NEXT GENERATION FAST TURBULENT IGNITERS (FTI)

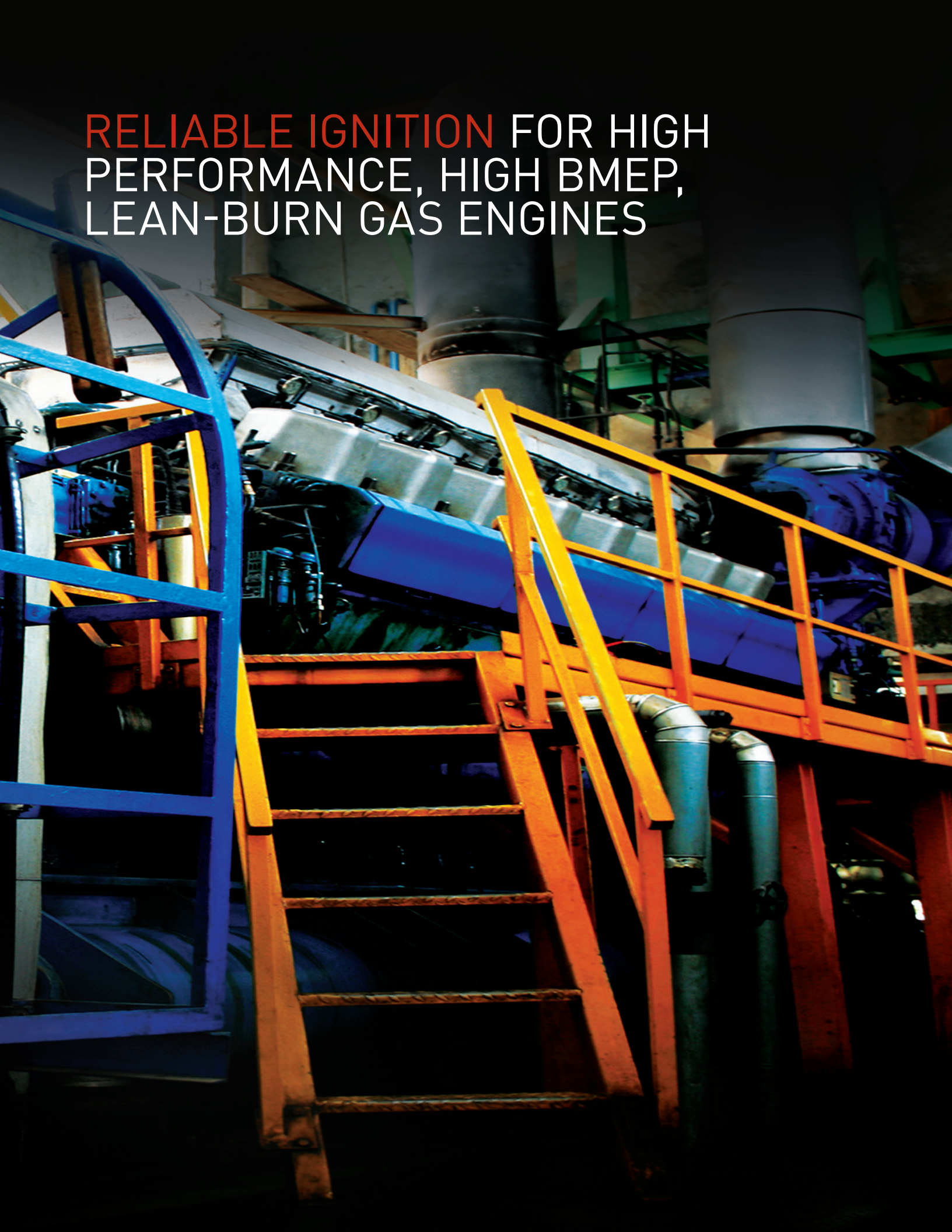
WOODWARD | ENGINE SYSTEMS

FTI IGNITERS | FOR HIGH BMEP LEAN-BURN GAS ENGINES

Always Innovating for a Better Future

WOODWARD

RELIABLE IGNITION FOR HIGH PERFORMANCE, HIGH BMEP, LEAN-BURN GAS ENGINES



Woodward's FTI igniters are a leap forward in "spark igniters" for high BMEP, lean burn gas engines that burn natural gas or biogas. The FTI plug is proven to improve combustion stability and combustion speed. When customized for specific engine requirements the FTI greatly increases engine efficiency and stability. These new igniters use a "break-through" design that extends the igniter's operating life with and without using precious metal electrodes to meet the demands of longer operating life.

As high BMEP gas engines move toward leaner fuel operations to meet increasingly more stringent emission requirements, it becomes more difficult to ignite leaner fuel mixtures. There is simply less gas in the cylinder to burn, causing slow laminar flame speeds that can result in engine misfire. In addition, large cylinder bore engines have longer fuel burn times because of the distance the flame front has to travel, making that flame front susceptible to high in-chamber turbulence, which increases ignition variability.

