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# US Army Ground Systems Alternative Fuels Update

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# Report Documentation Page

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- Two alternative fuels for which evaluations are being completed to assess their impacts on tactical ground systems
  - Blends of JP-8 and up to 50% by volume of
    - Fischer-Tropsch Synthetic Paraffinic Kerosene (FT SPK)
    - Hydroprocessed Renewable Jet (HRJ)
  - Both products (FT SPK and HRJ) are very similar compositionally
    - Resultant properties are very similar
    - Evaluations thus conducted using one of these blends will be representative of evaluations for the other by similarity
  - Evaluations are conducted using nominal 50:50 blends (volumetric basis)
- Several types of evaluations already completed or planned
  - Laboratory bench-top testing
  - Rig testing of fuel injection systems
  - Tactical vehicle engine testing
  - Pilot demonstrations in tactical ground systems (vehicles, force projection equipment, generator sets)

- Tactical Wheeled Vehicle Pilot Field Demo conducted at Ft. Bliss, TX (2009)
  - Half of fleet on JP-8, other half on synthetic fuel blend
  - Miles driven per driver training protocol
  - No issues, no discernible differences of vehicle performance/maintenance between the fuels
- HMMWV Test Track Evaluation (2009)
  - GEP 6.5L non-turbo evaluated
  - Loaded vs. unloaded, uphill vs. flat vs. downhill, on-road vs. off-road
  - Test fuels: DF2, JP-8, FT SPK, and FT SPK/JP-8 blend
  - Noticeable acceleration loss using blend
- Tactical Generator Set Pilot Demo (2007)
  - Three 10-kW generator sets in side-by-side operation
  - 1000 hours total test time each
  - Test fuels: DF2 (break-in), JP-8, FT SPK, and FT SPK/JP-8 blend
  - No issues



TARDEC photo by R. Alvarez,  
TARDEC Fuels & Lubricants Research Facility

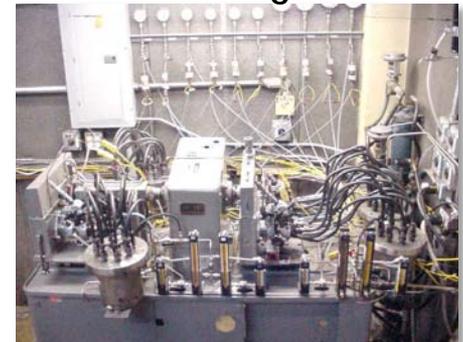
- Endurance testing of tactical vehicle engines
- Modified NATO 400-Hour Cycle testing conducted at TARDEC Propulsion Lab (2008-2010)
  - Engines tested (2008-2010)
    - GEP 6.5L Turbo (HMMWV)
    - CAT 7.2L Engine (Stryker, FMTV)
    - Cummins V903T Engine (Bradley) (2010)
    - DDC 8V92-TA Engine (HEMTT) (2010 – Report Pending)
  - Power curves generated at start of, during, and at end of test
  - Testing at elevated/desert temperatures whenever possible
  - Test fuels: JP-8 (baseline) and FT SPK/JP-8 Blend
  - Slight power differences between JP-8 and the blend
- Army/CRC 210-Hour Wheeled Vehicle Cycle testing conducted at TARDEC Fuels & Lubricants Facility (2007)
  - CAT 7.2L Engine (Stryker, FMTV)
  - Twice through (2X) 210-hr test cycle performed using FT SPK (100%)
  - Power curves generated at start and end of test for ULSD, JP-8, FT SPK, FT SPK/JP-8 blend
  - No issues



6.5L Turbo Engine

- Laboratory evaluations of FT SPK
  - Elastomer Compatibility / O-ring Studies (2003-2006)
  - Fuel Blend Studies (2005-2006)
  - Cetane Study (2008-2009)
    - Measured, calculated, and derived
  - Lubricity Study (2008-2009)
    - BOCLE, SLBOCLE, and HFRR
- Rotary injection fuel pump evaluation (2004)
  - FT SPK neat and FT SPK treated with military-approved lubricity improver additive (CI/LI)
  - Testing not done at elevated temperatures
  - Pump failure after just 96 hours with untreated FT SPK
  - Pump ran full test (500 hours) with treated FT SPK

