

EVO MT Systems

EVO-MT[®] 9300 LNG Conversion for Komatsu 930E Mine Haul Trucks

The EVO-MT[®] 9300 System enables operators of Komatsu 930E 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 the engine to operate with up to 70% gas and the balance diesel fuel. Trucks converted to natural gas plus diesel, NG+D[®] operation exhibit diesel-like performance in such critical areas as power, response and efficiency.



Engine Conversion

The EVO-MT[®] System allows for the in-field conversion of the haul truck engine to NG+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. Retaining the OEM diesel fuel system in its entirety, the engine maintains the capability to operate solely on diesel fuel when required. The 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. Installation is performed using conventional shop tools and equipment.

Protection and Control

The EVO-MT[®] System includes a powerful Electronic Control Unit (ECU) that monitors critical engine, chassis and system data and uses this information using Dynamic Setpoint Protection[®] to control the operating fuel mode of the engine. The ECU also provides sophisticated engine protection and monitoring functionality with pre-alarm, alarm and system shutoff logic that allows the engine to be switched from NG+D[®] mode to diesel-only operation seamlessly and automatically. These protective systems and control algorithms ensure continued engine reliability and uptime when operating on LNG. The ECU monitors critical engine parameters including exhaust gas temperature, manifold air temperature, manifold air pressure, engine knock, engine coolant temperature and engine speed. Each ECU data channel is sampled 50 times per second (50 Hz) ensuring rapid detection and correction of anomalies.

Graphical User Interface

The GUI allows for quick and simple access to both real time using a proprietary graphical user interface (GUI) program. The GUI program is PC compatible and technical personnel can access System data using a convenient USB interface located in the operator cab. In addition to accessing System data, the GUI program is utilized during setup and commissioning of the haul truck, for creation or loading of fuel mapping algorithms as well as for programming various System control, pre-alarm and alarm setpoints.

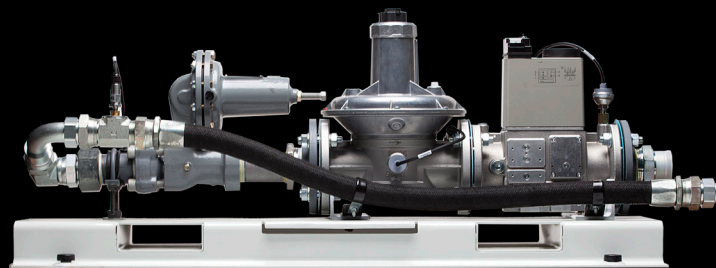
On-Board LNG Storage

LNG is safely and securely stored onboard the mine haul truck using a fully-integrated hydraulic fluid / LNG Fuel Storage Module (FSM) that replaces the OEM hydraulic tank or additionally in an optional diesel / LNG FSM to increase time before refueling events. The FSM includes a double walled, vacuum insulated cryogenic tank, LNG vaporizer and cryogenic safety controls. The FSM is a fully-engineered, pre-fabricated assembly that significantly minimizes the required installation down-time of the truck. FSM's are shipped to the mine site completely assembled and tested and can be installed using a fork lift. The FSM is designed for the Komatsu 930 haul truck and typical duty cycles, providing sufficient LNG storage capacity for a 12 hour refueling cycle under normal operation.

LNG Refueling

The LNG tank is filled via a refueling receptacle that is co-located with a diesel quick fill receptacle located in a fueling compartment on the front of the tank. LNG refueling is performed using a pressurized, quick-disconnect coupling that allows for the safe and rapid refueling of the FSM. LNG refueling can be done in parallel with diesel refueling using either permanent, semi-permanent or mobile cryogenic fuel transfer systems.

EVO-MT[®] 9300 | Specifications



Integrated Fuel Storage Modules (FSM)

Hydraulic / LNG FSM (Standard)

- 330 U.S. Gallon (1,249 liter) Water Volume
- Approximately 300 U.S. Gallon (1135 liter) LNG Capacity
- 246 U.S. Gallon Hydraulic Fluid Maximum Diesel / LNG FSM (Optional)
- 700 U.S. Gallons (2460 liters) Diesel, 650 Usable
- Additional 300 U.S. Gallons of LNG
- 100-150 PSI Operating Pressure
- 230 PSI Max Allowable Working Pressure
- Mounts to OEM Hydraulic Tank Mount with Minor Modification (retains ability to reinstall OEM Hydraulic Tank)
- Optional Diesel / LNG FSM Mounts Directly to OEM Mounting Location (no modification required)
- LNG Tanks Designed, Constructed and Tested to ASME section VIII, Dev. 1 or SAE J2343, NFPA 52, and Other Applicable Standards.
- Double-Walled and Vacuum-Insulated Cryogenic Tank
- 5 Day Hold Time
- Cryogenic Shut-Off Solenoid Valves
- Integrated LNG Fill Port @ 50-100 GPM Fill Rate
- Remote Venting System
- Single Stage LNG Vaporizer

Gas Train

- CSA Certified or CRN High Pressure Regulator
- CSA Certified Low Pressure Regulator ANSI Z21.18
- CSA Certified Dual Solenoid Valve ANSI Z21.21

Electronic Control Unit (ECU)

- 32-bit Microcontroller with USB and CAN Communications
- J1939 Compatible
- Programmable Fuel Mapping
- Remote Graphic User Interface
- Monitors >25 Sensors 50X per Second
- Four Channel Throttle-Body Control Output
- 24V Input Power, Load Dump Overvoltage > 100V, Under-Voltage Lockout < 18V, Reverse polarity and Double Battery Voltage Protected

ECU Environmental Ratings

- *Ambient Operating Temperature:* -40°C to +105°C
- *Storage Temperature:* -40°C to +125°C
- *EMC/EMI:* EN61000-6-2/-4
ISO 10605
ISO 11452-2,4
CISPR 25
- *Humidity:* MIL-STD-810D, 507.2
- *Chemical Resistance:* SAE J1455, 4.4.3
- *Shock:* 40 Gs
- *Vibration:* Random: 0.3G²/Hz, 10-2000 Hz
- *Thermal Shock:* SAE J1455, 4.1.3.2
- *Ingress Protection:* IP56 Per IEC 60529
SAE J1455

Gas Distribution System

- Fire Shielded Eaton FC3000 Hoses
- 8" or 10" Air / Gas Mixers
- Mass Air Flow Sensor
- Fast Acting Throttle Bodies

Engine / Truck Safety

- Flame Detection
- Air-Gas Mixture Inflammable Outside Combustion Chamber
- High Exhaust / Turbo Temperature
- High Boost Pressure / Temperature
- Engine Over-Speed Protection
- Engine Knock Detection
- Gas Throttle Position Feedback Loop
- Tie-In to Truck Fire Control System

Operator Safety

- In-Cab Combustible Gas Detection
- In-Cab System E-Stop (Optional)
- External system E-Stop (Optional)
- Automatic Gas Shutdown in Rollover
- Automatic Gas Shutdown on Truck Over-Speed
- Automatic Reversion to Diesel Operation

System Weight (Standard System)

- Fully filled with LNG ~ 6700 pounds net
- Optional Diesel / LNG FSM - Net Neutral

Engines / Drives Supported

- Cummins QSK60
- MTU 16V4000
- GE AC Drive System
- GE Invertex

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