FTI igniters set the standard for performance in lean burn engine operations with ultra-low ignition variability and extending engine operating limits for low NOx emissions. They are capable of increasing combustion efficiency from 1% to 4%.

BETTER RELIABILITY

Designed to handle the rigors of modern high BMEP engines, FTI has shown a 2x increase in operating life over traditional plugs, well exceeding normal engine service intervals.

ENGINE COMPATIBLE

FTI igniters are customized to fit specific engine combustion requirements.

REDUCED EMISSIONS

FTI reduces the possibility of misfires when igniting leaner fuel mixtures, resulting in lower NOx emissions and the occurrence of unburned hydrocarbons.

MANUFACTURED BY NGK

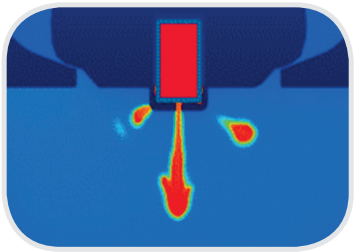
Our partnership with the world class manufacturer NGK ensures FTI will deliver reliability at competitive costs.

ADVANCED COMBUSTION

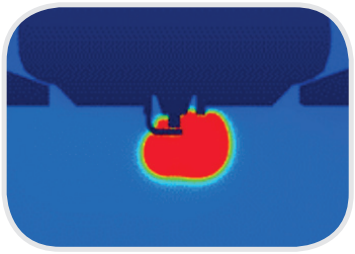
The FTI igniter's proprietary design utilizes turbulent jet combustion to provide consistent "shot-to-shot" ignition stability. It uses the high pressure rise of the initial gas charge to provide high velocity ignition jets for faster ignition of the fuel charge.

The multi-jet flame front coming out of the FTI igniter generates its own in-chamber turbulence. This self-generating turbulence adds to the existing in-chamber turbulence while being highly tolerant to other in-chamber turbulence promoting rapid flame growth throughout the fuel mixture.

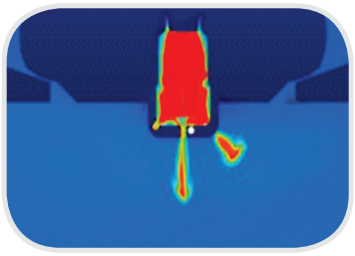
Since the FTI doesn't rely on "hot surface" method to obtain fast combustion, initial ignition is not a thermally driven design. This reduces the possibility of pre-ignition (knock) and thermal run-away often associated with pre-chamber spark plugs. Secondly, the FTI igniter properly manages residual exhaust exchange in the pre-chamber, keeping residual gases to a minimum after the exhaust stroke and properly recharging the chamber during each shot.



FTI Igniter



J-Gap Plug



Pre-Chamber Plug

Heat Map (Left)
Heat map comparison between the FTI igniter, J-Gap, and Pre-Chamber Plugs.

EMISSIONS AND EXTENDED LIFE

Most new engine design goals include increasing combustion stability while reducing NOx emissions. But, reducing the AFR (air/fuel ratio) to reduce NOx emissions can only be done to a certain point before it starts adversely affecting combustion stability.

Often the ignition timing is advanced to compensate for this slower burn rate to assure peak cylinder pressure occurs. The result of advancing timing too much can lead to knock, so identifying the optimum operating condition often becomes a compromise between knock and misfire. This, along with the fuel burn rates can impair the engine's performance, leading to higher exhaust emissions.

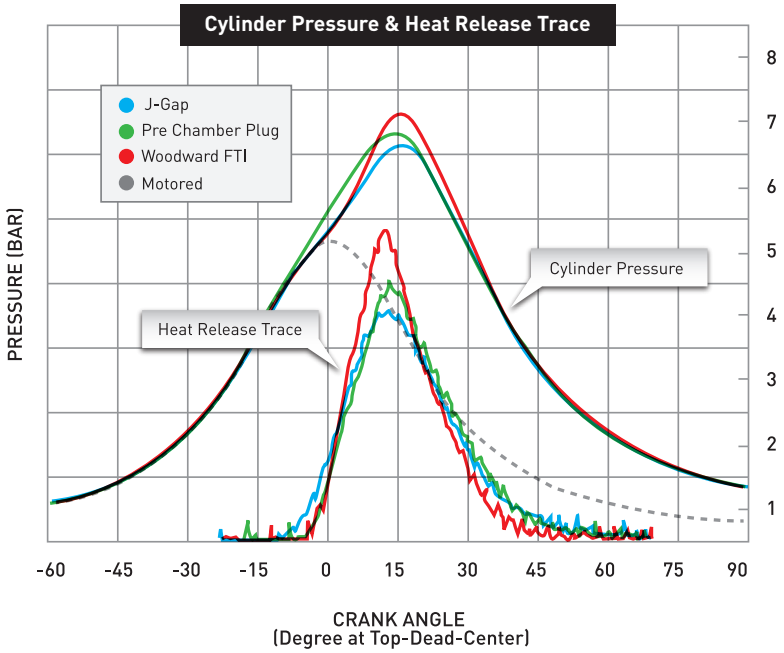
In order to mitigate these combustion issues, many engine operators increase the ignition energy delivered to their typical "J-Gap" type electrode spark plugs. Unfortunately, this added spark energy burns up the plug's electrodes faster and shortens the life of the spark plug and creates a "quenching" effect on the spark plug's performance. Another approach is to use precious metals for the electrodes to slow down erosion at higher ignition energies, but this significantly increases the cost of the spark plugs.

