carbon build-up from a luminosity probe. Also, an ultrasonic cleaning unit, with a solution used for cleaning injector nozzles, will help to loosen deposits. Do not place hot probe in liquid.
4. Sooty, dirty or broken probes will result in retarded readings. The luminosity probe will soot up very fast when used in a cold engine.
5. Use a dry cotton swab to clean the lens in an optical pick-up. Do not use solvent or an ultrasonic cleaner.
6. Clean any spills, such as gasoline, brake fluid, cleaning solvents, etc. from the meter's exterior immediately to protect the finish.
7. When not in use, the inductive pick-up should be stored in the open position. This will help to protect it if it is dropped.
8. Periodically check external lead connections to make sure they are secure.
9. For convenience, keep the enclosed quick reference ENTER OFFSET CHART near the meter.
10. The MT1480A is a highly sensitive and versatile test instrument. Yet, if handled with care it should provide years of dependable trouble-free service.

Testing Tips

1. Engine must be in good running order before timing adjustments can be done correctly.
2. Test engine must be at normal operating temperature for accurate test results.
3. Make sure that manufacturer's preliminary test procedures are followed to ensure accurate test results.
4. The current diesel engine applications for the two luminosity probes included with the MT1480 are:

MT160	GM 4.3L V-6 GM 4.3L V-8 GM 5.7L V-8 Ford 6.9L V-8
MT161	GM 6.2L V-8

5. When test readings are first displayed, allow a few seconds for display readings to stabilize.
6. Clean any dirt from the engine probe holder and crankshaft balancer rim.
7. A cylinder misfire can cause a momentary increase in the timing reading. If this occurs, allow the meter reading to stabilize.
8. If magnetic pick-up signal is lost when you let go of an inserted magnetic pick-up, it may be due to a spring-like return of the magnetic pick-up receptacle caused by a too snug fit. A spray lubricant applied to the pick-up or receptacle may solve this problem.
9. On some engines, such as the Chevrolet 2.5L four cylinder, access to the magnetic pick-up receptacle is restricted. The MT89 Magnetic Pick-up is designed for use in these situations.
10. Some V-6 gas engines (GM 2.8L) have three notches equally spaced on the harmonic balancer or front crank pulley; offset entries for these engines are the same for each cylinder (9.5°).
11. Some engines (Ford 6.9L diesel & Chevrolet 2.8L gas) have a magnetic pick-up holder tube that is too long to allow the MT88A Magnetic pick-up to be inserted full depth. Test these vehicles with the MT89 Magnetic Pick-up after stretching its strain relief spring about 1-1/2".
12. On Ford 6.9L diesel engines equipped with two magnetic pick-up receptacles, use the receptacle positioned at -20° ATDC.
13. Some diesel engines (Ford 6.9L & Chevrolet 6.2L) may not display a timing reading at low rpm. The timing reading should be obtained when engine speed is adjusted to specified timing rpm.
14. Two methods of inserting the magnetic pick-up to monitor a rotating protrusion, instead of a groove or notch, are described in the testing section - engine running and engine off. Keeping your safety and the equipment in mind, use the most convenient method.

Diesel Engine Timing

We at Snap-on believe that using luminosity as the reference for timing diesel automobile engines offers the most reliable and expedient method for service technicians. Several manufacturers, having recognized the benefits inherent in the dynamic timing method, versus static timing, provide luminosity timing procedures and specifications in their service manuals. For some of those that do not, luminosity timing technology may still be applied for testing their engines. This is done by monitoring the timing readings of known accurately timed engines and recording the readings for future use.

The following test procedures - "Timing Diesel Engines to Manufacturer's Specifications" and "Timing Volkswagen (VW) Diesel Engines" - provides: (1) a general test procedure for timing diesel engines that have manufacturer's luminosity timing specifications, and (2) a more informative and detailed test procedure for timing VW, which is intended as a example of using luminosity technology to test timing on engines without luminosity specifications.

TIMING DIESEL ENGINES TO MANUFACTURER'S SPECIFICATIONS

1. Place transmission selector in park (neutral for manual transmission), apply parking brake and block the drive wheels.

2. Clean timing (witness) marks located on pump flange and/or adaptor, if needed, and check the position of the marks.

   Note: Normally the alignment of the marks will be quite close. If they are not, a variation in timing from the manufacturer's specifications can be expected.

