



Improving Engine Performance:

A CONCISE GUIDE TO ENGINE INSULATION

INTRODUCTION

Why would anybody want to insulate an engine? How can insulation help my engine? These are common questions that arise when discussing engine insulation. So, what is engine insulation? It's the application of materials that slow down heat transfer to an engine. The purpose of this white paper is to help explain why engine insulation is useful to engine owner/operators. Engine insulation is a relatively recent development in the world of engine optimization and maintenance.

WHAT CAN ENGINE INSULATION DO FOR ME?

There are a few major benefits of engine insulation:

- ▶ **INCREASED HORSEPOWER**
- ▶ **IMPROVED SAFETY**
- ▶ **LONGER ENGINE LIFE**

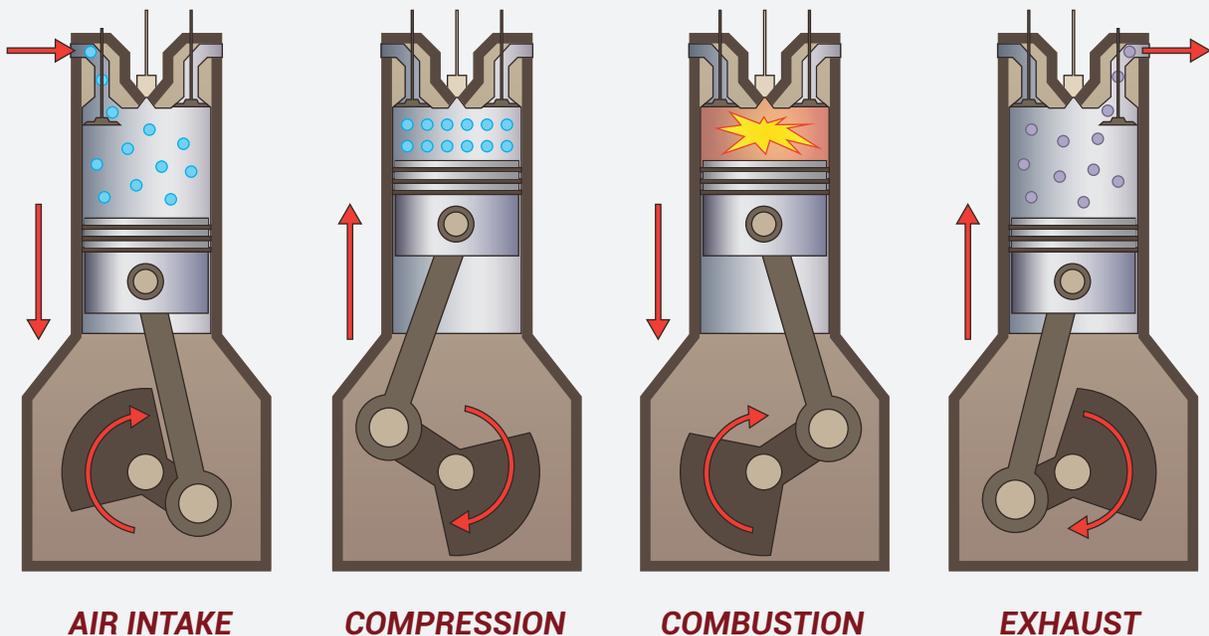
The best way to understand engine insulation is to start by learning how engines work. Most engines run on fossil fuels; this means they take stored chemical energy from a fuel such as diesel and convert it into usable mechanical energy. But how do they take the stored chemical energy from a fuel such as gasoline and convert it into mechanical energy used to propel a large ship or heavy-duty truck? Let's take a look at how engines work.

HOW ENGINES WORK

The process consists of four basic steps:

- ▶ **AIR INTAKE**
- ▶ **COMPRESSION**
- ▶ **COMBUSTION**
- ▶ **EXHAUST**

The air intake phase is when the engine draws in cool air from outside of the engine; this air is then funneled toward the combustion chamber. When the cool air gets inside of the combustion chamber it is mixed with fuel, and then compressed by lowering the piston. After the piston has compressed the air, a spark plug fires and sets off a controlled explosion inside of the chamber. This explosion drives the piston back upward, and the force of that rising piston is then transferred to the vehicle's drive train for propulsion. Finally, the spent air and gas mixture is ejected from the combustion chamber in the form of exhaust. The complete engine cycle process is then repeated thousands of times per minute. Of these four parts of the process, HTI is focused on the exhaust system. However, a working knowledge of the complete engine cycle is helpful. Now that we understand the process, we can think about ways to improve it.



HOW DOES INSULATION IMPROVE ENGINE PERFORMANCE?

A great place to start is at the beginning, so we'll start with the air intake. It's important to remember that the primary force behind the engine's power lies in the difference between the volume of the cool air that goes into the engine and the warm air that results from the combustion. This is because cool air has a greater density than warm air; or to put it another way, cool air takes up less space than warm air and heating the cool air will cause it to expand. This means that the greater the difference between the temperatures going into the vehicle and the air after combustion, the greater the power generated by the engine. The problem is that the air outside of the engine can warm up on its way to the combustion chamber.

