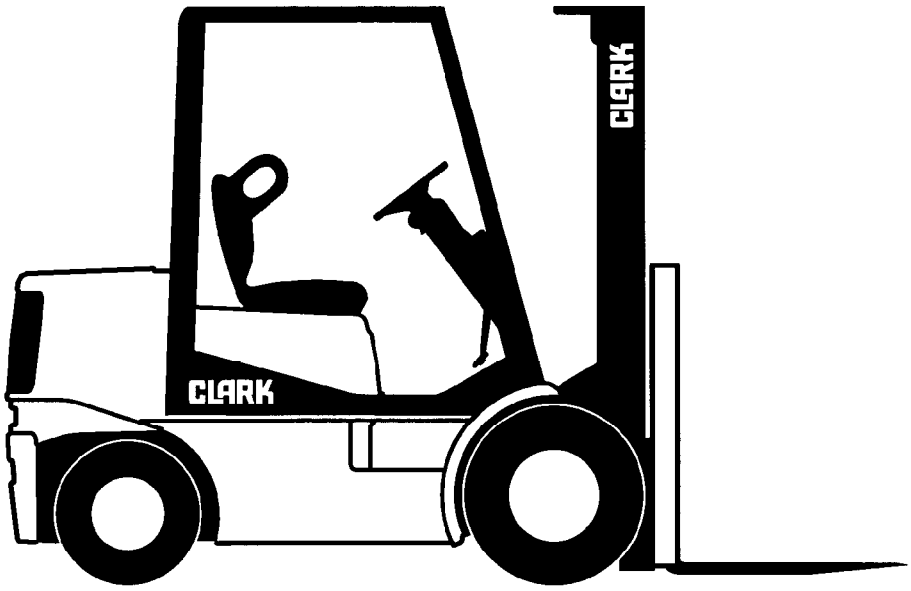
# SM-520R
# GCS/GCS

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Lexington, KY
40508

### Battery

14. If the battery has been "running down" (discharging) or if engine cranking speed is low, check the alternator circuit and battery. See cranking test above.

*Refer to Section 6.8, Alternator Maintenance.*

**NOTICE** - The above preliminary tests show whether the basic engine sytems are functioning and that charging and cranking systems are okay or in need of repair. Remove the voltmeter after these tests are made.

### Fuel Supply System

#### Gasoline engines

1. Check if there is a fuel system problem by accelerating engine with the choke knob in and the tilt lever fully forward (or back) to put hydraulic system in bypass to load engine.

2. If engine operation is erratic, pull choke knob out and again accelerate under hydraulic by-pass load. If engine smooths out there is a problem in the fuel system due to insufficient fuel flow to engine.

1) Check in-line fuel filter. Replace, as necessary.
2) Check fuel pump flow and pressure. Repair or replace fuel pump, as required.
3) Check carburetor. Repair, clean or replace.

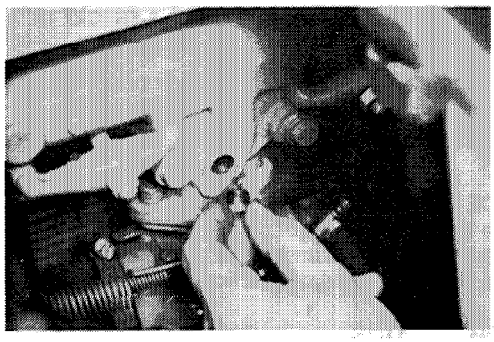
#### LPG engines

*For LPG trucks, refer to Section 5.2, LPG Fuel System.*

## 2-Tune-Up Procedures

1. Connect a tachometer, or combination test instrument such as the Clark Dynamic Engine Analyzer, Part No. 1802047, to the engine.

2. Install a vacuum gauge. The pick-up location to install a vacuum gauge will vary between engines. Find a location where the vacuum gauge may be connected to measure intake manifold vacuum.



**D176GA [2.9L] Engine.** Install vacuum gauge at the plug fitting in the intake manifold (shown).

**4G54 [2.6L] Engine.** Install the vacuum gauge at the breather hose leading from the valve cover to the intake manifold. Use a nipple or an adapter to connect to the vacuum hose.

