PROPERLY SET TIMING ON CLASSIC 65/66 MUSTANG!
STEP-BY-STEP DETAILED INSTRUCTIONS

With this Manual you will:

• Understand timing basics
• Prepare your car for a tune up
• Set the timing without a timing light or timing marks!
• Trouble shoot rough idle and timing problems
• Enjoy a better stronger engine

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What's inside this Manual

Timing is everything, and without a correct timing setting you will never see a smooth and stable idle or good acceleration.

Every classic Mustang owner wants his car to run "like new". Actually classic Mustangs did not necessarily run all that well when new! A smooth idle and seamless acceleration were not a given even on new Mustangs made in the 60s!

Modern cars utilize sophisticated computer controlled ignition and fuel injection systems which can make an anemic engine outperform reasonable expectations. The challenge is how to make 1960s technology work better so you can enjoy your classic Mustang not just when you are working on it but when you are actually driving it.

Inside you will find detailed instructions on how to set the timing on your classic 65 or 66 Mustang.

This manual will explain just what timing is and how it effects your engines power capabilities. We will review in detail what tools you need to accurately set the timing and how they are used.

In addition this manual will show you how to prepare your Mustang for a good timing setting and what pitfalls to avoid.

Finally his manual will provide you with detailed instructions on exactly how to set the timing on a classic Mustang and how to test and adjust your timing so that maximum power can be provided by your Mustang engine.

The information provided in this manual is specifically geared for use with classic Mustangs years 64 1/2 to 68 all engine sizes. However, since timing is such a universally accepted part of any gasoline engine the information here is generally applicable to any car using a carburetor.

Now we will get on with understand what timing is and how it impacts your car’s performance.

What is timing?

All classic Mustangs are equipped with four-cycle gasoline engines. The four cycles are intake, compression, power, and exhaust.

How does and engine produce power from these four cycles? Air and fuel must first be mixed into a vapor or mist before entering the combustion chamber above the piston. Liquid gasoline, as a rule, doesn’t burn. The vapor mixed with oxygen does!

When gasoline becomes vaporized (mixed with air), it can be ignited with an explosive force, which makes heat and pressure that can be used to move the engines’ pistons, the crankshaft, transmission, and ultimately the drive wheels.

Fuel becomes a vapor in two basic ways. Carburetors, common in Mustangs prior to 1968, mix fuel and air to create the vapor needed to support combustion.

Figure 1 shows what happens during the intake portion of the cycle. Vaporized fuel is drawn into the combustion chamber by the moving piston in the cylinder bore. An open intake valve provides the entry point. This is called intake stroke.

When the piston reaches the bottom of the bore, the intake valve closes, termi-
nating the entry of fuel and air.

When the piston begins its journey back to the top of the cylinder bore, it compresses the fuel and air against the top of the cylinder. This is called compression stroke. As the piston nears the top of the cylinder bore, the spark plug fires, igniting the fuel/air mixture.

The heat and pressure created during ignition exerts force on the piston, pushing it downward in the cylinder bore, applying pressure on the connecting rod and crankshaft. We call this the power stroke. This linear force turns the crankshaft, becoming rotary motion.

As the piston nears the bottom of the cylinder in the power stroke, the exhaust valve opens. The piston begins its journey back to the top of the bore, forcing exhaust gasses out through the open exhaust valve. This is called the exhaust stroke. Our engine’s four power cycles are complete.

We have now introduced you to the workings of a single cylinder. If Mustangs had only one cylinder, there wouldn’t be enough power to get the job done. Since 1964, Mustangs have been available with either six or eight cylinders. From 1964-’73, Mustangs came standard with six cylinder engines—with six cylinders positioned in a row along a long crankshaft.

Eight-cylinder engines have always been optional, with eight cylinders in a “V” configuration on two banks of four cylinders each.

Timing refers to the adjusting the moment of firing of the spark plug during the compression stroke.

The stroke is further divided into degrees 360 to be exact. The exact moment of spark plug firing before the cylinder has reached the top of the cylinder known as BTDC or Before Top Dead Center is measured in degrees.