For obvious reasons the area around the engine is very hot, and the air will begin to warm on its way to the combustion chamber. It is a good idea to keep the air on its way to the combustion chamber as cool as possible. This is where insulation can be extremely helpful as it helps keep the cool air from picking up heat from the surrounding hot engine parts. For this reason we insulate the intake. We call the difference between the air before and after combustion the volumetric efficiency of the engine.

The greater the temperature difference between the air coming in and the air after combustion, the more horsepower is generated.

The next step in combustion is the combustion chamber. At this point the air has already arrived in the engine and is ready to be expanded. Heat is helpful here: A hot engine will heat the air better and will increase the power it creates. For this reason we want the combustion chamber to retain as much heat as possible. Once again insulation can help us; by insulating the engine itself we can seal in the heat that is created when combustion occurs. This means that more of the chemical energy from the gasoline combusting is retained by the engine and put to work.

The final step is the exhaust. This is where the spent fuel and air mixture from the engine is removed from the vehicle. While it may seem inconsequential, it is still important that the engine push hot air from the combustion chamber as quickly as possible. There are a couple of reasons for this: first, if the exhaust stays in the combustion chamber it will be included in the next combustion cycle and will reduce its efficiency. We want to have as much clean air enter the chamber as possible. In order to do this, we need to give the clean air room inside the combustion chamber. This means that

the faster the exhaust can be pushed from the engine the better the engine will operate. Just like in the combustion chamber, warm air is the way to go here. Warm air is less dense than cold air, which means that it creates less air resistance as it flows through the exhaust system. By keeping this area hot we can keep the air flowing at a faster rate. Once again, insulation here can be extremely helpful. This way the exhaust system can hold onto the heat that is being passed through it and keep the air hot as it leaves the engine. All of this means a more efficient exhaust system. This is the part of the engine where HTI focuses its efforts. By improving the exhaust system the overall engine efficiency can be greatly improved.

ENGINE LIFE

Improved horsepower isn't the only thing to consider when thinking about engine insulation. Another important thing to consider is how it affects the life of your engine. Like we said earlier, the pistons in your engine go up and down thousands of times per minute. Your engine is constantly repeating its cycle over and over with parts that are manufactured with extreme precision. All of this heating and cooling results in an engine that has many interlocking parts heating and cooling at different rates. Over time these parts can shift their alignment in a way that will begin to wear on the engine. By insulating your engine you can slow down this process as your engine will now have a much more consistent operating temperature. This can help extend the life of your engine and reduce the amount of time and money that is spent on repairs.

Insulation can keep your engine running more consistently, which also means reliably.

SAFETY

A final consideration regarding engine insulation is safety. Human skin suffers first-degree burns at temperatures above 140° F; an uninsulated engine can reach temperatures that exceed 1,100° F. That is well above the threshold for a first-degree burn; in fact a third-degree or fourth-degree burn may occur. By insulating an engine, the surface temperature can be lowered down to a much safer 250° F. While this is still hot enough to give someone a burn, it is nowhere near as dangerous as an un-insulated engine.

TYPES OF INSULATION

Once you decide to insulate your engine it's time to consider how you plan to do it. There are a few different ways. One of the most common is to just wrap insulation foam around the important engine parts. While this may be easy, it has significant disadvantages. First of all, insulation is most effective when it fits snugly around engine surfaces. It is very hard to get this kind of fit using a typical wrap method. Another issue is safety during repairs: while working on an engine a mechanic might be tempted to remove the insulation wrap. This means that it can be lost or damaged, and it removes all of the safety advantages of the insulation.

This is why HTI uses custom fiberglass insulation that is baked on. It offers all of the advantages of an insulation wrap with none of the added problems. The baked on fiberglass insulation is permanent and it doesn't add unnecessary bulk to the engine component. Using a baked insulation method guarantees that your engine insulation will be as effective as possible; you don't have to worry about whether your insulation is pressed tightly against the engine part.

CONCLUSION

Engine insulation is a great idea for anyone interested in keeping an engine running efficiently and safely. Owners and employees can benefit from the improved engine power, life and safety.



ABOUT HTI

High Tech Insulators has been a leading provider of baked-on engine insulation since 1985. They specialize in using state of the art techniques to insulate vital engine components such as turbo chargers, exhaust tubes, and exhaust manifolds. HTI has provided thousands of parts to clients in extremely demanding industries such as marine, mining, and defense. By using the highest quality materials coupled with rigorous industry standards their products excel in the harshest of conditions. No matter what the situation, parts insulated by HTI go above and beyond their client's demands. For more information on how HTI can solve your engine insulation needs, contact adama@sales-eng.com or visit hightechinsulators.com.