

Alternative Aviation Fuels

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Administration**



Presentation Overview

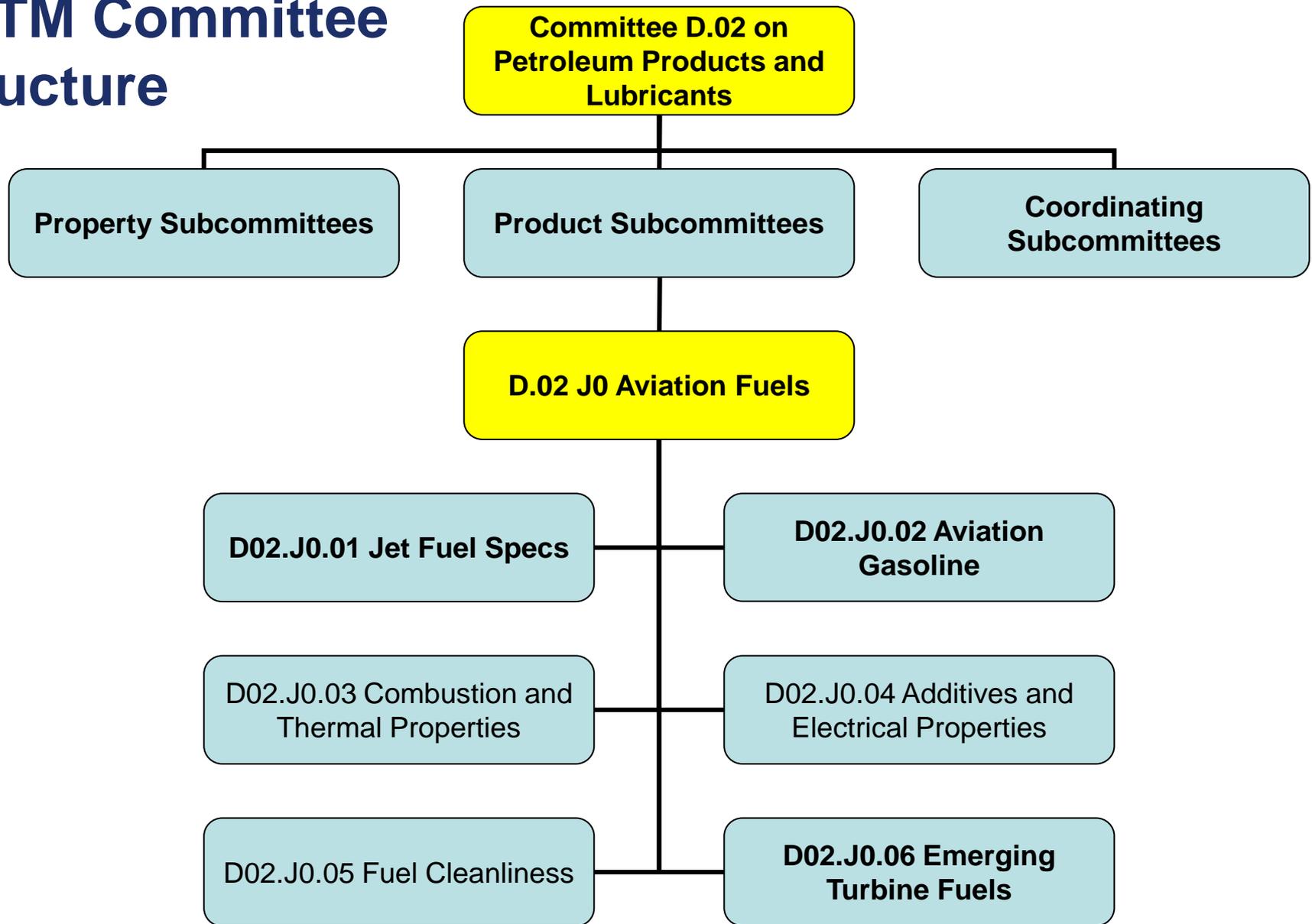
- **ASTM International Overview**
- **FAA Regulatory Oversight of Aviation Fuel**
- **Alternative Jet Fuels**



