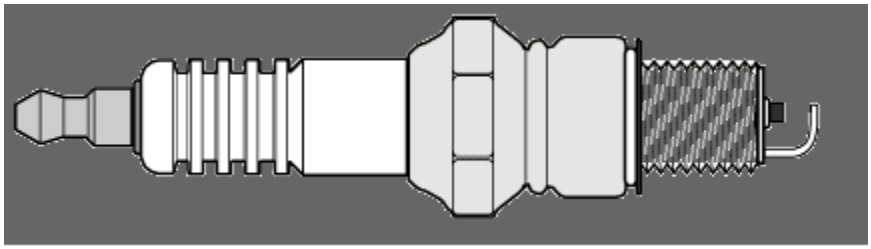
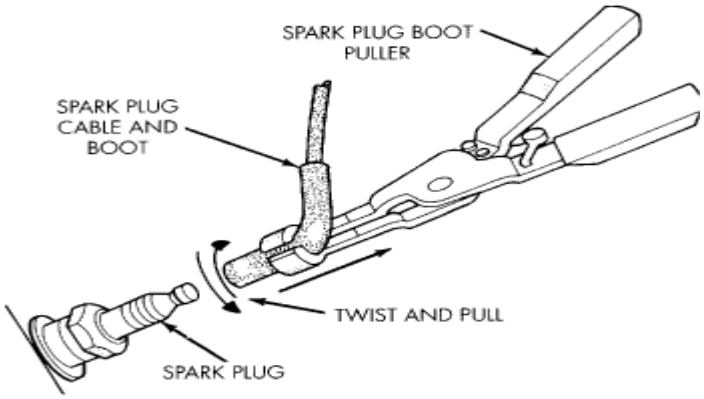
Spark Plugs Removal & Replacement



Removing spark plugs is best done on a cold engine however when performing a compression test, or a cylinder leakage test the engine must be at operating temperature. Removing sparkplugs may require you to work close to the exhaust manifold that can quickly and severely burn your hands or arms. If you are working near a hot exhaust manifold I recommend wearing a quality pair of mechanics gloves made of a heat resistant material. Most commonly this is leather however Kevlar gloves may provide superior protection. Some gloves have extra-long cuffs designed to protect your fore arms from burning on a manifold. Exhaust manifolds on a running engine are about 300 degrees and can easily get up to 500 degrees under a load. Without proper hand and arm protection you can quickly get a very bad burn just by accidentally touching the exhaust manifold.

Many technicians wear disposable nitrile gloves when working on vehicles. I personally recommend this practice as used motor oil is a known carcinogen. Some technicians will become hyper sensitive to motor oil and develop skin rashes when working around motor oil and grease. A good work practice is to wear nitrile gloves, or mechanics gloves and also to wash hands often if they become oily or greasy. It is also a good practice to change clothing if gas or oil is spilled on them. Be sure to remove disposable (nitrile) gloves before working around a hot engine as they can easily melt and make a burn much worse.

Before removing any spark plugs take compressed air and blow out all the dust and junk that may collect around the outside of the spark plug. **Of course you will always wear safety glasses!** Some spark plugs point straight down into the engine and this is an excellent catch basin for dirty and abrasive junk that can damage the inside of the combustion chamber. If you notice extra oil collecting around the spark plug recommend new valve cover gaskets and oil seals as this will deteriorate spark plug wires and will lead to an engine misfire.



Use care when removing the spark plug wires. The end of the wire can easily pull off. Do not pull on the wire. Grab onto the spark plug boot or get under the boot to pop it off. There are special pliers and tools designed to help remove spark plug wires. Twisting the boot may help break it loose from the ceramic spark plug shell. If the plug wire becomes damaged, you should replace the entire plug wire and I recommend replacing all spark plug wires. Spark plug wires wear out over time and there is no way to reliably repair them. Also when installing any spark plug wire it is a good practice to place di-electric silicon grease between the spark plug and the spark plug boot. This will make it much easier to remove the plug wire in the future. It will also help seal out moisture that can cause corrosion and high resistance at the plug to wire connection.

All gasoline engines have a very specific firing order. If you get the wrong plug wire back on the spark plug you will have a misfiring engine. Be very careful to not mix up the firing order when removing spark plugs and spark plug wires.

When replacing spark plugs be sure to use a spark plug socket. A good spark plug socket will have a rubber or foam insert that will protect the ceramic shell of the spark plug. If the ceramic (glass) shell gets cracked the spark plug will misfire. A minor crack may not misfire until the engine is under a load (acceleration) and not be obvious until the vehicle is driven away from the shop.

Upon occasion a spark plug will become really stuck in the cylinder head. It is a bad idea to use too much torque or twisting force when trying to remove a stuck spark plug as this can easily damage the aluminum threads in the cylinder head. If a spark plug is forced out it can easily remove the threads from the cylinder head. This can require major engine work to repair! If a spark plug is stuck in the head try these steps.

#1 spray a good quality penetrant all around the spark plug. Heat riser solvent is often a good choice for this. PB Blaster also works well. The penetrant requires time to soak in so do this first.

#2 After applying penetrant, tap on the spark plug socket with a hammer. This vibration can help the penetrant soak into the threads. #3 Allow the penetrant time to soak in and allow the engine to cool down completely if it is warm. This can take hours so go do something else to give the penetrant time to work. #4 Try tightening the plug. This is a good practice for any stuck bolt or fastener after applying penetrant. Tightening can sometimes break the corrosion loose. Again, do not use too much force! #5 Work the threads back and forth to help the penetrant work into all threads. #6 If the plug does not begin to easily unscrew, DO NOT FORCE IT OUT. This is when the major damage to the cylinder head will occur. At this point you should contact the shop foreman and/or customer to alert them to this potentially expensive situation. You did not cause the spark plug to become stuck so be sure you do not cause the engine to become damaged!