3. Clean the magnetic pick-up receptacle and the harmonic balancer or flywheel as required.

4. Start the engine and allow it to idle until it reaches normal operating temperature. Shut off the engine.

   Note: Failure to fully warm the engine may result in erroneous readings and improper pump adjustment. Combustion timing will vary until the temperature stabilizes.

5. Check the manufacturer's procedure for disconnecting vacuum lines and/or electrical connections.

6. Remove the air cleaner assembly, if necessary, and install a protective cover screen or baffle to prevent foreign matter from entering the engine.

7. Select cylinder to be used for testing.

   Note: Chart on page 14 shows the correct offset to be entered for cylinder selected.

8. Clean dirt from around the glow plug of cylinder selected.

9. Remove glow plug.

   Note: If a carbon build-up around the glow plug heater element causes difficulty in removing the glow plug, remove the build-up. This will help to keep the luminosity probe's "window" clean.

   The MT150 Glow Plug Hole Cleaner, included with the meter, is used for cleaning glow plug holes that use the MT160 and MT161 luminosity probes. Clean other size glow plug holes by hand-turning the proper size drill bit through the hole.

10. Install proper luminosity probe in glow plug hole and torque to 8 - 9 lb. ft. (10 - 12 N·m).

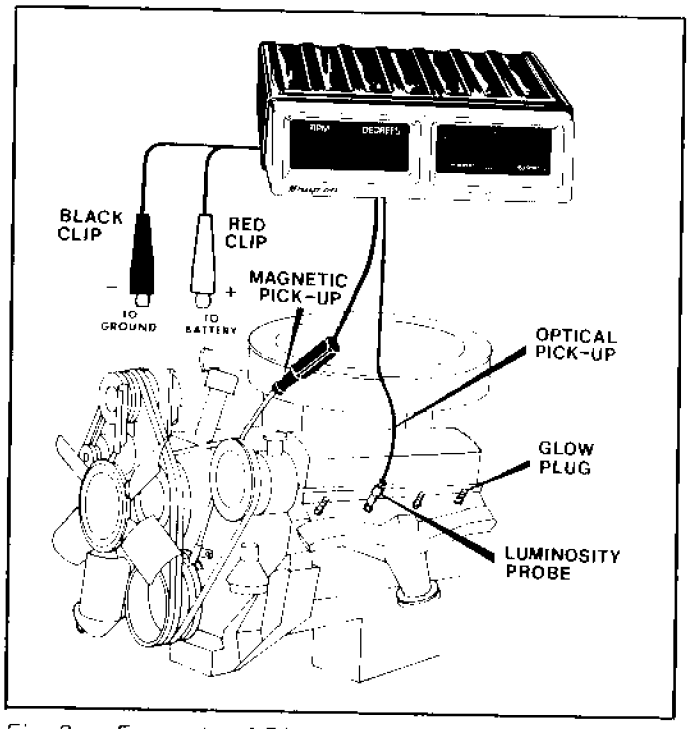


Fig. 2 — Example of Diesel Timing Hook-up

Caution: Do not over-tighten luminosity probe. Do not install a luminosity probe in an engine it is not specified for use on, as it may result in insufficient thread engagement.

11. Insert magnetic pick-up into pick-up receptacle, making sure it is in far enough to make contact with harmonic balancer, flywheel or crankshaft pulley.
    If the pickup will be monitoring a protrusion, rotate the engine slowly and position the protrusion in line with the pick-up receptacle hole. Insert the pick-up until it contacts the top of the protrusion, and then back it out slightly.

12. Connect MT1480 power leads to battery; red to positive (+) and black to negative (-). "E" should be displayed on RPM display. If not, press "ENTER OFFSET" switch until "E" appears.

13. Enter the proper offset for the cylinder used for testing (refer to chart on page 14).

14. Start engine and adjust rpm to manufacturer's specification. Make sure that lead wires are clear of all moving or hot engine parts.

15. Observe light pulses for steadiness through luminosity probe window. If pulses are steady, continue testing. Irregular pulses indicate a malfunction that must be corrected before timing adjustments can be properly made.

16. Connect optical pick-up to luminosity probe.

17. After engine has run several minutes at the specified rpm, observe the timing reading. Recheck timing reading at two minute intervals until reading stabilizes. This usually takes 4 - 6 minutes. Do not accept a reading that does not repeat at two minute intervals.

Note: Follow manufacturer's procedures exactly, as procedures may vary.