Rotary fuel injection pump  
test rig



TARDEC photo by E. Frame,  
TARDEC Fuels & Lubricants Research Facility

- Modified NATO 400-Hour Cycle testing of selected tactical vehicle engines (HRJ/JP-8 blend)
  - Continental 1790 (Recovery Vehicle)
  - Navistar MaxxForce 9.3L (MRAP)
  - GEP 6.5L Turbo (HMMWV)
- Army/CRC 210-Hour TWV Cycle testing at TFLRF
  - Ford Scorpion 6.7L (Joint testing with USAF)
    - Test fuels: ULSD, JP-8, neat FT SPK, and JP-8/FT SPK blend
    - “Desert-like” conditions
  - CAT C7 (neat HR Diesel)
    - Ambient and “desert-like” conditions
- Rotary injection fuel pump testing, high temperature (FT SPK/JP-8 blend)
- High pressure common rail fuel system testing (blends of FT SPK or HRJ with JP-8)
- Tactical generator sets, 10 kW to 100 kW sizes (HRJ/JP-8 Blend)
  - In coordination with CERDEC
  - 1500-hour reliability testing
  - Other performance testing (electrical characteristics, fuel consumption, etc.)
- Pilot field demonstration of Force Projection equipment operating on fuel blend (HRJ/JP-8 Blend)



# Completed TARDEC Evaluations Reports and Papers



Document Title	Publication	Publication Reference	
	Date	DTIC	Other
Synthetic Fuel Lubricity Evaluations	Sep-03	ADA421822	Interim Report TFLRF No. 367
Synthetic JP-5 Aviation Turbine Fuel Elastomer Compatibility	Nov-03	ADA477802	TARDEC Report No. 13978
Exhaust Emissions From a 6.5L Diesel Engine Using Synthetic Fuel and Low-Sulfur Diesel Fuel	Dec-03	ADA426513	Interim Report TFLRF No. 370
Alternative Fuels: Assessment of Fischer-Tropsch Fuel for Military Use in 6.5L Diesel Engine	Jan-04	--	SAE Paper No. 2004-01-2961
Evaluation of Ball on Three Disks as Lubricity Evaluator for CI/LI in Synthetic JP-5	Apr-04	ADA462280	TARDEC Report No. 13977
Synthetic Fischer-Tropsch (FT) JP-5/JP-8 Aviation Turbine Fuel Elastomer Compatibility	Feb-05	ADA477802	TARDEC Report No. 15043
Bench Top Lubricity Evaluator Correlation with Military Rotary Fuel Injection Pump Test Rig	Oct-05	ADA524925	SAE Paper No. 2005-01-3899
Properties of Fischer-Tropsch (FT) Blends for Use in Military Equipment	Apr-06	ADA521910	SAE Paper No. 2006-01-0702
Elastomer Impact When Switch-Loading Synthetic Fuel Blends and Petroleum Fuels	Jul-06	ADA459513	TARDEC Report No. 16028
The Effect of Switch-Loading Fuels on Fuel-Wetted Elastomers	Jan-07	ADA497968	SAE Paper No. 2007-01-1453
Evaluation of Synthetic Fuel in Military Tactical Generators	Jun-08	ADA482914	Interim Report TFLRF No. 392
Engine Durability Evaluation Using Synthetic Fuel, Caterpillar C7 Engine	Oct-08	ADA494498	Interim Report TFLRF No. 391
Fischer-Tropsch Synthetic Fuel Evaluations: HMMWV Test Track Evaluation	Sep-09	ADA509165	Interim Report TFLRF No. 400
Evaluation of the Fuel Effects of Synthetic JP-8 Blends on the 6.5L Turbo Diesel V8 from General Engine Products (GEP) Using the NATO Standard Engine Laboratory Test AEP-5, Edition 3, May 1988	Dec-09	--	TARDEC Report, Distr A
Durability Evaluation of Two New Production Caterpillar C7 Engines Subjected to Elevated Temperature 400 Hour NATO Tests Fueled by JP-8 and 50%/50% Blend of JP-8 and S-8	Feb-10	--	TARDEC Report, Distr E
Synthetic Fuel Blend Demonstration Program at Fort Bliss, Texas	May-10	ADA533890	Interim Report TFLRF No. 407
Lubricity and Derived Cetane Number Measurements of Jet Fuels, Alternative Fuels and Fuel Blends	Jul-10	ADA529442	Interim Report TFLRF No. 405
Cummins V903 Alternative Fuel Evaluation, NATO Modified Standard Laboratory Test AEP-5	May-11	ADB369316	TARDEC Report, Distr D