ASTM International Overview

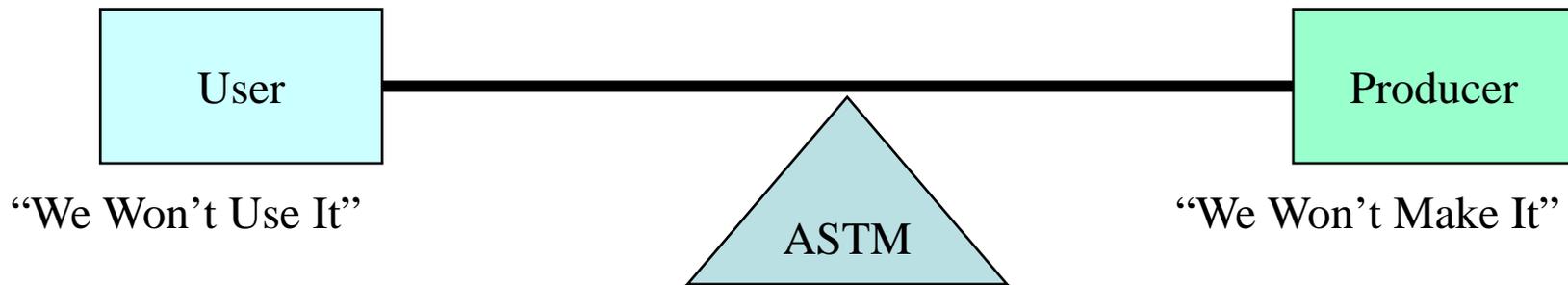


ASTM Committee Structure



ASTM Consensus-Based Concept

- **Standards-Writing Organization**
 - Specifications, Procedures, Practices
 - To Meet Policy/Regulatory Needs
- **Consensus-Based Organization**
 - Members Vote on Specifications
 - All Negative Votes Reconciled Based on Technical Merit
- **Balanced Membership (Aviation Fuels Subcommittee)**
 - Users: Engine/Aircraft OEMs, Airlines, Military
 - Producers: Oil Cos, Additive Mfgs, Alt Fuel Cos.

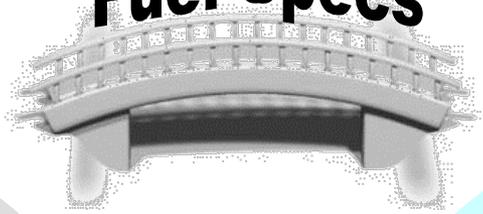


ASTM Fuel Specifications Bridge the Gap Between Petroleum Industry and Civil Aviation

Petroleum Industry

Civil Aviation

Fuel Specs



ASTM International Subcommittee J

- **Global Outreach**

- June 2008 Aviation Fuel Subcommittee J Meeting in Warsaw, Poland
- May 2013 Aviation Fuel Subcommittee J Meeting in Berlin, Germany
 - Coincident with IATA Fuels Group Meeting
- Anticipate Next Meeting Outside USA in 2018
 - Europe or Asia?
- International Membership
 - Over 400 Members from Across the Globe
 - Interested Parties from all Nations Welcome
- Global Leadership Role in Standards for Aviation Alternative Fuels



ASTM Aviation Fuel Specifications

Leaded Aviation Gasolines

Aviation Gasoline



- **D910 : Aviation Gasolines**
 - 100/130, 100LL, 80/87, 91/98
- **D6227: Unleaded Aviation Gasoline Containing a Non-hydrocarbon Component**
 - 82UL & 87UL
- **D7547: Unleaded Aviation Gasoline**
 - UL91 & UL94
- **D7719: High Aromatic Unleaded Aviation Gasoline**
- **D7690: Unleaded Aviation Gasoline Test Fuel**

Unleaded Aviation Gasolines

Conventional Jet Fuels

Jet Fuel



- **D1655**
 - Aviation Turbine Fuels (Jet A/A-1)
- **D6615**
 - Jet B Wide-Cut Aviation Turbine Fuel
- **D7223**
 - Aviation Certification Turbine Fuel
- **D7566**
 - Aviation Turbine Fuel Containing Synthesized Hydrocarbons

Alternative Jet Fuel

ASTM Subcommittee J Current Activities

- **50 ppm FAME Limit**
 - Specified in Table 3, Incidental Materials
 - Intent is to Review Service Data to Increase to 100 ppm
 - Working on OEM Emergency Procedures for 50-100 ppm range
 - Associated FAA Bulletin TBD
- **Co-Processing of Triglyceride Oils with Crude Oil**
 - Blend up to 5% Renewable Feedstock for Diesel Production
 - Renewable Product also in Jet Fraction
- **MDA Usage Control for Thermal Stability**
 - Prevent unstable fuel in supply system
- **Viscosity Limitation**
 - Current 8 cSt at -20 C limit may not be adequate
 - APUs Require 12 cSt at -40 C
- **Other Table 3 Incidental Materials Just Balloted:**
 - Pipeline Drag Reducer Additive, D7872, (0.072 mg/l)
 - Chloride (salt), D7959, (0.09 mg/l)



ASTM Subcommittee J Current Activities

- **D4054 Qualification of New Fuels and Additives**
 - Adding Tier levels (1, 2, 3, 4) for ease of reference.
 - Adding a Table to show typical fuel volumes required per Tier
 - Materials Compatibility Section Updated to Reflect Experience
 - Annex A1 Fuel Property Experience Graphs



ASTM Subcommittee J Current Activities

- **Additives in D4054 Review:**
 - **AFTON HiTec 4547 Avguard SDA**
 - Completed OEM Review
 - Will Be Balloted to ASTM Subcommittee
 - **BASF Kerostat 8118™ SDA**
 - D4054 Testing Still In Process
 - **BASF Aquarius**
 - D4054 Testing Completed
 - Supplemental Testing at Airbus in Process



ASTM Subcommittee J Current Activities

- **International Coordination**

- **Russian TS-1**

- GOST R 10227-2013 still slated for release 01 Jan. 2017
- MOU with ASTM to use test methods
- Working with EI to establish similar MOU for IP standards.

