U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – GROUND VEHICLE SYSTEMS CENTER

Fuels, Fluids, and Lubricants Update to Industry

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AGENDA

- F&L Modernization Strategy
- Fuels: Current & Future State
- Lubricants & Fluids: Current & Future State

F&L MODERNIZATION STRATEGY

Adapt Commercial Specifications for Military Use

- ✓ Products for use in all environments
- ✓ Incorporate military specific requirements (legacy and future)
- ✓ Prevents product proliferation
- ✓ Endure long term storage without degradation/deterioration
- ✓ Increase competition & reduce reliance on one source
- ✓ Ensure product of requisite quality (qualified products)
- ✓ Minimize supply issues & misapplication during maintenance
- ✓ Maintain interoperability with Allied Partners
- ✓ Extend shelf life of products with specifications

Maintain compliance with AR 70-12

FUELS: CURRENT STATE

AVIATION FUELS
JP-8 & F-24

- Used by Army since the 1980s
- AR 70-12 directs use in all Army aviation & ground systems
- Army requires lubricity improver additive
- Highly harmonized around the world
- Tactical distribution force structure is based on single predominate fuel

SUSTAINABLE AVIATION FUELS

- Drop-in replacements for petroleum fuel at specified vol %
- Common names:
  - Alternative
  - Synthetic Aviation Fuel (SAF)
  - Bio
  - Renewable
- 11 SAF blends are approved in the commercial specs
- Army ground has approved 2 SAF blends, FT-SPK and HEFA-SPK

DIESEL FUELS

- Biodiesel allowed up to 5% (more if authorized by the local authorities) in US
- Concerns with global fuel quality and sulfur content as specifications are not harmonized around the world
- Long term storage stability issues
- Seasonal & Regional – supply chain may lag

ARMY USES COMMERCIAL FUELS

FUELS: FUTURE STATE

- Maintain compliance to AR 70-12
- Army community education on SAF & **fuel lubricity**
- Monitor commercial fuels & evaluate **risk** of emerging fuels to US Army ground vehicle & equipment
- Evaluate Sustainable Aviation Fuels – 9 pathways
  - Focusing on 2 Risk Categories: Lubrication/Tribology & Combustion Properties
  - Ensure fuels are **within the window of experience**
  - Document risk assessments
  - Develop risk mitigation strategies, as necessary
- Communicate with the Army & Ground Vehicle community

