

# Alternative Aviation Fuels

**EASA Fuel Quality Seminar  
Cologne, Germany  
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Aircraft Certification**



**Federal Aviation  
Administration**



# Presentation Overview

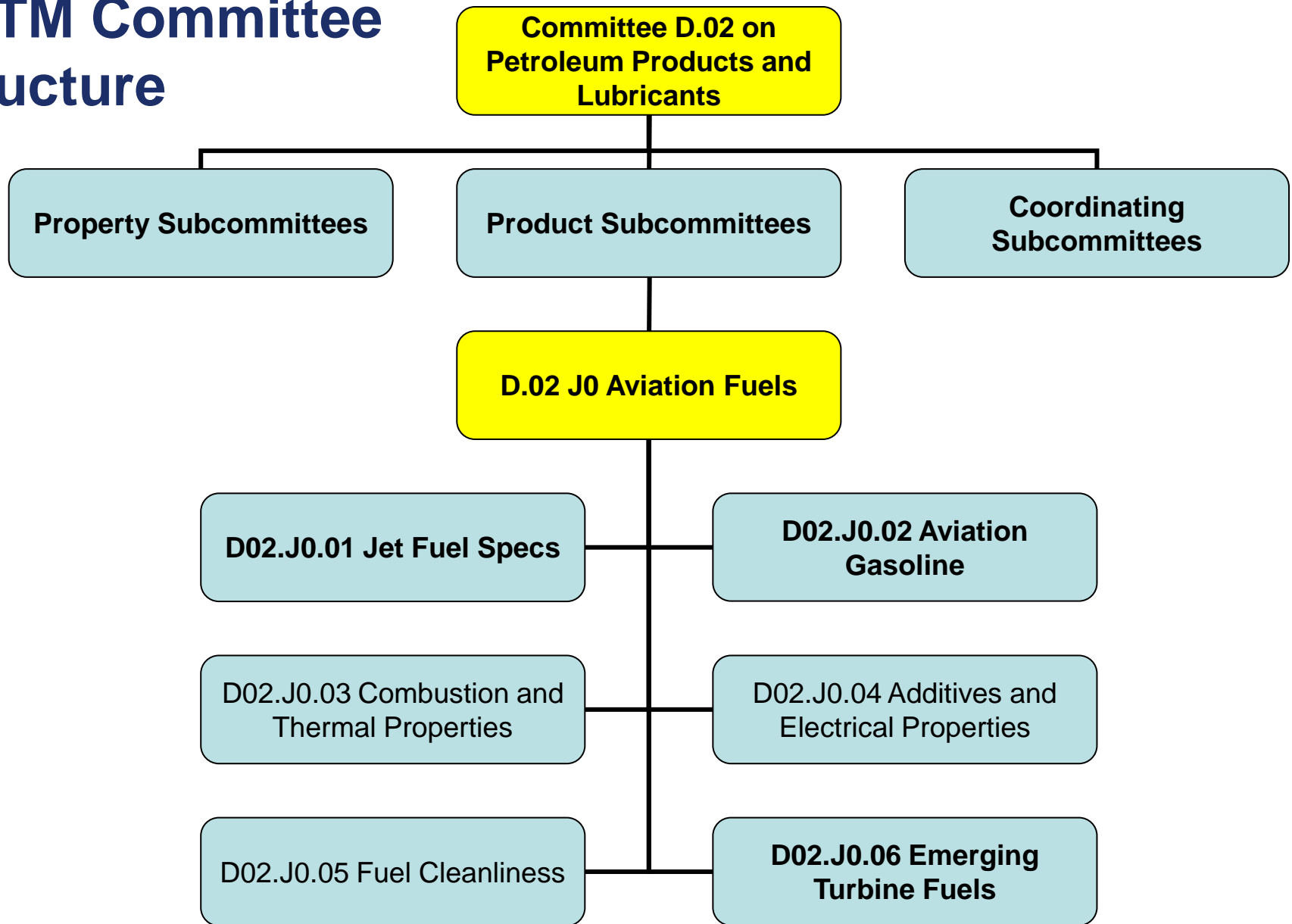
- **ASTM International Overview**
- **FAA Regulatory Oversight of Aviation Fuel**
- **Alternative Jet Fuels**