- **Chinese No. 3 Jet Fuel**

- Additives Not Approved by all OEMs:
 - T1502 conductivity improver
 - T1601 & T1602, CI/LI Additives
- OEMs, CAAC and FAA Discussing Approval Status

- **UK MOD DEF STAN 91-91 & 91-90**

- On-going coordination

FAA Regulatory Oversight of Aviation Fuel



FAA Oversight of Fuel

Aircraft Parts

FAA Targets Oversight Here (Part 21)

Oversight of Part Design Not Necessary Because Part Design Will Not Change



Aviation Fuel

Oversight of Composition Ineffective Because Fuel Composition May Change

FAA Indirect Oversight via Airline (Part 121)

FAA Targets Oversight Here (Part 91)



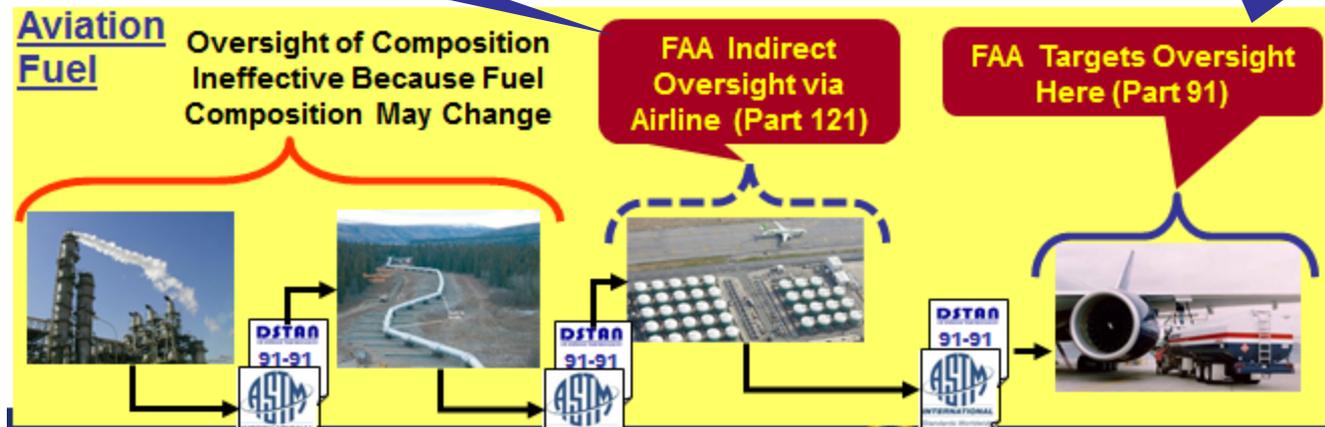
FAA Oversight of Fuel

FAA Audits Airline to Ensure they are following operating instructions and manuals

Operating Limitations Defined by Fuel Specifications

121.135 (b) (19)
Airline Operating Manual Requires Procedures for eliminating fuel contamination.

91.9
Operator [airline] must comply with the [fuel] operating limitations specified by the engine and aircraft manufacturer

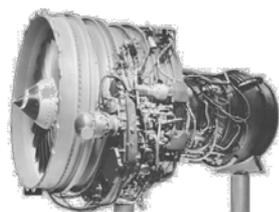


Operating Limitations Rely on Industry Fuel Specifications

The FAA Does Not Certify Fuel, We Certify Airplanes and Engines to Operate on Specified (Existing) Fuel

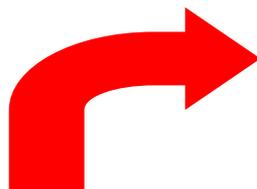


ASTM Fuel Specification



33.7 - Engine Ratings and Operating Limitations

- Fuel Specification

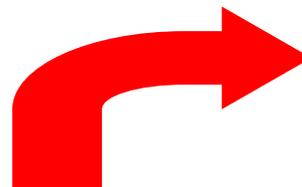


25.1521 - Powerplant Limitations

- Fuel Specification

25.1583 - Operating Limitations

- Powerplant limitations in Airplane Flight Manual



91.9 – Civil Aircraft Flight Manual

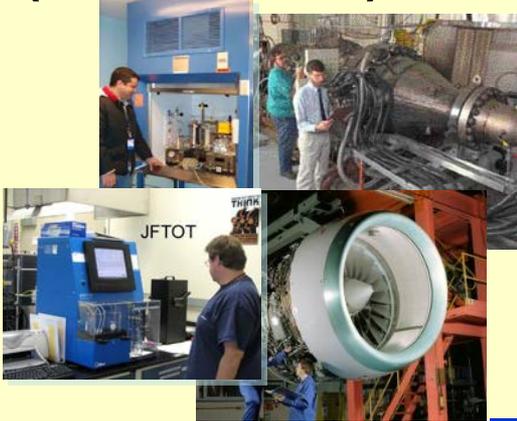
- no person may operate a civil aircraft without complying with the operating limitations specified in the approved AFM