Maintain interoperability with commercial fuels

ARMY RISK CATEGORIES FOR SAF

Lubrication / Tribology

- Lubricity
  - BOCLE, HFRR
  - Response to CI/LI
- Viscosity
  - 40°C

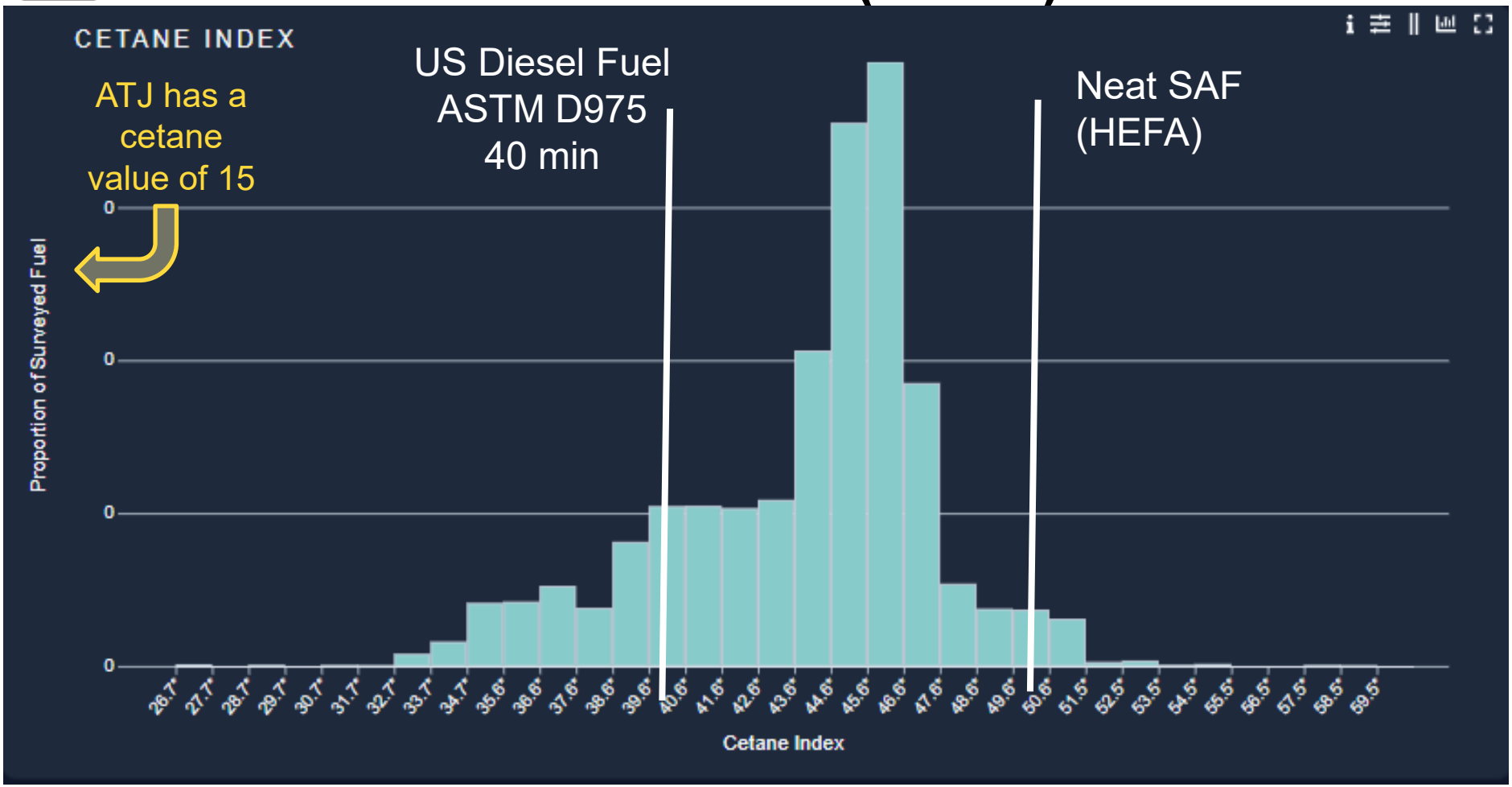
Combustion Properties

Cetane/Ignition Delay
Cold Startability (low cetane fuels)

Primary Properties

Volatility
Atomization
Surface tension
Bulk modulus (injection delay in low pressure systems)
Composition
Viscosity (internal leakage/injector fuel return flow)
Injector Deposits

JET FUEL DATA
CETANE INDEX (CALC)



MIN	26.7
AVERAGE	43.88
MAX	59.5

Data courtesy of US Navy

LUBRICANTS & FLUIDS: CURRENT STATE

- Products conform to AR 70-12
- 30+ year old formulation/additive technology
- Interoperable with NATO Countries
- Use of current standard military products offers worldwide availability, reduced logistic support, shorter lead times
- OEM specific products may be required (ie transmission fluids) – but could be hard to get in some locations
- Compatibility issues may exist when using non-standard products in the field that weren't reviewed prior to use
- Reacting to advances in technology requiring new fluids (e.g. Brake Fluid in ABS)

LUBRICANTS & FLUIDS: FUTURE STATE

Maintain compliance to AR 70-12

- Implement updated technology into military standard specifications

Modernize lubricant & fluid technology

- Synthetic, modern formulations
- Fuel Efficient
- Longer life
- Increase to drain intervals
- Compatibility with new hardware technology