**TM27 [2.7L] Engine.** Attach vacuum gauge to PCV fitting on intake manifold.

3. Start the engine, and let it warm up. While doing this, look for excessive exhaust smoke and listen for any unusual engine noise.

**Note** - Blue exhaust smoke indicates excessive oil consumption caused by faulty seating of piston rings, dirt, or worn engine components such as rings, cylinders, pistons, or valve guides. Black smoke indicates excessive fuel consumption caused by faulty carburetor or choke problem (gasoline engines only).

### 1. Stall Test

1. First, perform a stall test to determine engine condition and whether engine and other components are functioning correctly. **Check:**

1) Idle speed and vacuum
2) No-load governed speed and vacuum
3) Speed and vacuum in hydraulic (tilt) bypass
4) Engine stall speed and vacuum

*Refer to Section 4.7, RPM, Vacuum & Stall Tests, for procedures and analysis of test results.*

*Also see Section 2.1, Service Specifications.*

**NOTICE** - A stall test is perhaps the most important and useful test for quickly determining engine condition. Stall tests should be a part of all engine tune-ups and must be carefully conducted and analyzed to pinpoint specific problems.

Stall tests must include RPM, vacuum and hydraulic pressure measurements to accurately diagnose specific problem areas. For this reason, stall testing is described in a separate, detailed section noted above.

Engine speed and vacuum checks with engine under load, are made to also determine whether major components or systems other than the engine are causing problems.

**Note** - If stall speed is low, do not automatically blame the torque converter. Carefully check engine condition. Frequently an obstruction, e.g., carbon plugging, in the air intake or exhaust system is the problem.

### 2. Idle Speed

1. Check engine idle speed and adjust carburetor idle setting if idle speed is not correct.

*Refer to Section 4.10 for Carburetor Idle Adjustment.*

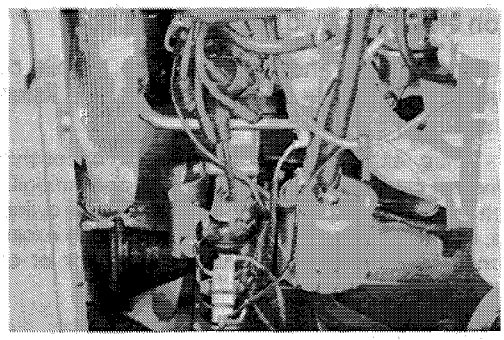
| | |
|---|---|
| 4G54 Engine | 650 rpm (600-700 rpm) |
| TM(D)27 Engine | 650 rpm (600-700 rpm) |
| D176GA Engine | 650 rpm (600-700 rpm) |

*Reference Section 2.1, Service Specifications.*

## 3. Ignition System

*Refer to Section 6.3, Ignition System Maintenance, for additional procedures.*

### 1-Distributor, Coil and Wiring



1. First, check the distributor, coil and ignition wiring (4G54 engine shown).

2. Remove the distributor cap and check its condition for:
   - cracks
   - carbon tracking or flashover burn marks
   - corrosion, rusting or damage of terminals
   - burned center terminal or side inserts
   - dirt inside and outside
   - moisture

It is very important for the cap to be clean. Moisture and dirt make a good path for flashover. Once a carbon track has started, the cap must be replaced.

3. Clean the distributor cap and terminals, or replace, as needed.

4. Remove the spark plug wires (cables) from the distributor cap. Inspect the cable socket terminals in the cap for corrosion and burn damage. Clean the towers and terminals, as needed.

5. Remove the rotor and inspect it for:
   - cracks
   - carbon tracking or flashover burn marks
   - burned, pitted , bent or worn terminal tip
   - moisture, contamination and dirt buildup

   Clean or replace the rotor, as needed.

6. Check centrifugal advance governor. Install the rotor. Turn (rotate) the rotor in the direction of rotation and release it to confirm that the rotor returns to the original position smoothly.

#### Adjust or Replace Ignition Points

1. *4G54 [2.6L] engine only.*
   1. Inspect the ignition points for wear condition, etc.
   2. Inspect condenser and condition of installation.
   3. Replace ignition points and condenser, as needed.
   4. Lubricate distributor cam and pivots (see below).
   5. Check point gap setting (see Ignition Timing below).
   6. Check electronic ignition unit, as applicable.