18. Shut off the engine.

    A. If timing *is within* specifications, go to step 24.

    B. If timing is not within specifications, go to step 19.

19. Loosen fuel injection pump bolts (or retaining nuts) to allow the pump to be rotated.

20. Rotate the pump to advance or retard the timing as needed.

21. Retorque the pump bolts.

22. Start the engine and recheck the timing.

23. Repeat steps 17 to 22 until timing is to specifications.
    If the timing marks are far apart after resetting the timing and the engine still has a problem, the dynamic timing could still be incorrect because of a malfunctioning cylinder. When this occurs, check timing from any other cylinder. If there is still a difference in timing between cylinders, try averaging the timing by adding the timing readings and dividing by the number of cylinders checked

24. Reset the idle to specifications and shut off the engine.

25. Remove the meter and its attachments from the vehicle.

26. Replace and retorque the glow plug. Connect wire.

27. Replace air cleaner and reconnect any vacuum lines and electrical connections that were disconnected.

TIMING DIESEL ENGINES WITHOUT A MANUFACTURER'S SPECIFICATION

Luminosity timing technology can be used to test diesel engines that the manufacturer does not provide a luminosity specification for, if that engine is compatible to the LUMY/MAG II's luminosity probes, magnetic pick-ups, and/or available adaptors and accessories. It requires very little time and effort, and eliminates always having to perform the more difficult and time consuming "static" injection timing procedures prescribed by manufacturers. First, monitor the "dynamic" ignition timing of a known accurately "static" timed diesel engine. Second, record the dynamic timing reading, along with the following vehicle data: year, make, model, injection pump series, test rpm, and the static timing specification. And then use the recorded reading to check/adjust the dynamic timing of an identical vehicle at the same test rpm.

Timing Volkswagen (VW) Diesel Engines

The following VW information and timing procedure is provided as an example of how luminosity timing technology can be used to dynamic time a diesel engine that does not have a manufacturer's luminosity timing procedure or specification.

VW Timing Data:

Luminosity probe: MT162 (not included)

Magnetic pick-up adaptor: MT93 (not included)

Position of notch or protrusion: protrusion at 20° ATDC

Width of protrusion: approximately 3°

Firing order: 1342

Cylinder #4 offers easiest access and is recommended for luminosity probe.

Meter offset entry: **23°** for #1 or #4 cylinder
203° for #3 or #2 cylinder

Current (thru 1986) VW diesel engines have two flywheel protrusions, located at 12° BTDC and 20° ATDC. The magnetic pick-up senses the trailing edge of the 20° ATDC protrusion (senses the leading edge of a notch). The 3° width of the protrusion is added to the 20° ATDC for a total offset entry of 23° when using #1 or #4 cylinder. For ignition timing check using #3 or #2 cylinder an additional 180° is added for a total offset entry of 203°. *Offset entries on page 14 are total offsets.* If the magnetic pick-up alone (without optical input signal) is used on VW engines, the RPM readings are doubled and must be divided by two.

Note: When monitoring dynamic ignition timing, which is to be recorded and used for timing identical vehicles, and the width of the protrusion is not known, monitor the timing as if there was a notch instead (do not add any degrees to the position of the protrusion). The timing reading received will be a "reference" number, not the "actual" number of crankshaft degrees before or after TDC. Timing by "reference" number will provide equally accurate end results.

A. VW Static Timing Procedure

1. Check and/or adjust injection pump timing using prescribed VW static timing procedure (dial indicator method). Observe all VW cautions and warnings.

   Consult manufacturer's shop manual or a reliable service manual, such as a Mitchell Manual, for procedure and specifications.

B. Record Dynamic Timing Reading

2. Place the transmission selector in park (neutral for manual transmission), apply parking brake and block drive wheels.

3. Start engine and allow it to idle until it reaches operating temperature. Shut off the engine.

   Observe all VW cautions.

   Check belt drive tension.

   Be sure cold start advance is pushed in.

   Be sure cold start lever is against stop (toward drive gear on pump.

4. Remove the main glow plug feed wire and insulate it from touching ground.

5. Remove glow plug and install MT162 Luminosity Probe. Torque to 10 - 12 lb. ft. (13 - 16 N·m).

6. Insert the MT93 Magnetic Pick-up Adaptor into the center hole of the plastic screw-in plug located atop the bell housing. Do not insert magnetic pick-up.