Alternative Jet Fuel



Certification of Alternative Fuels

Industry Qualification (ASTM D4054)



Drop-In Fuel
ASTM D7566
Spec

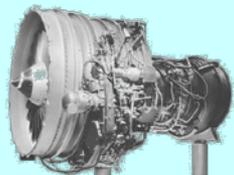


Non-Drop-In Fuel
New Spec
(e.g., UL avgas)

Unchanged
Operating
Limitation

New Oper Limitation

FAA Certification



Engine Operating
Limitations



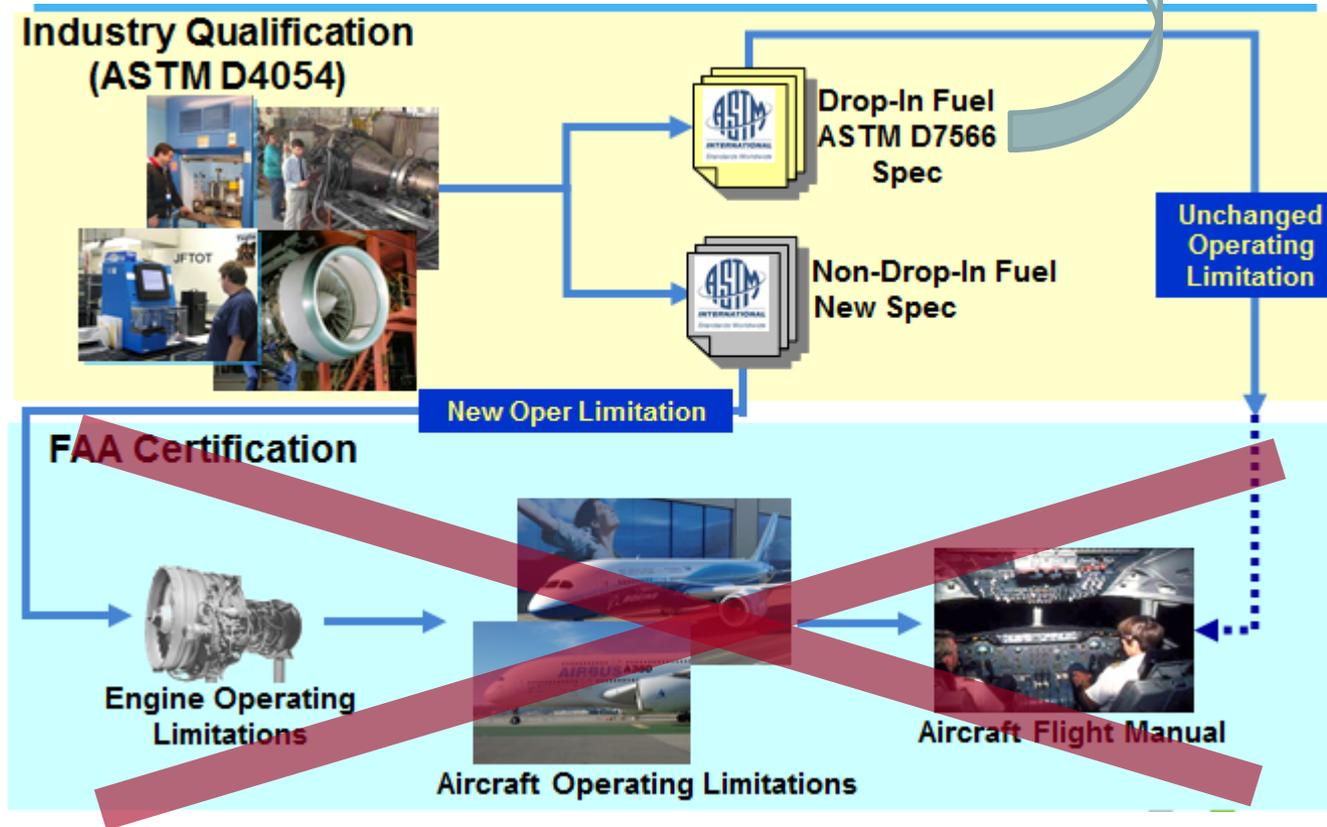
Aircraft Operating Limitations



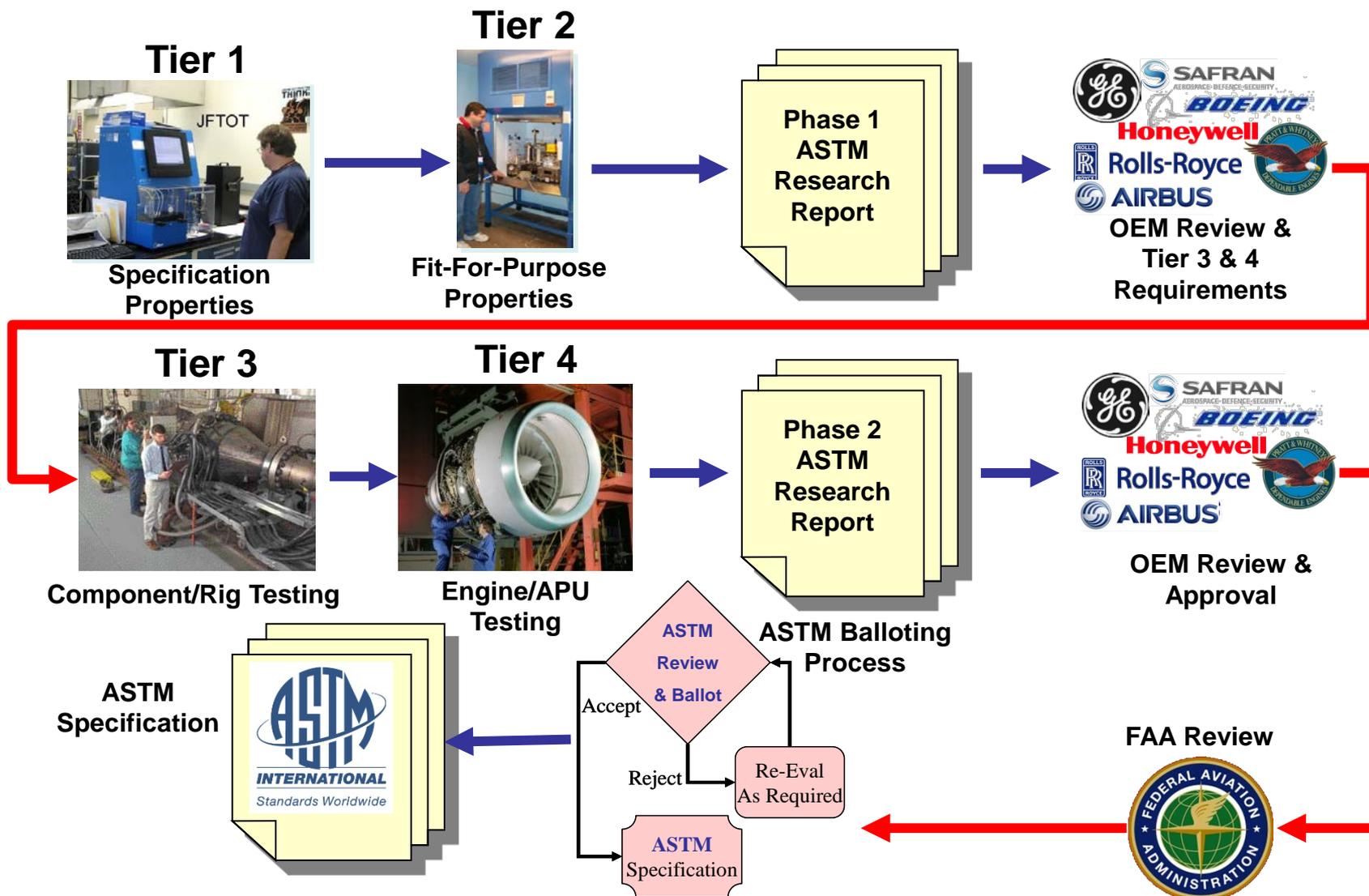
Aircraft Flight Manual

For Drop-in Fuels...