*Refer to Section 6.4, Ignition System - 4G54 Engine.*

2. *TM27 [2.7L] & D176GA [2.9L] engines.*
   1. Inspect electronic ignition unit. Check air gap.

*Refer to Section 6.5, Ignition System - TM27 Engine.*
*Refer to Section 6.6, Ignition System - D176GA Engine.*

#### Lubrication

*Refer to Section 6.4, Ignition System-4G54 [2.6L] Engine.*

**Note** - TM27 [2.7L] and D176GA [2.9L] engine distributors do not require periodic lubrication.

#### Coil

1. Ignition coils do not normally require any service except keeping all terminals and connections clean and tight. The coil should be kept reasonably clean; however, it must not be subjected to steam cleaning or similar cleaning methods that may cause moisture to enter the coil.

2. Check the ignition coil tower for tracking and obvious damage. Be sure the tower is clean and dry. Check coil boot nipple for correct sealing and insulating qualities. If flashover occurs here, the engine probably won't start.

3. Check primary circuit wires for tight connections and correct polarity. When the ignition coil is wired up incorrectly with the distributor, it can cause high speed missing with loss of power and performance under heavy loads.

4. Check the coil to distributor cap high-tension (secondary) cable. Check the fit of the boot on the coil and distributor cap towers. A high voltage leak at this point will cause the engine not to start.

5. *Test the Coil When Necessary.* If the coil is suspected of being faulty, remove and check its operation on a coil tester and replace it if inoperative.

#### Spark Plug Wires

1. Check spark plug cables and boots for cuts, cracking, brittleness, burns or excessive corrosion of the terminals on both ends, and general deterioration. If the cables are three years old or more, replace them.

2. To install new cables, remove one old wire at a time and match it to a new one. Use all looms and separators and route the wires exactly as the old ones.

**NOTICE - Dielectric Grease.** The use of a dielectric silicone grease at high-voltage connecting points such as coil and distributor cap towers and spark plugs is recommended to ensure good electrical connection and prevent corrosion.

### 2-Spark Plugs

1. Use an air nozzle to blow dirt and contamination out of the spark plug wells, before and after loosening the plugs.

| IMPORTANT |
| --- |
| Do not allow dirt and contaminants to enter spark plug openings when the plugs are removed. |

2. Remove and check the spark plugs and clean, adjust or replace, as necessary.

3. As each plug is removed, keep it in cylinder order and examine it carefully. Check spark plugs for burned electrodes, wear, carbon deposits and gap setting. Inspect closely for cracked insulators.

4. If the edges of the plug's inner and outer electrodes are noticeably eroded, replace it. Generally, spark plugs used with breaker-point ignition should be replaced per recommended schedule. With electronic ignition, check each plug for excessive wear.

5. It may be necessary to periodically clean the plugs with a plug cleaner and to reset the gaps to correct specifications. Check the gap of the plugs with a wire gauge, using the tool at the end of the gauge to bend the outer electrode to change the gap.

6. Spark plugs must be correctly installed in order to obtain good performance from them. Clean the spark plug seat in the cylinder head. Use new seat gaskets and screw plug in by hand. Tighten all plugs to correct torque with socket wrench of correct size. Wipe insulators clean before installing the boots and cables.

*Refer to Section 6.3, Ignition System Maintenance, for additional spark plug maintenance procedures.*

## 3-Ignition Timing and Advance

**IMPORTANT** - Correct ignition timing is vital to the proper and efficient operation of the engine. Incorrect timing can result in engine overheating, with resultant reduced piston and valve life, and lowered fuel economy.

It is important that the ignition point gap or air gap (electronic ignition) is set correctly before checking and adjusting the timing.

Checking timing is counter-productive if the point gap is not set to specification. Timing is set using a timing light. The light flashes when the "points" open. If the points open at the wrong time, the timing marks are seen at the wrong time. And therefore, based on this, the timing is set incorrectly.

To insure accuracy, the points must be set using a dwell meter. Using a feeler gauge to set points can be very inaccurate due to variations in judgment of "feel" as well as other mechanical variations. *Use a dwell meter to set points.*

*Refer to Section 4.4, Ignition Timing Procedures.*

1. Using a dwell meter, check and adjust point gap or air gap (electronic ignition) first and then check ignition timing and advance.