7. Connect MT1480A power leads to battery; first red to positive (+) and then black to negative (-). "E" should be displayed on RPM display. If not, press "ENTER OFFSET" until "E" appears.

8. Enter the proper offset for the cylinder used for testing (refer to chart on page 14).

9. Start engine and observe light pulses for steadiness through luminosity probe window. Continue testing if pulses are steady. Irregular pulses indicate a malfunction that must be corrected before resuming test.

10. Slowly insert magnetic pick-up into MT93 adaptor until meter displays a steady RPM reading. Do not allow the pick-up to hit the rotating flywheel protrusions.

11. Connect optical pick-up to luminosity probe.

12. Bring engine speed to 1200 RPM and note ignition timing reading.

13. Shut off engine. Disconnect meter and components. Replace glow plug and glow plug feed wire.

14. Record reading for future use, along with make, year, model, injection pump series and static timing specification.

C. Dynamic Timing Using Recorded Timing Readings.

The following time and labor saving dynamic timing procedure can be used only if (1) you have a reliable dynamic timing reading for an engine that has been accurately timed per the manufacturer's static timing procedure and specifications, and (2) the vehicle being timed is of the same year and model, and has the same injection pump (check series number) and timing specification.

15. Check injection pump reference marks on pump mounting flange. If necessary, scribe marks to original position.

16. Perform steps 2 through 12.

17. Shut off engine.

18. Compare timing reading to previously recorded readings taken from vehicle of same year, model, injection pump series and timing specification.

    The degrees of timing can vary above or below the recorded value (VW dial indicator method allows ± .5 mm tolerance) to allow a slight amount of advance or retard from basic setting. The "longer" the pump stroke (VW dial indicator method) the more advanced the timing will be.

A. If an injection pump timing adjustment is **not** required, proceed to step 22.

B. If an injection pump timing adjustment is required, proceed to step 19.

19. Loosen bolts on injection pump mounting plate and support and turn the pump a slight amount. Retighten bolts to proper value.

20. Start engine and recheck ignition timing.

21. Repeat steps 17 through 20 until timing is to specification.

22. Disconnect meter and components. Replace glow plug and glow plug feed wire.

Gasoline Engine Timing

Before base (initial) ignition timing can be checked, certain prerequisite procedures are required. For many years this involved only that the idle speed be low enough or at a specific rpm and/or disabling the vacuum advance unit. Today, in order to meet emissions and fuel economy demands, engines have been equipped with a wide variety of computerized control systems. Base timing prerequisite procedures may now include one or more of the following steps, which are just a few examples of the many prescribed by manufacturers:

— Disconnect the 4-wire Electric Spark Timing (EST) connector.

— Disconnect EGR hose, canister purge hose, purge control hose, vacuum at Spark Control Computer (SCC), electric fan, ...

— Disconnect barometric pressure sensor from ignition module and place a jumper wire across Yellow and Black wire pins in ignition module connector.

— Ground test terminal in the diagnostic connector under the dash.

- Open the "set" timing connector.

If a vehicle's timing procedure and specification is not readily available on a Emission Control Label, refer to a reliable service manual. Locating this information in a manual will require some or all of the following vehicle data: year of manufacture, vehicle identification number (VIN), engine displacement, type of transmission, and whether it is equipped for Federal or California standards.