Shift to Lubricants targeted for Electrification Applications

- Thermal Management Fluids
- Specialized Lubricants

MODERNIZATION SNAP SHOT – LUBRICANTS & FLUIDS

- Synthetic Multipurpose Lubricant (SMPL)
- Fuel Efficient Gear Oil (FEGO)
- **Brake Fluid for ABS systems (BFABS)**
- **Extended Life Coolants (ELC)**
- Sustainable Vapor Degreasing Solvent
- **Thermal Management Fluids for Vehicle Electrification**
- Specialized Fluids for Electric Components

MODERNIZATION SNAP SHOT – BRAKE FLUIDS FOR ABS

PAYOFF: Standard brake fluid & MILSPEC available for ALL new Army vehicles equipped with ABS (MIL-PRF-32701)

Risks of Poly-glycol Brake Fluid (PBF):

- Sluggish brakes at low temperatures
- Corrosion of brake system
- Vapor lock at high temperature

BFABS has identified military operational requirements; these requirements are **NOT** all met by a commercial specification

MODERNIZATION SNAP SHOT – EXTENDED LIFE COOLANTS

PAYOFF: Reduced logistics & maintenance burden by increasing drain/refill intervals up to 5 years with no re-inhibition required

Army uses conventional, Inorganic Acid Technology (IAT) coolant which lacks advantages of ELCs

ELC utilizes OAT = Organic Acid Technology

Benefits: Longer life, additives do not deplete as quickly and no reinhibition is required, less maintenance burden

MODERNIZATION SNAP SHOT – THERMAL MANAGEMENT FLUIDS

for Hybrid/Battery Electric Vehicles (HEVs/BEVs)

PAYOFF: Safety, Vehicle/Battery Performance, Enabler to Ultra Fast Charging, selection of the best product for military while prevent proliferation of the supply chain

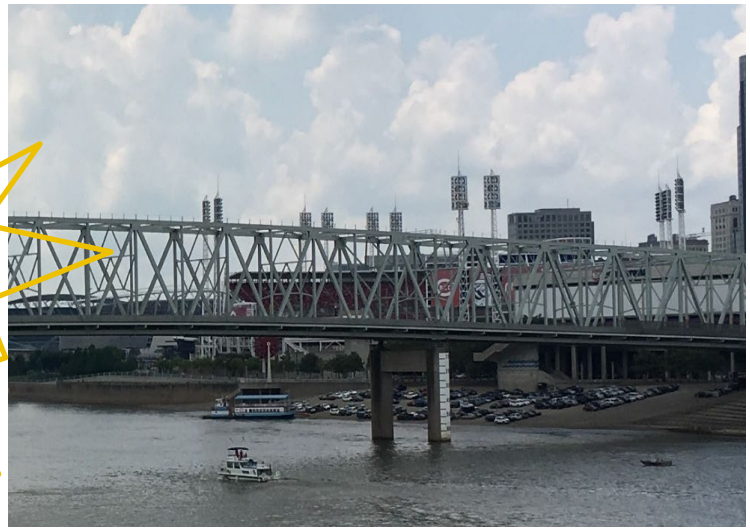
Risks of inadequate thermal management

- Decreased performance and life
- Slower charging
- Thermal runaway

Benefits: Designing spec around emerging fluid technologies as DoD spins up HEVs/BEVs

THE VALLEY OF DEATH WITH F&L MODERNIZATION

Fluids & Fuels fall right in the middle



Acquisition

- There is no process to accept modernized fluids
- Acquisition programs hesitant to accept without ROI
- Transition of modernized fluids is difficult with no forcing function

Sustainment

- Army unable to capitalize on the benefits of the modernized fluids since they aren't approved
- Modernized fluids directly impact maintainability, reliability, interoperability, and mission readiness

THANK YOU!

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