*See Section 2.1, Service Specifications, for your engine.*

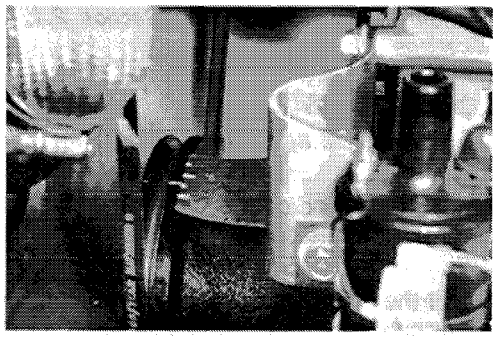
2. Adjust idle speed to 500 rpm.

3. Disconnect vacuum advance hose at distributor (as applicable) and plug or clamp the open end.

4. Install a timing light.

| CAUTION |
| --- |
| Engine Fan |
| Be careful of rotating fan blades when using a timing light. |

5. With engine running at 500 rpm idle speed and vacuum advance disconnected, aim the timing light at the crankshaft pulley and timing indicator.



6. Check the initial (basic) timing by alignment of timing notch on crank pulley with mark on timing indicator (4G54 engine shown). Adjust timing, as necessary.

*Refer to Section 4.4, Ignition Timing Procedures.*

*See also Section 2.1, Service Specifications.*

7. Check spark advance mechanism(s). Accelerate the engine speed slowly to determine if there is a steady and smooth spark advance. This will be indicated by the notch on crankshaft pulley, which will appear to move away from the initial timing point and, generally, upwards, as viewed in truck.

8. Run engine at steady 1600-1800 rpm. Temporarily connect the vacuum advance hose and check for correct advance. If there is no advance or if it is erratic, the distributor advance mechanisms must be inspected and repaired or replaced. Check for hose leaks, etc., or replace advance diaphragm.

*Refer to Part 6, Ignition System Maintenance procedures for your engine.*

9. Reconnect vacuum advance and set idle speed to specification.

## 4. Readjust Idle Speed

1. After replacement or adjustment of ignition components or other engine parts, recheck and adjust the carburetor idle speed to specification and adjust idle air-fuel ratio.

2. Adjust idle air-fuel ratio to obtain low carbon monoxide (use CO meter).

## 5. Compression Check

1. If the stall speed reading is not in the correct range or the engine runs erratically, perform an engine compression check. This will check the condition of the piston rings and engine valves.

*Refer to Section 4.6, Engine Cylinder Compression Test.*
*See Section 2.1, Service Specifications.*

## 6. Valve Clearance Settings

1. If the engine compression test indicates a valve problem, or valve train is noisy, check and adjust valve (tappet) clearances, as necessary.

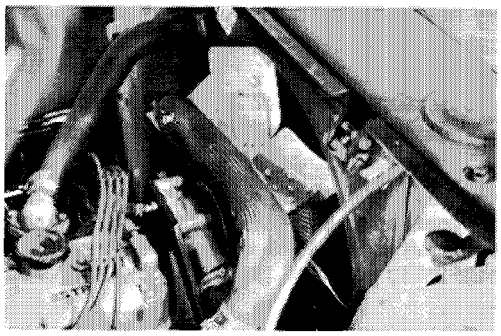
*Refer to Section 4.5, Valve Tappet Clearance Adjustment.*
*Valve Clearance Settings: See Section 2.1, Service Specifications*

## 7. Cooling System

*Refer to Section 4.8, Cooling System for additional information.*

1. If there is an indication of engine overheating, perform a complete check of the engine cooling system.

2. Inspect the radiator for damage and clogging from dirt contamination. Air clean the radiator, if it has not already been cleaned as part of the PM procedure.



