

The EVO-MT System

The EVO-MT™ System enables operators of mine haul trucks to substantially reduce operational costs and improve sustainability by substituting diesel fuel with lower cost, cleaner burning natural gas. The EVO-MT™ System is comprised of patented and proprietary technologies that allow haul trucks to safely operate on gas percentages of up to 50% of their total fuel requirement. Trucks converted to a diesel + LNG operation exhibit diesel-like performance in such critical areas as power, response and efficiency.

The EVO-MT™ System has been developed as a fully integrated solution and includes all required hardware for conversion to LNG operation. The EVO-MT™ System is comprised of various components and assemblies that are retrofitted into the haul truck's engine bay, chassis and operator cabin. The installation of the EVO-MT™ System is performed onsite and without significant modification to the vehicle or engine utilizing conventional shop facilities and general technical labor. After the EVO-MT™ System has been installed, the truck can be operated on either 100% diesel fuel or on a combination of diesel fuel and LNG. The operating fuel mode can be manually selected if desired, however the system has been designed to automatically utilize LNG whenever it is available. In the event that the on-board LNG supply is exhausted, the System automatically reverts the engine to 100% diesel operation irrespective of operating mode or load condition. The switch from LNG/diesel (LNG+D) mode to 100% diesel mode is seamless and requires no action by the operator. After the LNG supply is replenished, the EVO-MT™ System automatically reverts the engine to LNG+D mode. When operating on LNG+D, the converted haul truck meets or exceeds OEM standards for performance, efficiency and reliability.

The EVO-MT™ System allows for the in-frame conversion of the haul truck engine to LNG+D operation. The conversion process utilizes components that are installed externally of the engine and no changes or modifications to the cylinders, pistons, fuel injectors or cylinder heads are required. The EVO-MT™ System retains the OEM diesel fuel system in its entirety and the engine maintains the capability to operate solely on diesel fuel when required. The EVO-MT™ System interfaces with the engine cooling circuit in order to supply high temperature coolant to a heat exchanger / vaporizer for efficient conversion of the LNG from a liquid to a vapor state. Once the LNG is converted to a vapor phase, it is supplied to the engine's air-intake system at a point upstream of the turbo-compressor inlets using low restriction air-gas mixing technology.

This new innovation is the first of its kind in the world. No other system exists to allow large, 100 ton+ capacity, mine haul trucks to operate on a mixture of liquid natural gas and diesel fuel. The system is a product of ongoing development of bi fuel technology that the management of GFS Corp developed for the stationary power generation market in 1998. The liquid natural gas mine truck conversion system has been in development since 2007. In late 2010 the first test was conducted using a Caterpillar 777 in Harlen, Kentucky. The successful test saw gas substitution rates of up to 60%. The first commercial units were installed on Caterpillar 793B trucks at Alpha Coal West in Gillette, Wyoming in early 2012. These units are still operational running a 24/7 duty cycle, producing significant savings. Gas substitution rates of up to 41% have been documented on these trucks in recent testing. Long term fuel savings studies are underway. Gas substitution rates will vary based on truck make and model as well as the duty cycle of the truck. Projects are underway to convert Komatsu 830 trucks with installations expected at the Komatsu test facility in Arizona in August 2013. Additional mining companies in the South West United States have signed agreements for various projects including Arch Coal and the Barrick Goal Strike mine. Interest in the product has come from around the world due to its dramatic fuel cost savings and rapid payback on investment.

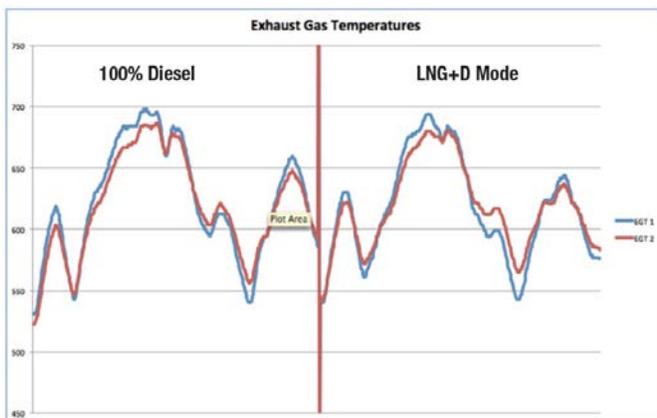
Liquid Natural Gas Mine Haul Truck Conversion

The EVO-MT System



Taken just after installation in early 2012, this photograph shows the EVO-MT System installed on a Caterpillar 793B truck with a coal haul dump bed. Here the trucks are already being used in normal operation and are parked for the 12 hour shift change. The system is designed to carry ample LNG for an entire shift (approximately 400 gallons in this configuration) so as to allow concurrent LNG refueling with the diesel refueling process. Drivers can be seen in the background preparing to take the trucks out to the mine pit.

The fuel storage pod safely houses the LNG in cryogenic tanks, evaporators, gas train and regulators, etc. It has been structurally engineered for the harsh environment that mine haul truck must endure. The pod incorporates a tilt back feature that keeps the pod out of the way during engine maintenance. Safety was a primary concern in the design. The unique shape allows the driver to exit through the passenger side door should the need arise. Again, here the installation is on a Cat 793. Other mechanical drive trucks will have a similar solution. Systems for electric drive trucks are currently under development and will employ a different fuel storage solution.



Exhaust gas temperatures are among the data the system records. Here, on a typical run it is easy to see that there is no adverse effect running in LNG+D mode. The engine's performance in LNG+D mode matches 100% diesel mode in every way.



Here, one of the trucks at Alpha Coal West is shown preparing to dump a load of coal in the coal hopper. Each load is approximately 240 tons for the Cat 793. Future EVO-MT Systems are being designed for trucks with much larger capacities.