The spark plug must fire ( firing means a high voltage electric arc is created by the ignition system causing a spark at the end of the plug ) before the piston reaches the top of the cylinder or considerable power loss will occur.

Therefore when we say the timing is set to 10 deg. BTDC we are expressing how far before the piston reaches the top of its travel we want the spark to fire.
Tools and Techniques

Typically timing is set with a timing light. A timing light is simply a strobe light which is triggered by a spark discharge on the number 1 plug. The light produced by the timing light can illuminate marks on crankshaft pulley or harmonic balancer. Since the timing light will “strobe” just at the instant the timing marks are inline with a pointer affixed to the engine block the actual point of firing the #1 spark-plug can be measured. The marks on the engine block allow direct reading of the degrees BTDC that the firing occurs. The figures below show how these marks appear when “strobed”.

This technique is useful on newer cars but using it with a 30 or 40 year car may produce dubious results.

This is because the crankshaft pulley may have been replaced or moved. The pointers may have been broken or removed. A replaced distributor may have been assembled such that the marks have no meaning now.

We will use a technique for setting the timing which does not require the use of a timing light or timing marks.

Our primary tools will be a vacuum gauge and a tachometer.

The tachometer like the one pictured in Figure 4 is connected to the battery terminals and to the coil as described later on in this manual.

Figure 4 also shows a typical vacuum gauge. A vacuum gauge and tachometer are indispensable tools that you will use extensively in tuning and maintaining your classic Mustang.

A bit about what we mean by vacuum in an engine is needed here. The piston traveling down in the cylinder...
der through the intake stroke draws air through the carburetor and then the manifold at high velocity. As the air passes through the bore of the carburetor, it goes through a section that is slightly narrower (the venturi) than the rest of the carburetor bore.

At this point there is a pressure drop or partial vacuum, which increases according to how fast the air is rushing through.

When the engine is idling, the throttle plate is nearly closed there is not really enough air flowing through the carburetor bore venturi to create a vacuum. However, on the bottom side of the throttle plate there is a lot of vacuum (because the throttle plate is restricting the airflow) any place where the air pressure is suddenly increased by a constriction such as a partially closed throttle plate will be a place of low pressure.

The degree of vacuum or air pressure under atmospheric is a reflection of how fast the pistons are moving down the cylinders as well as the general health of many engine components. At idle when timing is set at its optimum point the vacuum will be at a maximum.

We will also use a tachometer to measure engine RPM (revolutions per minute). The tachometer essentially “counts” spark discharges so that we can infer the rate that the engine is rotating. We will generally adjust engine timing at idle for the maximum vacuum reading and engine RPM. More details on how to do this in the following sections.

The only other tools we will need are a 1/2 inch box open ended wrench and a flat blade screwdriver. We will use these tools to adjust the timing and the carburetor idle set screw.
Preparing your Mustang

It is critical to properly prepare your Mustang before attempting to set an optimum idle.

**Smooth Idle and Easy Starting**

While looking at timing you will often find that a rough idle can be caused by a poorly performing carburetor. Any carburetor work should be completed before timing is finally set.

With our test car we discovered that previous owners had replaced the original Autolite carburetor with a rebuilt Holley. We found a good condition Autolite 2100 and rebuilt it to original factory specifications.

This smoothed the idle and resulted in better overall performance. If you don’t feel comfortable rebuilding your own carburetor check out www.ponycarburetors.com. They do an excellent job and can rebuild your carb or sell you a completely new carburetor.

In addition we installed an electronic ignition from Pertronix. This is a well designed product that replaces your existing points with an electronics module right in your distributor cap.

We installed the Ignitor II in one of our test cars. Compared to a point type system the Pertronix Ignitor II develops an average of 4 times more available energy between 3000 and 4000 RPM and 2 times more available plug voltage according to Pertronix.