3. Check to be sure that the fan blades are not loose or damaged and that the fan is installed correctly *(fan installed backwards is a common problem.)*

***NOTICE** - The fan is designed as a "pusher-type" fan, i.e., to push air through the radiator. The fan blades should be installed with their curve to push air into the radiator as they turn in the direction of right-hand engine rotation.*

**IMPORTANT** - Fan blades should engage 1/3 of the depth of the radiator shroud.

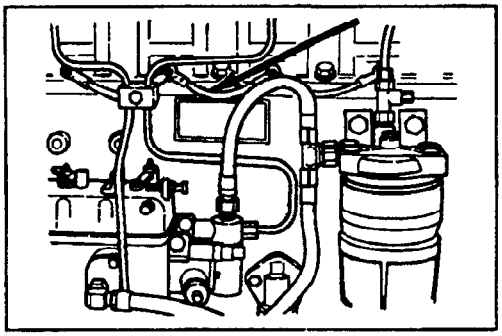
4. On optional models with viscous fan drive, check the fan drive (speed control) assembly.

5. Check the fan drive belt for proper tension and adjust, as necessary. If tension is low, the belt will slip. If belt tension is too high the bearings and seals in the water pump and alternator can be damaged.

6. Check the exhaust pipe to be sure that exhaust is not blowing into the radiator (except GS, LPS, DS construction with piccolo tube).

7. As a final step, if necessary:
   1) pressure test the cooling system.
   2) pressure test the radiator cap.
   3) check the thermostat.
   4) check the coolant for freeze protection level.
   5) check overflow reservoir and hoses.

## 8. TMD27 [2.9L] Diesel Engine



1. Check glow plugs and inspect glow plug wiring. Repair or replace, as needed.

2. Inspect fuel lines for leaks. Adjust fuel control linkage, and accelerator pedal linkage to allow for full travel of arm on fuel injection pump, as necessary.
Refer to Section 5.3, Diesel Fuel System for additional information.

## 9. Recheck Engine Performance

1. **Stall Test.** Run a stall test to check engine performance after tune-up.

*Remove the tachometer, vacuum gauge and timing light.*

# Tune-Up Completion

*When you have systematically completed these tune-up procedures you should have been successful in restoring the engine to its peak level of performance, or otherwise determined the need for additional maintenance or repair of the engine.*

1. Lower and latch the seat deck. *Be sure seat deck is correctly latched.* Install and close the side doors. Lower the drive wheels to the floor and remove any blocking, if used.

2. Test drive the truck.

3. Clean up any loose dirt and spills. Wipe off the truck.

# 4.4 Ignition Timing Procedures



***Engine Ignition Timing*** *procedures include:*

*1) checking the point gap (air gap on electronic ignition) and initial (basic) timing of the distributor to the engine,*

*2) adjusting the timing when timing is found to be incorrect, and*

*3) checking spark advance.*

*Normally Clark industrial engines with distributor-ignition are timed to have the distributor points open (or electronic breaker trigger) when the #1 cylinder is on compression stroke and the crankshaft (or crankshaft pulley) mark lines up with the pointer or timing indicator on the engine.*

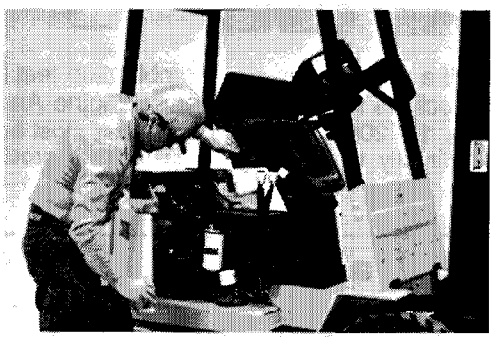
*The general timing procedures are the same for all G(P)X, GCS/GPS 17-30 engine models, whether equipped with contact breaker-point distributor or electronic ignition distributor. Both types of ignition utilize a typical distributor mounted and driven in the conventional manner. Individual differences in components and procedures are noted or shown where applicable.*

***Note*** *- The following pages describe general engine ignition timing procedures illustrated with typical views of the subject activity. Please check your engine model for specific component arrangement and corresponding service requirement.*

*Refer to Part 6, Ignition System maintenance for your engine model.*

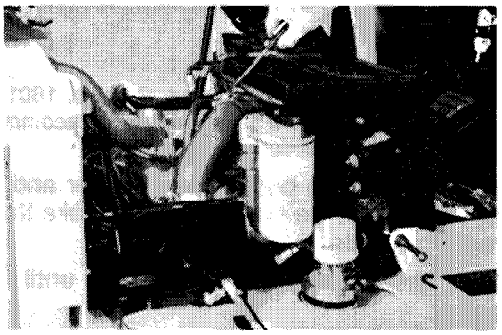
## General Procedures

| WARNING |
| --- |
| Engine Fan |
| Be careful of rotating fan blades when using a timing light. |