Removing and installing any spark plug requires care. If the spark plug is not in perfect shape it is foolish to put it back into the engine. The cost of labor is much more than the cost of a new spark plug and all spark plugs wear out over time. Be sure any new spark plug is the correct one for that specific engine. There are many different heat ranges and types of spark plugs. Using the wrong spark plug can lead to early failure and may even damage the engine.

Be sure you look up and adjust each spark plug to the specified plug gap. Use a round feeler gauge. Spark plugs come pre-gapped but they are set for the most popular specification and your engine may have a different requirement. Also the gap can easily change during shipping and handling. Many spark plugs are easy to damage if any force is placed on the center electrode when adjusting the plug gap. Please watch this short video to learn about adjusting a spark plug gap. http://www.youtube.com/watch?v=lk70oyUEftY Careless plug gapping can lead to misfire and poor performance. Be very careful to only bend the ground electrode and not apply any force to the center electrode.

Carefully inspect the spark plug. Look for any cracks in the ceramic (glass) insulator. Spark plugs are very fragile and a spark plug that has been dropped, even while still in the box, can easily get cracked. Remember a cracked insulator may not misfire until the engine is placed under load. This means it might run fine when you back it out of the shop and then misfire when the customer is driving home.

Some technicians do not use a torque wrench when installing spark plugs and in some engine locations it is not possible to use a torque wrench. Many spark plug sockets have a swivel adapter and if there is any angle on that swivel the torque wrench will not be accurate. For these reasons most spark plugs are either over, or under torqued.

A spark plug that is too loose will not have good heat transfer and may allow the plug to overheat. This can cause pre-ignition or "spark knock". Loose plugs can allow compression to leak past the threads and over time this will damage the threads. An under-torqued spark plug can also work loose and fall out of the engine. (This will not happen right away so the customer will be the one finding that loose spark plug).

A spark plug that is over-torqued will stretch the threads and cause them to break during install, or during removal the next time. Stretched threads are also more likely to seize over time and be difficult or impossible to remove without damage to the cylinder head. Sometimes you can crack the insulation on a spark plug if you over-tighten it. This will lead to a misfire under load.

Some technicians will tell you to always use anti-seize on the threads of spark plug but many manufacturers tell you not to do this. Many problems occur when using too much anti-seize on the threads. The anti-seize can squeeze out onto the electrode and cause it to misfire and it can squeeze out on the sealing surface and change the heat range.

Because of these issues most manufacturers recommend against using anti-seize. This article explains how looking at the spark plug can tell you if a new spark plugs does not need anti-seize http://www.ngksparkplugs.com/pdf/TB-0630111antisieze.pdf. In this article they state "Metal shell plating acts as a "lubricant" which breaks away from the main body of the spark plug during removal, preventing damage to the spark plug and or threads in the cylinder head." What this does not state is that when you re-install that spark plug you will no longer have that anti-seize protection.

In my opinion it is a good idea to use a VERY SMALL AMOUNT of the proper anti-sieze when installing spark plugs. Using too much can cause the spark plug to misfire if any anti-seize gets on the electrode. Also it can interfere with the heat transfer if it gets onto the spark plug seat. If you use too much anti-seize it will squeeze out of the threads when you tighten it and get on both the electrodes and the spark plug seat! I recommend a graphite based anti-seize. Champion 2612 is a graphite anti-seize specifically for spark plugs, and Loctite recommends using graphite-50 anti-seize for spark plugs.

Another danger in using anti-seize is that it will lubricate the threads and change the torque specification. If you use anti-seize: #1 use just a little bit. #2 make sure it is only on the threads, not the electrodes, or the spark plug seat #3 reduce the torque wrench setting by 15 - 20%.

Spark plugs should easily screw in until they reach the end of their threads. You should be able to screw them in using a piece of vacuum or fuel line, or just the spark plug socket and extension. If they are difficult to screw in the threads need to be cleaned and the torque will not be accurate until this is done. Tighten them as far as possible by hand and then use a torque wrench to bring them to the proper torque. Remember to reduce the specified torque value by 15 - 20% if using anti-seize on the spark plug threads.

If you must use an extension that places the torque wrench at any angle other than 90 degrees to the spark plug the torque wrench will no longer be accurate. If you cannot use a torque wrench then you can use a torque angle procedure to approximate the correct torque. The torque angle to use depends upon the style of the spark plug seal.

There are two types of spark plug seals, one uses a compressible metal gasket or washer with a flat seat, the other uses a tapered seat with no gasket. For a tapered seat (no gasket) turn the plug 1/8 of a turn past contact with the seat. The plug will get much tighter as you do this. Experience will help you know if you have gone too far.

For spark plugs with a compressible gasket how far you turn the plug after it gets to the seat is different for new and previously installed spark plugs. If the gasket has never been used, it will compress and gradually increase the torque value. For a new gasket tighten the spark plug about ½ to ¼ turn after it first begins to compress the gasket. You will feel the torque drastically increase as you turn the plug past the point of full gasket compression. If the spark plug has been previously installed the gasket will have already been compressed and you will need less turning to get to the proper torque. When installing a plug with a previously compressed gasket tighten about 1/8 turn past the seat. Again experience is required to know when a plug is too loose, or too tight. I strongly encourage you to practice with a torque wrench and without a torque wrench to develop the proper feel for how tight is correct when installing spark plugs.

Before you replace the wire onto the spark plug, remember to use some di-electric silicon grease in the spark plug boot. This will help seal the connection from moisture and make it easier for the next technician to remove the spark plug wire.

An excellent video on spark plug replacement is at
http://www.youtube.com/watch?v=LtQ0LV7u1OE&feature=related