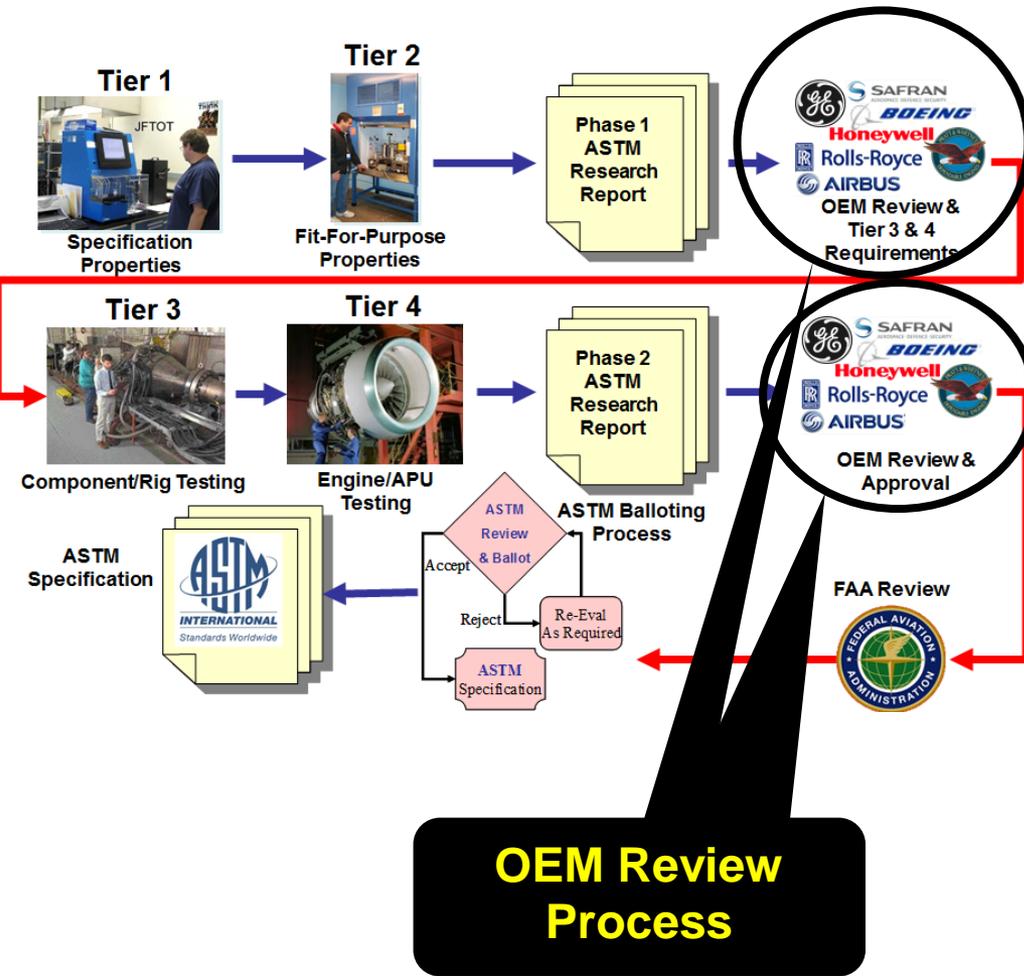
ASTM Qualification = FAA Certification



D4054 Qualification Process

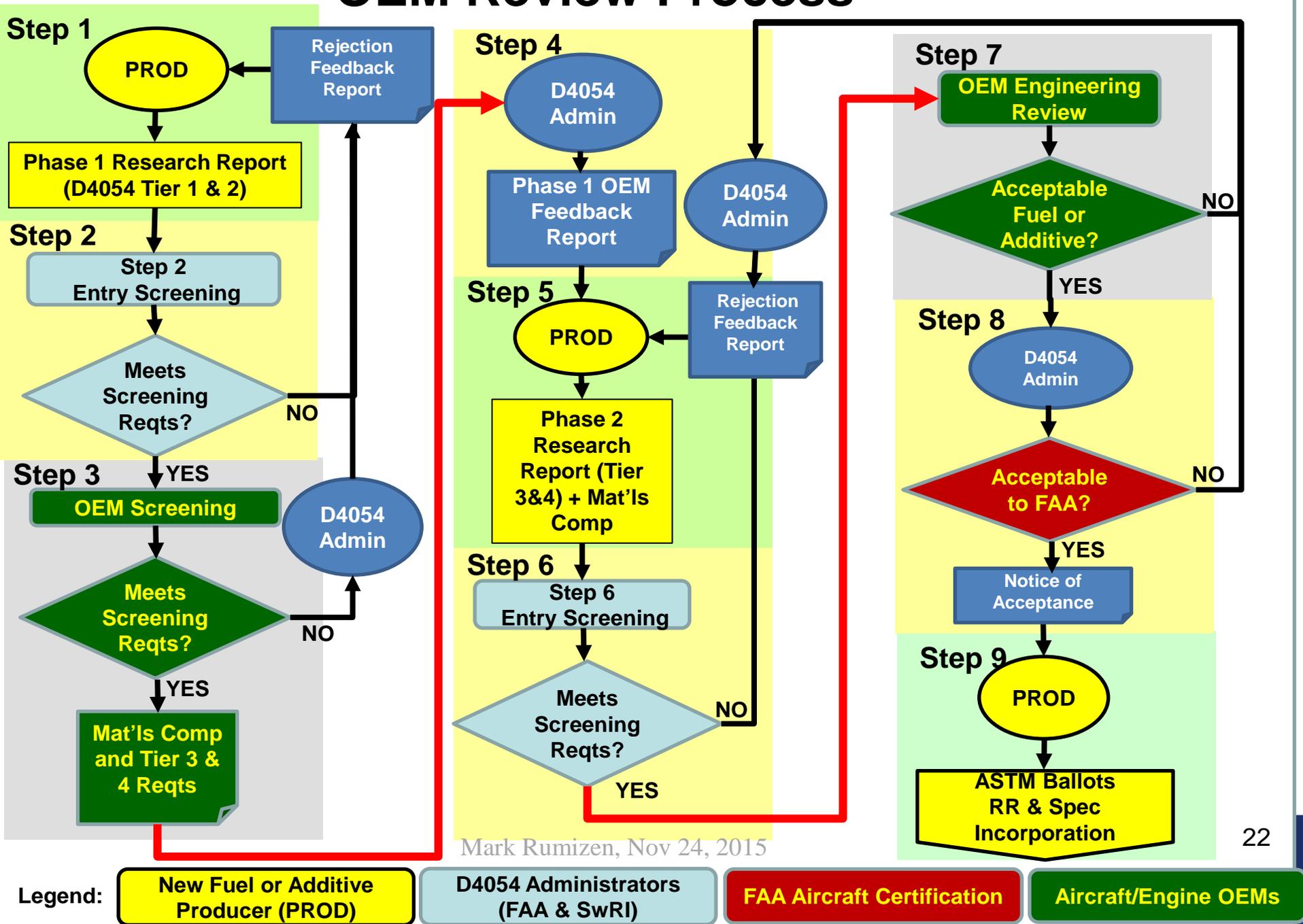


OEM Review Process



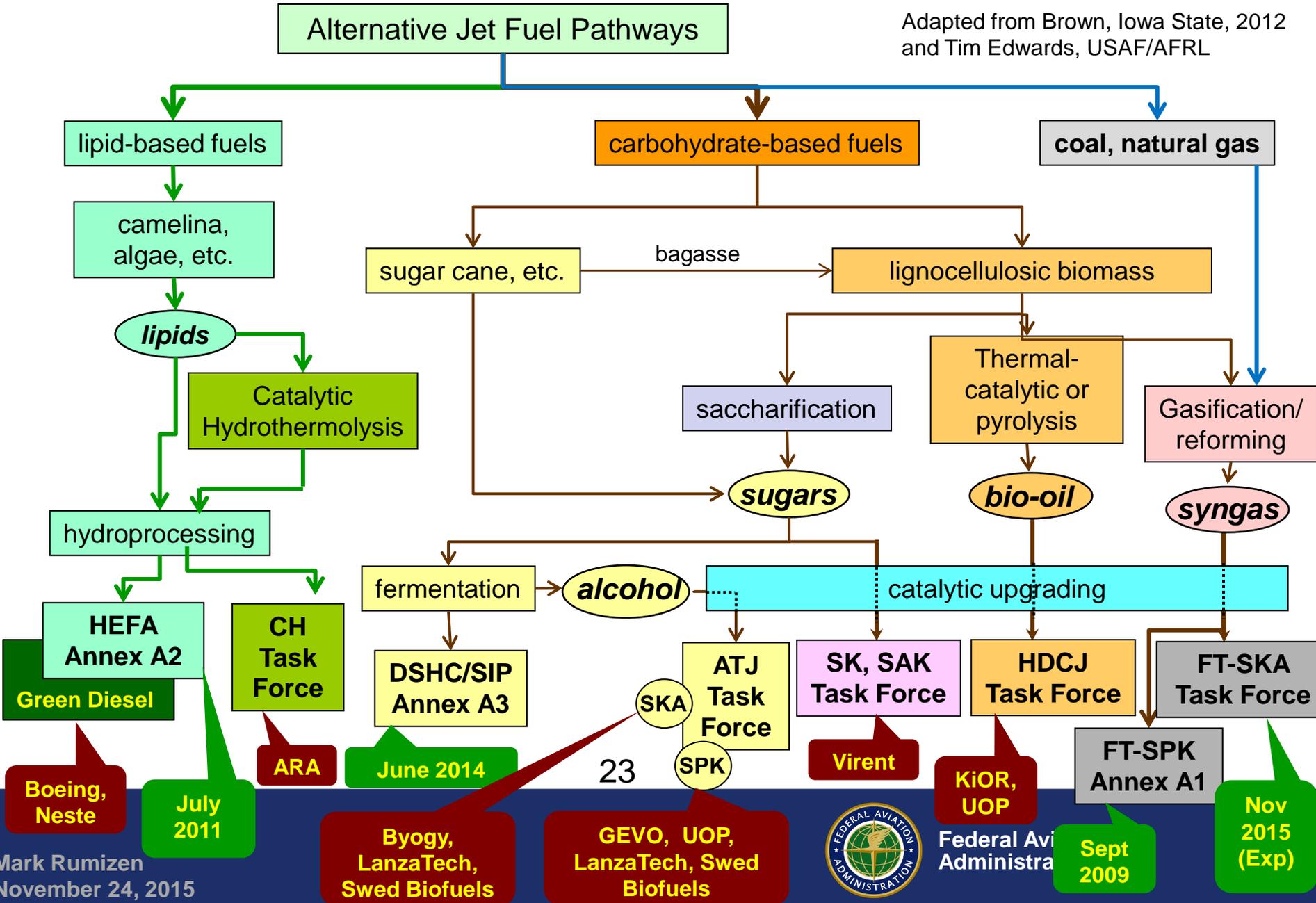
- Provides Feedback on Suitability of Product for Use on Aircraft/Engines/APUs
- Necessary for FAA to Make a Determination that D1655 will Continue to Provide Airworthy Fuel
 - Certification Basis is Maintained on All Aircraft/Engines
- Required for Proposed Alternative Fuel to Advance to ASTM Balloting