1. Open and remove either the right hand (4G54 & TM27 engine) or left hand side door (D176GA engine), and raise the seat deck. *Be sure the seat deck support is securely latched.*

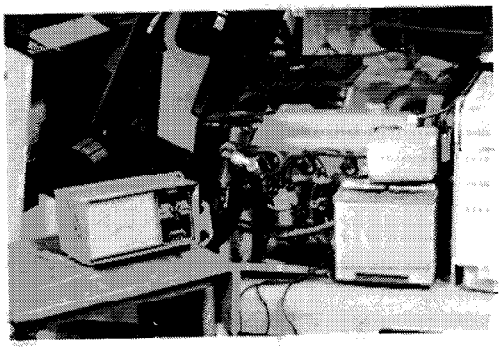
**NOTICE - 4G54 [2.6L] Engine Air Filter**



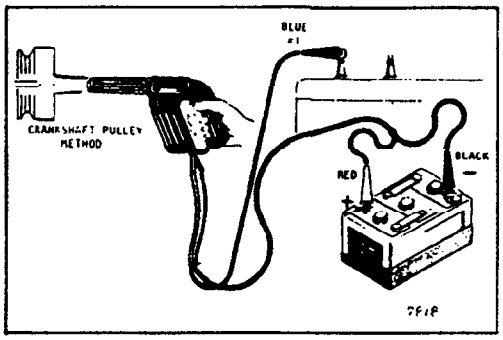
For best access to the distributor and timing indicator, it is recommended to remove the air filter housing from the truck. If you are unfamiliar with this procedure, please refer to Section 4.9, Air Filter.

*There are two methods of checking ignition timing: with or without a timing light. Timing without a light is an emergency method which is outlined at the end of this section. The preferred method is to use a timing light as described in the following procedures.*

## General Procedures (Cont'd)



2. Install a tachometer, or a combination test instrument, such as the Clark Dynamic Engine Analyzer, Part No. 1802047. **Note** - Tachometer must be connected directly to battery terminals (other ground not suitable).




3. Install a timing light.

**Note** - An ignition timing light, Clark Part No. 1801971, or equivalent, with inductive spark pickup is recommended. Install per manufacturer recommendations.

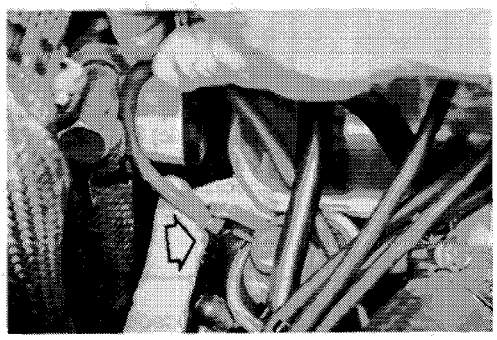
4. Clean the timing pointer or indicator and timing mark or notch on the crank pulley to make the mark more legible under the timing light.

5. Start the engine and warm it up until it runs smoothly.

6. Check and adjust ignition point gap or air gap (electronic ignition), as applicable, with a dwell meter.

**IMPORTANT** - To insure accuracy, always use a dwell meter to check and adjust point gap setting. See NOTICE at right.

*Refer to Part 6, Ignition System Maintenance for your engine model for ignition point or air gap settings.*



7. Disconnect vacuum hose from vacuum advance on distributor (as applicable). Plug or clamp the open end of vacuum hose to carburetor or manifold.

**Note** - D176GA [2.9L] engine does not have vacuum advance.

8. Lower the engine speed by adjusting the carburetor idle screw to obtain 500 rpm idle speed.

*Refer to Section 4.10, Engine Adjustments, for additional information on idle adjustment.*

9. Run engine at 500 rpm idle speed (unless otherwise noted), so the automatic advance of the distributor is not operating.

**Note** - It is standard practice to check engine initial (basic) timing with engine running at 500 rpm idle speed setting, so that the automatic advance of the distributor is completely retarded and not affecting timing. THIS IS VERY IMPORTANT TO OBTAIN CORRECT TIMING.