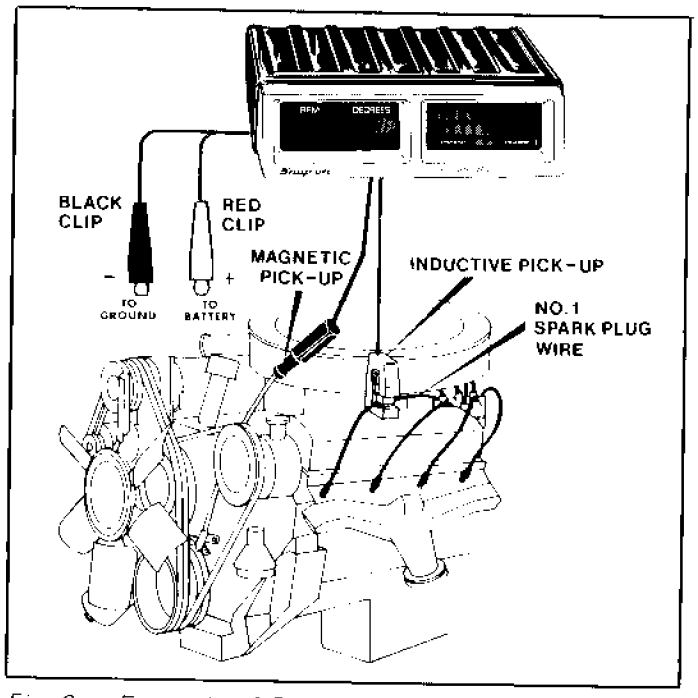


Fig. 3 — Example of Gasoline Timing Hook-up

Always refer to an Emission Control Label or a reliable service manual for timing procedures and specifications, as this abundance of data is too great to be covered in a manual such as this.

General Timing Procedure for Gasoline Engines

1. Consult manufacturer's shop manual or a reliable service manual, such as a Mitchell or Motor, for timing specification and procedure. Observe all cautions and warnings.
2. Place transmission selector in park (neutral for manual transmission) unless specified otherwise by manufacturer, apply parking brake and block drive wheels.
3. Connect MT1480A power leads to battery; first red to positive (+) and then black to negative (-). "E" should appear on RPM display. If not, press "ENTER OFFSET" until "E" appears.
4. Enter proper offset for engine cylinder used for testing (refer to chart on page 14) and press "ENTER OFFSET".
5. Carefully insert magnetic pick-up into the engine's pick-up receptacle.

   Note: For Chrysler Corp. engines, use either the MT88A4 or MT1480-10 adaptor. The MT1480-10 is designed specifically for use on V-type engines that have four grooves spaced 90° apart on the harmonic balancer.

6. Place the inductive pick-up over the spark plug wire of the cylinder selected for testing in step 4. Jaws must be firmly seated with the lock button in the lock position.
7. Start engine, but first make sure that lead wires are clear of all moving or hot engine components.
8. Guide the pick-up slowly toward the rotating wheel until the meter displays a steady RPM reading.
9. Compare DEGREES reading to manufacturer's specification.
10. Adjust timing, if necessary, per manufacturer's procedure and specification.
11. Shut off engine.
12. Disconnect black lead from battery and then red. Remove inductive pick-up (store with jaws closed). Remove magnetic pick-up, and adaptor if used. Reconnect any vacuum or electrical connections that were disconnected.

Averaging Method of Timing

Averaging procedures for setting ignition timing are specified by some automobile manufacturers. These procedures require that the ignition timing of two or more cylinders be monitored and averaged. The timing adjustment is the difference between the average reading and the timing specification, and results in the overall timing of cylinders being brought into closer agreement with the base timing specification.

The following procedure explains how the LUMY/MAG II is used to perform fast and accurate average timing adjustments:

AVERAGE TIMING USING #1 CYLINDER AND COMPANION CYLINDER

1. Refer to manufacturer's or other reliable service manual for timing specification and prerequisite timing procedures.

2. Following the normal LUMY/MAG II test procedures, monitor the timing reading for cyl. #1.

3. Move the inductive pick-up to cyl. #1's companion cylinder (the cylinder that uses the same offset entry - see chart) and note the timing reading.

4. Add the two readings and divide the total by two (2). The result is "average timing".

   Example:

#1 cyl	4°			
Companion cyl.	8	12° ÷ 2	6°	average
Total	12°			timing

5. Compare average timing to the timing specification and determine the timing adjustment.

   Example:

Timing specification	8°
Average timing	6°
Timing adjustment	2°

6. Place the inductive pick-up back over the #1 spark plug wire and advance or retard the timing reading in accordance to the timing adjustment calculated.

   Example: Advance cyl. #1's 4° timing reading by the 2° timing adjustment to read 6°.

This timing procedure can be extended to include all of an engine's cylinders by: (1) monitoring timing for each cylinder (refering to chart for proper offset entries) (2) totaling the timing readings (3) dividing the total by the number of cylinders monitored (4) comparing the average timing to the timing specification to determine the timing adjustment and (5) moving the inductive pick-up back to cyl. #1 and advancing or retarding the timing reading in accordance to the timing adjustment calculated.

Cranking RPM Test

1. Place the transmission selector in park (neutral for manual transmission), apply parking brake and block drive wheels.

2. Disable the engine to prevent it from starting.

   On ignition systems with a remote ignition coil - disconnect the coil wire from the distributor cap and ground it.

   On GM-HEI integral coil igntion system - disconnect the BAT wire from the distributor.