FTI igniters facilitate faster combustion speed and are demonstrated to extend lean burn operating limits at higher AFR to meet NOx emission requirements.

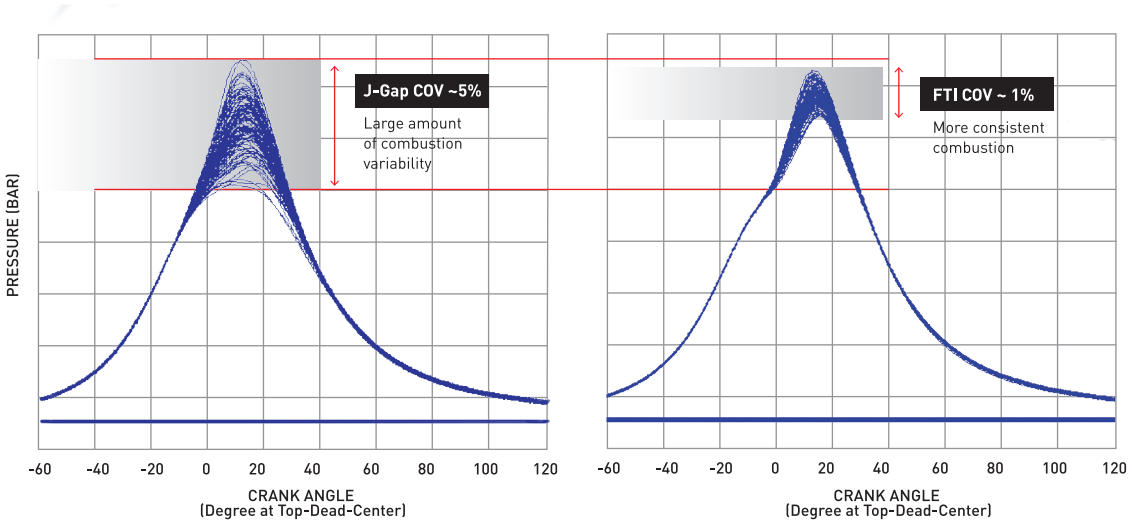
In addition, FTI igniters have been proven to perform 2000-3000 hours without using precious metals (depending on engine BMEP). Introducing precious metals to the FTI igniter is shown to approximately double the operating life of the plug.

PERFORMANCE

Coefficient of variability or "COV" is used to determine ignition consistency of the fuel charge within the engine cylinders. These new igniters use a unique pre-chamber design which dramatically reduces combustion variability while extending the igniter's operating life even without precious metal electrodes.



Cylinder Pressure and Heat Release Trace (Right)
Performance comparison of cylinder pressure and heat release. (FTI vs. Pre Chamber vs. J-Gap)



Combustion Variability (Left)
coefficient of variability (COV) of combustion from 100 different cylinder pressure cycles.

PLUG COMPARISONS

	J-Gap	Pre-Chamber Plug	FTI
Requirement			
Long Life	~ 1000 hrs	800 - 1500 hrs	> 2000 hrs
Knock Margin	Standard	Acceptable	Excellent
Stable Combustion	Variability < 5%	Good	Excellent Variability < 1.5%
Fast Combustion	30-35 degrees	N/A	27 deg @ 1.80 lambda

GLOBAL SUPPORT

Woodward knows that its customers need to locate in growth areas, so we are right there with them – designing, manufacturing, and servicing our products. Careful consideration of environmental and cultural differences is the key to establishing Woodward as a concerned global citizen.

Our internal teams are comprised of employees from many locations as well – encouraging fresh ideas, offering a variety of views on how to meet new challenges, and providing our employees the opportunity to make a worldwide impact. Woodward's plants, offices, and service centers span the globe:

North and Central America, South America, Europe, Middle East and Africa, Russia, China, India, ASEAN and Oceania.

Our global presence allows us to respond quickly to the needs of our customers. Customers and the industry at large recognize our people as a competitive advantage through their diverse representation of the global community. Additionally, as a company and as employees, we respond to the needs of our local communities by donating our time, talent, and money.

Technical and other after-sales support services for your Woodward on-engine control products.

Woodward's global network of independent Business Partners and our engine manufacturer and engine packager customers provide an extensive range of technical and other after-sales support services for your Woodward on-engine control products. For distributor information, visit us at: www.woodward.com/directory

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