In our installation the addition of the Ignitor II module made a very noticeable difference in idle smoothness by reducing missing and smoothing the idle. Visit www.pertronix.com for more detailed information.
Preparing your Mustang: Continued

We also installed a “Flamethrower” high voltage coil from Pertronix.

We painted the coil top yellow to match the original Ford coil. These modifications still maintain the original stock look with modern performance.

We decided to really modernize the ignition system and added a multi-spark ignition system from MSD.

This is a add-on box that creates multiple sparks each combustion cycle instead of the single spark normally available. We installed the MSD6A unit which you can see described at www.msdignition.com.

We noticed immediately better starting performance with our test car. Multiple sparks ensure that even with cold cylinders the fuel will be ignited in a more reliable and powerful fashion.

We installed the MSD unit under the battery stand and painted it the same color black as the rest of the engine compartment. Our engine compartment looks completely stock but the engine runs stronger and smoother.

This manual assumes that your engine is running but that you desire to pinpoint the best timing point to get the most out of your engine and to ensure a smooth and reliable driving experience. However, if for any reason you have had to remove the distributor and the engine has been cranked by hand or for some reason feel that the timing is completely wrong you can use the following technique to set a 0 deg. BTDC timing. From this point you can adjust the timing for more engine power using the techniques described later on.

If your engine is running fairly well you need not follow the Finding TDC procedure below.

Finding TDC

Our objective here it to find out when the #1 piston is at the very top of its travel in its cylinder. At that point we can remove the distributor cap and rotate the distributor so that the contact for the #1 cylinder are in line with the distributor rotor.

First remove the battery to ensure that the engine does not start during this procedure.

Now remove the #1 spark plug. A raised 1 will be evident on the intake manifold indicating the #1 cylinder. In fact all of the cylinders are marked this way.

Place your finger over the open spark plug hole while some one rotates the crankshaft by placing a wrench on the crankshaft center nut. This is easier than it sounds as even the 289 V8 engine can be cranked by hand. If you find this too difficult you may have to remove all of the spark plugs to reduce compression forces.

As the engine is cranked you will feel pressure pushing your finger from the sparkplug hole. At the point when this pressure is at its highest the cylinder is close to its top travel.

Now stop rotating the crank and remove the distributor cap and loosen the distributor hold down bolt. Rotate...
Before you start your engine make sure that all leads and vacuum lines are clear of all pulleys and the fan blade.

Our first task will be to connect the vacuum to a source of manifold vacuum. This is NOT the distributor vacuum advance line.

A good source of vacuum is the carburetor mounting spacer. At the rear of this spacer respective to the front of the car will be a port which on many cars will be attached via a hose to the PVC valve. It was convenient to pull the PCV valve from the valve cover and insert our vacuum gauge as shown in Figure 11.

On cars with no positive crankcase ventilation valve the manifold vacuum port is usually still present but will be capped. Remove this cap and insert your vacuum gauge probe.

Figure 13 shows how we attached the vacuum gauge on our test car.

It is important to disconnect the distributor vacuum advance line and plug it. Some classic Mustangs have a rubber hose line as shown in Figure 12. Others have a steel line. In either case disconnect these lines at the vacuum advance port at the distributor and plug the line so that there will be no vacuum loss.

We will have more information on how to interpret vacuum readings later on in this manual. Now we will attach the tachometer.

Most tachometers are connected to the battery terminals as a power source. A
Tuning: Attaching Vacuum and Tachometer Gauges

sense line is connected to the + terminal of the coil as shown in Figure 14 below.

You can now start the car but make sure that all vacuum lines and tachometer leads are clear of the belts and fan blade before cranking the engine.

Let the engine run for approximately 20 minutes or until thoroughly warm. Ensure that the fast idle is off and that the choke is fully open.

The engine idle speed as indicated by the tachometer should be in the normal slow idle range 500 to 800 RPM. However, the slow idle setting for your Mustang may vary. You will need to find this setting though trial and error. If your car stalls during idle while backing or during stopping you will need to increase the idle.