   On diesel engines - disconnect the fuel shut-off solenoid wire. If there is no plastic harness connector, insulate the removed wire terminal to prevent it from touching ground.

3. Connect MT1480A power leads to battery; first red to positive (+) and the black to negative (-). "E" should be displayed on RPM display. If not, press "ENTER OFFSET" until "E" appears.

4. If the magnetic pick-up will be monitoring a notch, refer to A. *Refer to B for a protrusion. Use appropriate pick-up adaptor.*

   A. Notch - Insert the magnetic pick-up into the pick-up receptacle until it contacts the surface of the harmonic balancer, flywheel or pulley.

   B. Protrusion - Rotate the engine slowly and position the protrusion in line with the pick-up receptacle hole. Insert the pick-up until it contacts the top of the protrusion, and then back it out just slightly.

5. Enter any valid offset and press "ENTER OFFSET". "1480 ready" should now move across the displays.

   Note: If the display is blank or anything other than "1480 ready" is displayed, disconnect leads at battery and then repeat steps 3 thru 5.

6. Crank engine and monitor rpm. The meter will hold the rpm reading for about five seconds after cranking is stopped.

   Some diesel manufacturers have a minimum cranking speed specification. Compare rpm reading to specification, if available.

How to Calculate "ENTER OFFSET" Settings

Note: The following method of determining "ENTER OFFSET" meter settings is valid only for engines with "even firing" intervals. Offset entries for "uneven firing" engines, such as some GM V-6 engines, can not be calculated using this method.

Determining the "ENTER OFFSET" meter settings for checking timing using any engine cylinder requires the following vehicle data:

1. Firing order.

2. Position of magnetic pick-up receptacle in relation to cylinder #1 TDC (measured in crankshaft degrees).

3. Firing interval - 90° (8 cyl.), 120° (6 cyl.) or 180° (4 cyl.).

   On the four cycle automobile engine, it takes two crankshaft revolutions (720°) to fire one cylinder or all cylinders. Half the cylinders fire in one revolution (360°), and two cylinders (called "companion cylinders") fire at the same location in relation to TDC. Therefore the firing interval is 90° for an eight cylinder engine (720° ÷ 8 = 90°), 120° for a six cylinder engine (720° ÷ 6 = 120°), and 180° for a four cylinder engine (720° ÷ 4 = 180°).

The following example illustrates how to use the above vehicle data requirements to calculate offset settings:

Vehicle Data

Make ..... GM
Year 1982
Engine ..... 5.7L (350") V-8 (gasoline)
1 Firing order 18436572
2 Position of magnetic pick-up receptacle ... 9.5° ATDC
3 Firing interval ..... 90°

1. Write down the firing order.

1	**8**	**4**	**3**	**6**	**5**	**7**	**2**

2. Under cylinder #1, place the number of crankshaft degrees that the magnetic pick-up receptacle is positioned from TDC.

1	8	4	3	6	5	7	2
9.5							

3. Add the firing interval to the "OFFSET ENTRY" setting for cylinder #1 (90 + 9.5 = 99.5) and write the total (99.5) under the cylinder that precedes #1 in the firing order, (the last cylinder in the firing order).

1	8	4	3	6	5	7	2
9.5							**99.5**

4. Add the firing interval to "OFFSET ENTRY" setting for the last cylinder in the firing order (90 + 99.5 = 189.5) and place this total (189.5) under the cylinder that precedes it in the firing order.

1	8	4	3	6	5	7	2
9.5						**189.5**	99.5

5. Add the firing interval to the last "OFFSET ENTRY" calculated (90 + 189.5 = 279.5) and place the total under the cylinder that precedes it in the firing order.

1	8	4	3	6	5	7	2
9.5					**279.5**	189.5	99.5

6. The remaining "ENTER OFFSET" settings can be calculated by continuing the above procedure. Note: When the total number of degrees exceeds 360, as it will for cylinder #6, subtract 360.

OR

Now that half of the cylinder's "ENTER OFFSET" settings have been calculated, simply apply these calculations to their "companion cylinders". "Companion cylinders" are determined by placing the last half of the firing order (6572) under the first half (1843). The top and bottom cylinders are "companion cylinders".

Example:

1	8	4	3
6	5	7	2

1	8	4	3	6	5	7	2
9.5	**279.5**	**189.5**	**99.5**	**9.5**	279.5	189.5	99.5

The same procedure is used to determine "ENTER OFFSET" settings for six and four cylinder engines, substituting 120° and 180° firing intervals respectively.