***NOTICE** - Correct ignition timing is vital to the proper and efficient operation of the engine. Incorrect timing can result in engine overheating, with resultant reduced piston and valve life, and lowered fuel economy.*

*It is important that the ignition point gap (or air gap on electronic ignition) is set correctly before checking and adjusting the timing.*

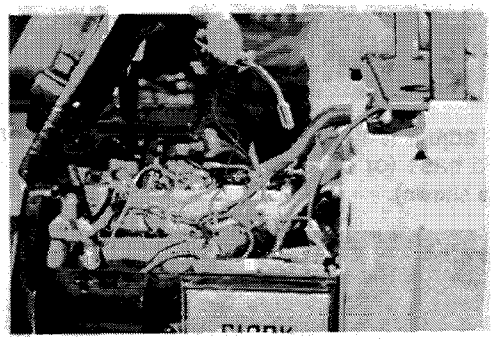
*Checking timing is counter-productive if the point gap is not set to specification. Timing is set using a timing light. The light flashes when the "points" open. If the points open at the wrong time, the timing marks are seen at the wrong time. And therefore, based on this, the timing is set incorrectly.*

*To insure accuracy, the points must be set using a dwell meter. Using a feeler gauge to set points can be inaccurate due to variations in judgment of "feel" as well as other mechanical variations. Always use a dwell meter to set points.*

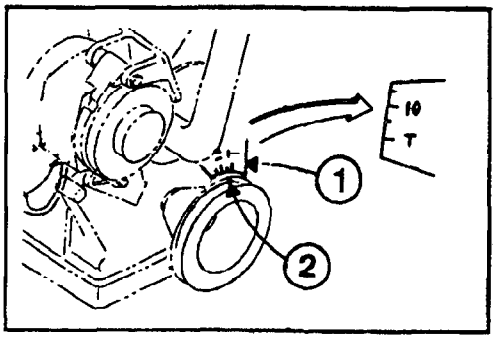
## Checking Ignition Timing

***IMPORTANT** - Distributors with vacuum advance. Before ignition timing can be checked or adjusted, disconnect vacuum advance line from distributor and plug or clamp the open end of line leading to the manifold to prevent loss of vacuum.*

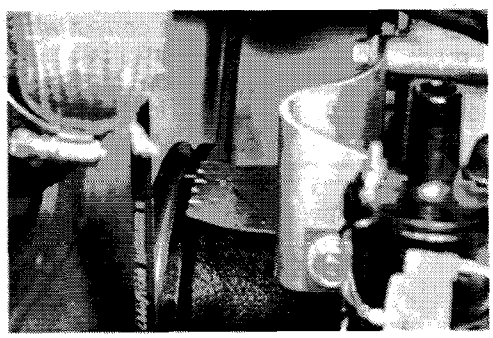
### 4G54 [2.6L] Engine



| CAUTION |
| --- |
| Engine Fan |
| Be sure to hold the timing light in a position to avoid being too close to the rotating fan blades. Be careful to stay away from the fan when leaning over to see the timing marks. |




1. The 4G54 engine timing indicator (1) is located near the crankshaft pulley (2) and may be seen from the right-hand side of the truck.

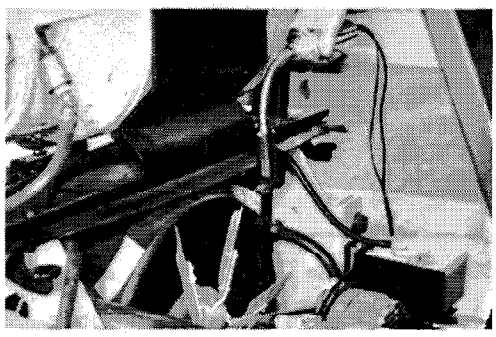


2. With engine running at the noted idle speed, aim the timing light at the crankshaft pulley and timing indicator. Note timing marks as light flashes. (4G54 [2.6L] engine shown.)

### TM27 [2.7L] Engine

1. The timing indicator is located near crankshaft pulley similar to the 4G54 [2.6L] engine and may be seen from right-hand side of truck.