If you see erratic or low vacuum you have some engine problem that needs to be corrected. The basic diagnosis possibilities are as follows:

- A steady needle normal reading (usually 17-22" Hg. in stock engines) indicates a sound engine.
- Intermittent fluctuation at idle can indicate an ignition miss, or sticking valves.
- A low, though steady reading may indicate late timing, low compression, sticking throttle valve, carb. or manifold vacuum leak.
- A drifting needle may be caused by improper carb. setting or a minor vacuum leak.
- A fluctuating needle as RPM increases could be ignition

miss, a blown head gasket, leaking valve or weak or broken valve spring(s).

- If the reading is steady, but the needle drops regularly a burnt valve or incorrect valve setting (too tight) may be indicated as the needle will fall when a bad valve operates.
- A gradual drop at Idle is often a clogged exhaust, excessive backpressure which in extreme cases causes the engine to die at idle.

Figure 12 Vacuum advance line plugged.

Figure 13 Vacuum gauge attachment.
Setting the initial timing:

If you need to reset the idle mixture on your carburetor now will be a good time to do this as you have the vacuum gauge attached. We won’t go into detail on this process in this manual.

With the engine off now mark the current position of the distributor just in case you need to get back to where you started and loosen the distributor hold down bolt as shown in Figure 14. Do not remove this bolt simply loosen it enough so that the distributor moves without too much force. The entire distributor assembly should rotate clockwise and counterclockwise.

Now restart the engine and again ensure that the engine is well warmed and running on slow idle. Slowly rotate the distributor counter-clockwise. This will retard the timing. If the engine RPM decreases reverse the direction of rotation and rotate the distributor clockwise. Adjust the distributor for maximum RPM and vacuum readings. You may have to reduce the engine idle speed by adjusting the carburetor idle set screw if idle climbs above about 1000 RPM.

You will want to advance the ignition as much as possible while avoiding engine ping or knock. This is technically known as “pre-detonation” which can be very harmful to an engine.

Detonation happens when the timing is so far advanced that the gasoline air mixture ignites with full force before the piston is near the top of its cylinder. A significant loss of power happens and damage to the piston and valve can occur. Detonation is easy to detect because it is accompanied by an unusual engine sound especially when accelerating up a steep incline.

Now that you have adjusted the distributor for maximum vacuum and RPM stop the engine and retighten the distributor hold down bolt. Reconnect the vacuum advance line to the distributor and remove the vacuum gauge and tachometer instrumentation.

“It is important now to test drive your car and listen carefully for any detonation or “pinging”...”

Never allow your engine to run with a knock or pinging. This can cause serious engine damage.
drive your car and listen carefully for any detonation or “pinging”. A high octane fuel can be used to avoid detonation with more initial advance.

If you do detect detonation you should safely stop the car and turn the distributor slightly (1/4") counterclockwise. Retest this new setting after re-tightening the distributor hold down bolt and again check for any pinging. Do this until you are convinced that there is no chance of detonation under all driving conditions.

Finalizing the timing will be a trial and error process at this point. Normally if the car pings during your test drive a single re-set of reduced advance (counter clockwise 1/4 inch) is all that is required. Be sure and retest the car after every adjustment.

Trouble shooting:
Vacuum leaks are quite common in classic cars. If your engine has a vacuum leak you will never be able to set the timing properly.

If you suspect a vacuum leak try the following.
With the engine running spray carburetor cleaner around the base of the carburetor. If engine idle or vacuum improves or changes you may have a leak where the carburetor mounts to the carb spacer and manifold.

Check the PVC hose for a crack or dislocation. You will be amazed at how poorly your engine will run with the PVC hose disconnected.

You can continue to spray carburetor cleaner at suspected vacuum leak locations. A vacuum leak will suck in the carburetor cleaner and immediately effect the engine idle.

All of the Mustang Project test cars utilize the highest octane fuel available. It is more expensive but avoiding detonation is critical so we don’t take any chances with our classic cars!

With higher octane fuel you can tune the timing for more advance and more likely more power.