OEM Review Process



ALTERNATIVE JET FUEL PATHWAYS

Adapted from Brown, Iowa State, 2012 and Tim Edwards, USAF/AFRL



Alternative Fuel Acronyms

ATJ: Alcohol to Jet

CH: Catalytic Hydrothermolysis

DSHC: Direct Sugar to Hydrocabons

FT: Fischer-Tropsch

FT-SKA: FT Synthetic Paraffinic Kerosene with Aromatics

FT-SPK: FT Synthetic Paraffinic Kerosene

HDCJ: Hydroprocessed Depolymerized Cellulosic Jet

HEFA: Hydroprocessed Esters and Fatty Acids

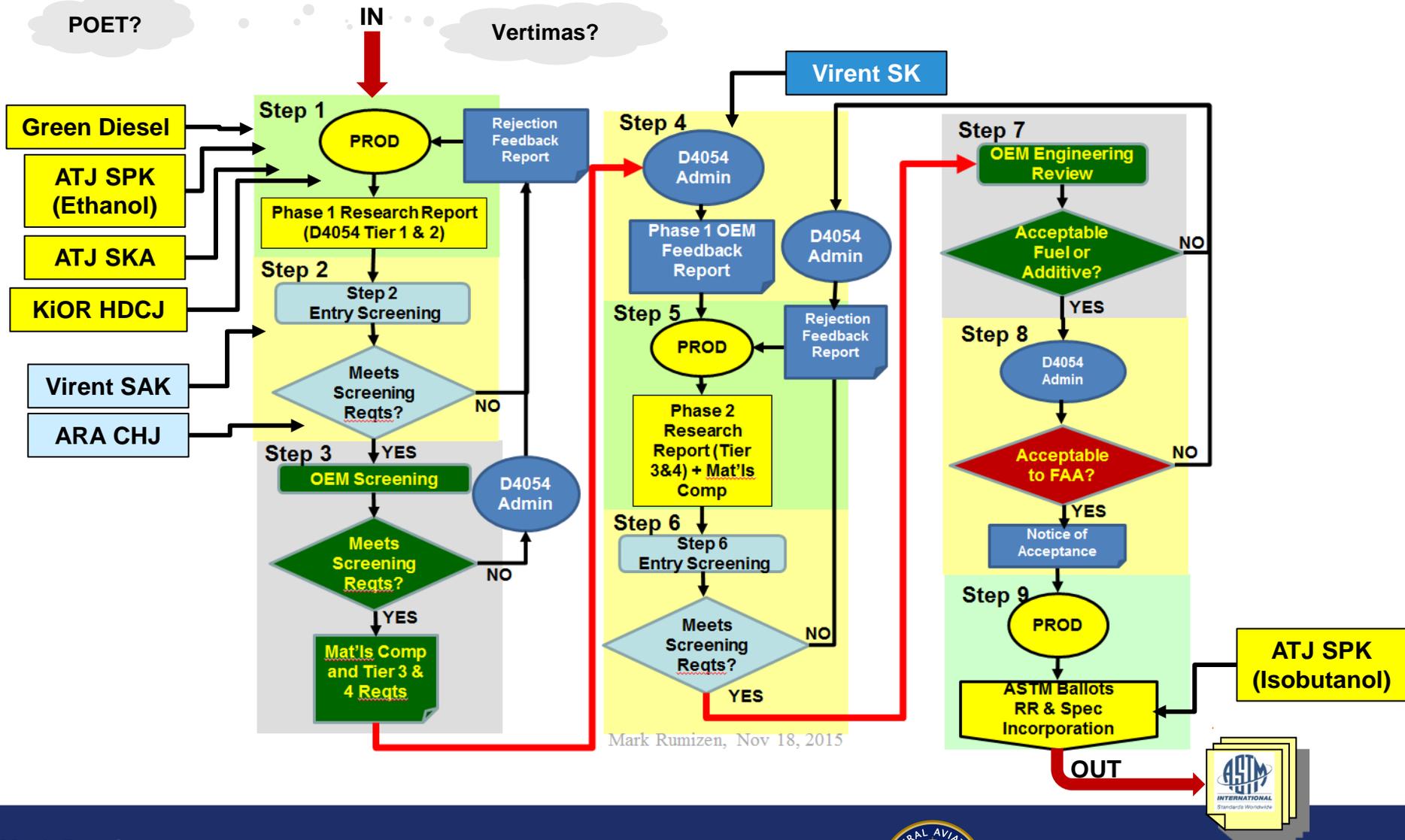
SAK: Synthetic Aromatic Kerosene

SK: Synthetic Kerosene

SPK: Synthetic Paraffinic Kerosene

SKA: Synthetic Paraffinic Kerosene with Aromatics

Status of Alternative Jet Fuels



Thank You



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