### D176GA [2.9L] Engine

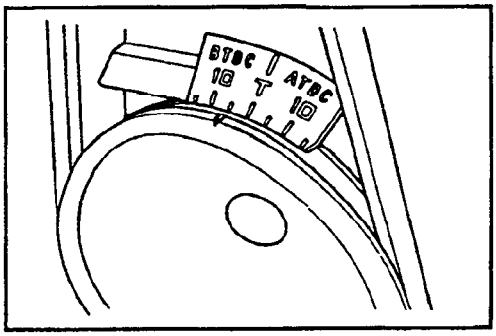


1. Stand at left side of truck and point timing light down in a vertical direction between the fan and alternator.

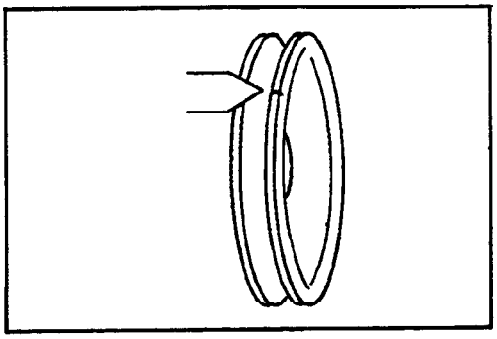
| CAUTION |
| --- |
| Engine Fan |
| Be sure to hold the timing light in a position above the top of the alternator (or radiator) to avoid being too close to the rotating fan blades. Be careful to stay away from the fan when leaning over to see the timing marks. |

## Initial (Basic) Ignition Timing

The initial (basic) ignition timing is correct when the timing mark (notch) on the crankshaft pulley is aligned with the correct position on the timing indicator (or pointer), at the noted idle speed.




4G54 [2.6L] Engine Timing Indicator



D176GA [2.9L] Engine Timing Indicator

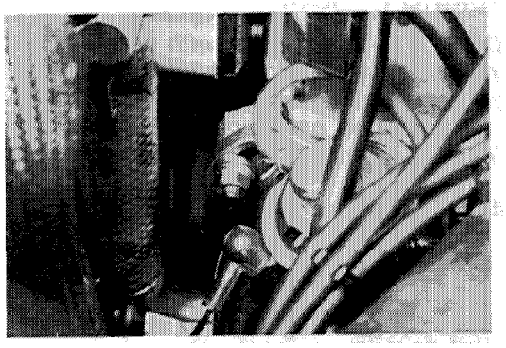
**Initial (Basic) Ignition Timing Chart**

| | | |
|---|---|---|
| 4G54 Engine | Gasoline<br>LPG | 6° BTDC @ 500 rpm<br>9° BTDC @ 500 rpm |
| TM27 Engine | Gasoline<br>LPG | 2° BTDC @ 500 rpm<br>5° BTDC @ 500 rpm |
| D176GA Engine | Gasoline & LPG | 5° BTDC @ 500 rpm |

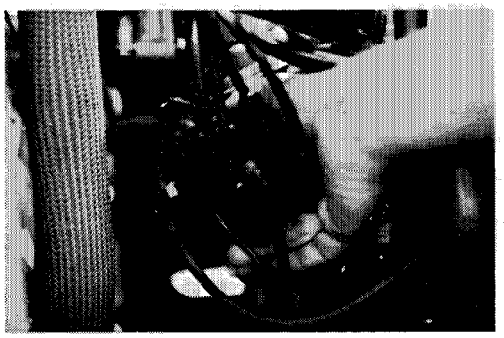
1. If ignition timing is not correct, adjust as necessary. See below.

## Ignition Timing Adjustment

1. Engine ignition timing is adjusted by slight movement (rotation) of the distributor body on the engine drive pad.



2. To adjust (set) the timing, loosen the nut on the slotted base (or clamp bolt) of the distributor (4G54 engine shown).



3. With engine running at correct idle speed, adjust the timing by carefully and slowly rotating the distributor in one direction or the other (see below) to retard or advance the timing.

**4G54 & D176GA Engines**

Turn distributor:
- clockwise to retard timing
- counterclockwise to advance timing

**TM27 Engine**

Turn distributor:
- clockwise = advance
- counterclockwise = retard timing

4. Turn distributor body until the timing mark and indicator are aligned correctly.

5. Tighten nut or clamp bolt at the base of distributor.

6. Recheck the timing to be sure that it did not change when distributor mounting bolt was tightened.