“Finalizing the timing will be a trial and error process at this point....”
This section on advance timing tell you how centrifugal and vacuum advance work in your classic Mustang.

“There are actually three types of timing. Initial, centrifugal, and vacuum...”

There are actually three type of timing. Initial, centrifugal, and vacuum. We are going to discuss how to set initial timing since unless you are creating a race engine you will not usually need to modify centrifugal or advance timing.

**Initial Timing:**
This is the timing we described how to set in this manual. This is the common adjustment that people associate with timing.

At idle, with the vacuum advance hose disconnected and plugged, this is the timing that you would see if you were able to observe timing marks using a timing light.

Again we will not use a timing light as we cannot trust the marks in a classic car even if they still exist! On typical stock engines initial timing might be set between 0 to as high as 15 degrees BTDC. The Ford Mustang shop manual specify 6-8 degrees initial timing advance for the 289 motors.

**Centrifugal Timing:**
Most V8 distributors contain an internal advance mechanism consisting of two each of weights, springs, and slotted 'reductor' arms. There is also a stop tab for the arms.

On Fords this assembly can only be seen by removing the cap, rotor, and breaker plate. As the distributor shaft spins with increasing RPM, the centrifugal force acts on the weights, which begin to force outwards against the springs. This movement rotates the shaft and thus advances the timing.

The slotted arm controls how much the weights can move the assembly, and the springs control how fast the assembly reaches that limit.

The reluctor arm on a Ford has two slotted sides, only one side contributes to the timing. On Fords each side is stamped with a number, usually 10L and 13L; or some have 15L and 18L. These numbers refer to 1/2 of the total degrees of timing that will be obtained when using that arm. So for example a 15L arm would contribute $15 \times 2 = 30$ degrees of timing when full against the stop.

**Vacuum Timing:**
Most Mustang distributors include a vacuum advance mechanism. This consists of a diaphragm vacuum canis-
Tuning: Understand Advanced Timing

ter, an arm from the canister to the breaker plate, and a hose or steel tube connected to an engine vacuum source. The purpose of this mechanism is to provide spark advance when the engine is not spinning fast enough to create the centrifugal advance.

Vacuum advance is an engine-load dependent advance. This would be a typical situation when climbing a steep hill, or driving at low RPMs, light throttle, conditions.

In these conditions there is high engine vacuum, so the vacuum signal applied to the diaphragm in the canister, via the hose, will cause a 'pull' effect on the arm, which moves the breaker plate and results in a timing advance.

During full throttle conditions there is very little engine vacuum, and thus the vacuum advance does not contribute to total advance.

Vacuum advance is tricky to tune because there is no direct measurement to verify. In fact, the reason you must measure initial timing with the vacuum hose disconnected is because when the engine is in neutral there no load, thus the vacuum is high, and if the hose were connected you’d see as high as 60 degrees advance and think something is really wrong! The only way to tune vacuum advance is on the road, by feel, and AFTER the initial advance is adjusted.

Vacuum advance was developed to optimize fuel economy and reduce emissions. In most street driven applications you will not need to adjust the vacuum advance. However, you can adjust the advance created by vacuum by using an allen wrench as shown in Figure 16.

By removing the vacuum advance hose and rotating the adjusting nut inside of the canister you can change the rate of vacuum advance. This changes the tension on the spring inside of the vacuum advance canister delaying or advance the onset of vacuum advance.

Again unless you are making optimizing for racing you normally need not make this modification.

“Vacuum advance was developed to optimize fuel economy and reduce emissions...”
The Mustang Project how-to manuals are designed to save you hours of work and enable you to create a more reliable and professional installation.

Mustang Project manuals are different. They are specific and detailed. The manuals all describe one specific project and in greater detail than ever before provided. You know that when you invest in a Mustang Project manual it will save you hours of work and give you a better result.

We hope that you have found this manual useful please leave us your feedback via E-mail or phone!

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- Front disk Brake Upgrade for Your 64 1/2 65 or 66 Mustang!
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- Detailing the Underside of your Car.
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