Note: If the magnetic pick-up is monitoring a protrusion or pin instead of a groove or notch, then the width of the protrusion (in crankshaft degrees) must be considered as in Volkswagen diesel timing on page 9.

Lumy/Mag II ENTER OFFSET CHART

Using the ENTER OFFSET CHART:

1. MAKE/ENGINE - Of the engines listed, most can be tested using MT1480 components and/or available accessories, except models not equipped with a magnet pick-up.

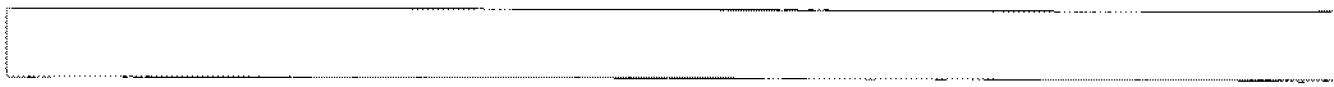
2. OFFSET ENTRIES - The offset entries are listed in crankshaft degrees, and correspond to the position of the magnetic pick-up receptacle in relation to TDC for the individual cylinders.

3. CYLINDER NUMBER IN THE FIRING ORDER - The numbers *1 thru 8* do not correspond to the cylinder numbers on the engine. They represent the cylinder number in the firing order. Example: If the engine's firing order is 1-8-4-3-6-5-7-2, "1" refers to cyl. #1 (the first cylinder in the firing order), "2" refers to cyl. #8 (the second cylinder in the firing order, "3" refers to cyl. #4 (the third cylinder in the firing order), etc.

MAKE / ENGINE (Thru Jan. 1990)	OFFSET ENTRIES	CYLINDER NUMBER IN FIRING ORDER 1	2	3	4	5	6	7	8
AMC (prior to 1988) and GM									
V-8 all gas or diesel		9.5	279.5	189.5	99.5	9.5	279.5	189.5	99.5
V-6 all gas, except the following:		9.5	249.5	129.5	9.5	249.5	129.5		
V-6 gas 2.8L (with 3 notches)		9.5	9.5	9.5	9.5	9.5	9.5		
78-79 Buick & Chevrolet VIN Code C (196")		9.5	237.5	129.5	357.5	249.5	117.5		
75-77 Buick VIN Code C (231")		9.5	219.5	129.5	339.5	249.5	99.5		
V-6 diesel		20	260	140	20	260	140		
6 cyl. (in line)		9.5	249.5	129.5	9.5	249.5	129.5		
4 cyl. all, except the following:		20	200	20	200				
1.6L (LeMans 88-89)		9.5	189.5	9.5	189.5				
CHRYSLER CORP.									
V-8 all		10	280	190	100	10	280	190	100
V-6 3.9L		10	242	130	2	250	122		
3.0L (with 3 notches)		10	10	10	10	10	10		
6 cyl. (in line)		10	250	130	10	250	130		
4 cyl. *Has two timing marks. Enter 190 if 10 gives unrealistic reading.*		10 190	10 190	10 190	10 190				
FORD MOTOR CO.									
V-8 (Gas) 5.0L, 5.8L "M" & all EEC-III		45	315	225	135	45	315	225	135
All other V-8		135	225	315	45	135	225	315	45
V-8 (Diesel) 6.9 & 7.3		20	290	200	110	20	290	200	110
V-6 all except the following:		135	15	255	135	15	255		
3.8L early 82		309	189	69	309	189	69		
3.8L since late 82		334	214	94	334	214	94		
6 cyl. (in line)		135	15	255	135	15	255		
4 cyl. 1.6L		68	248	68	248				
2.0L		20	200	20	200				
2.3 HSC engine		314	134	314	134				
2.3 OHC engine		52.5	232.5	52.5	232.5				
VOLKSWAGEN									
4 cyl. gas with V-notches in flywheel		20	200	20	200				
4 cyl. gas & diesel with protrusions on flywheel		23	203	23	203				

LUMINOSITY PROBE DIESEL ENGINE TIMING APPLICATIONS:

MT160 - GM 4.3L V-8, 5.7L V-8, 4.3L V-6 and Ford 6.9L, 7.3L V-8, **MT161** - GM 6.2L V-8, **MT162** - All VW



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