# ASTM International Overview

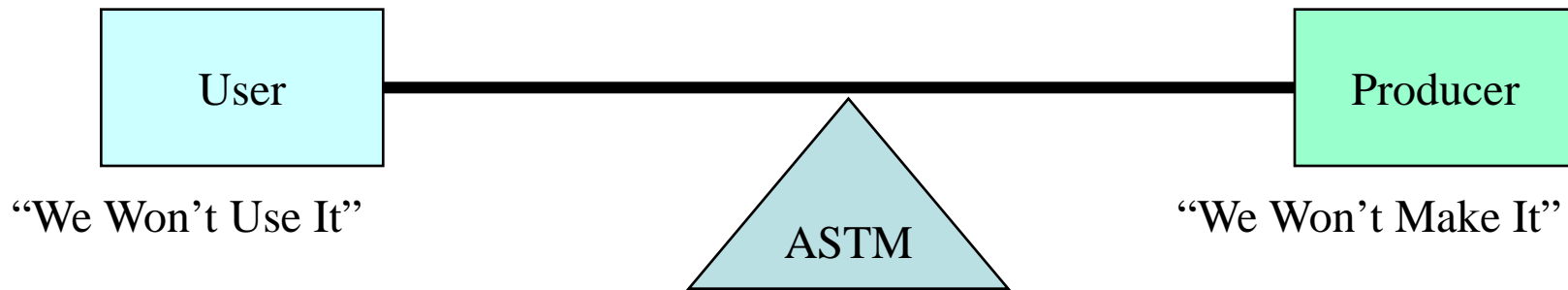


# ASTM Committee Structure



# 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



## Fuel Specs



Civil Aviation



# 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

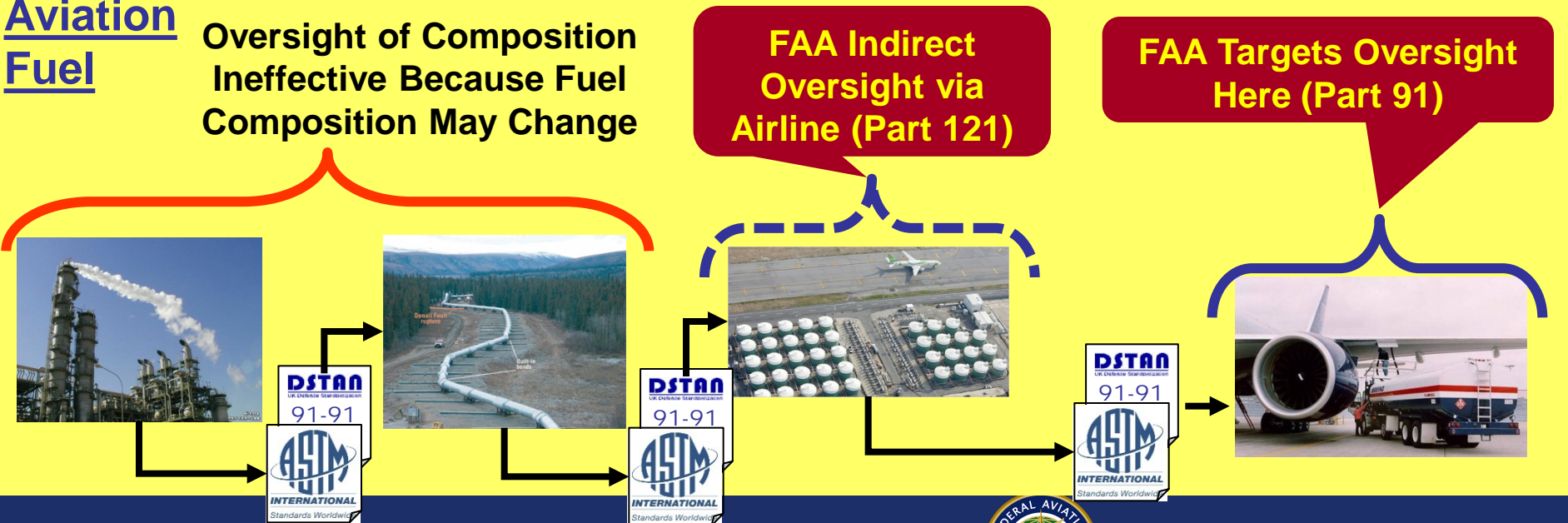


# FAA Oversight of Fuel

## Aircraft Parts



## Aviation Fuel



Federal Aviation Administration

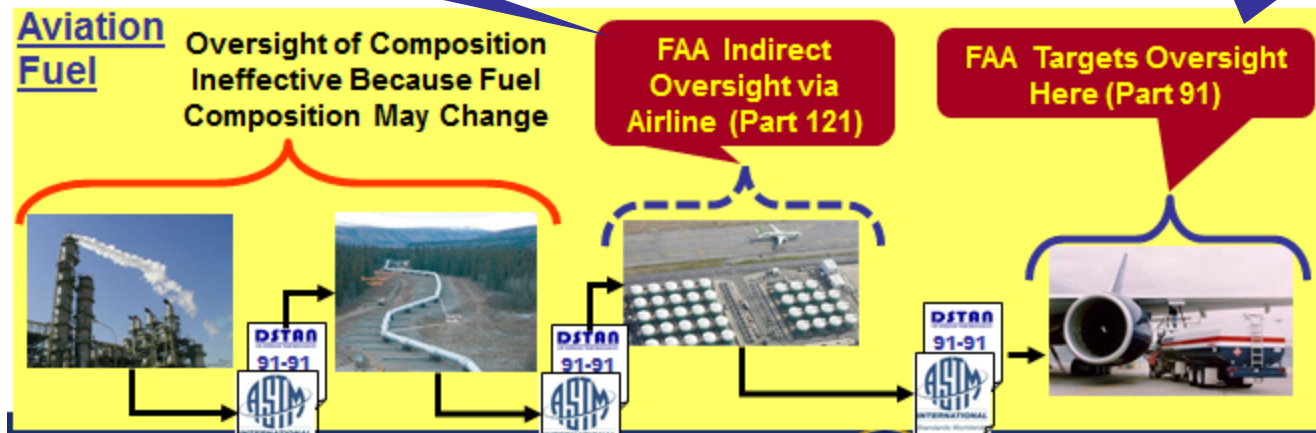
# FAA Oversight of Fuel

*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.

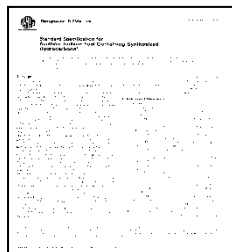
**91.9**  
Operator [airline] must comply with the [fuel] operating limitations specified by the engine and aircraft manufacturer



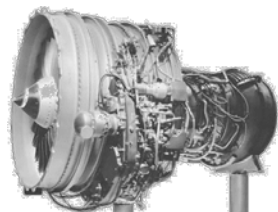
Federal Aviation  
Administration

# Operating Limitations Rely on Industry Fuel Specifications

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

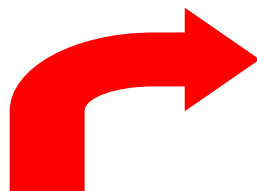


**ASTM Fuel Specification**



## **33.7 - Engine Ratings and Operating Limitations**

- Fuel Specification

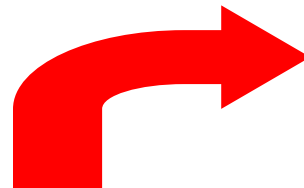


## **25.1521 - Powerplant Limitations**

- 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**

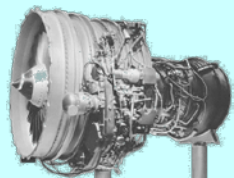


**Non-Drop-In Fuel**  
**New Spec**  
**(e.g., UL avgas)**

**Unchanged**  
**Operating**  
**Limitation**

**New Oper Limitation**

## FAA Certification



**Engine Operating**  
**Limitations**



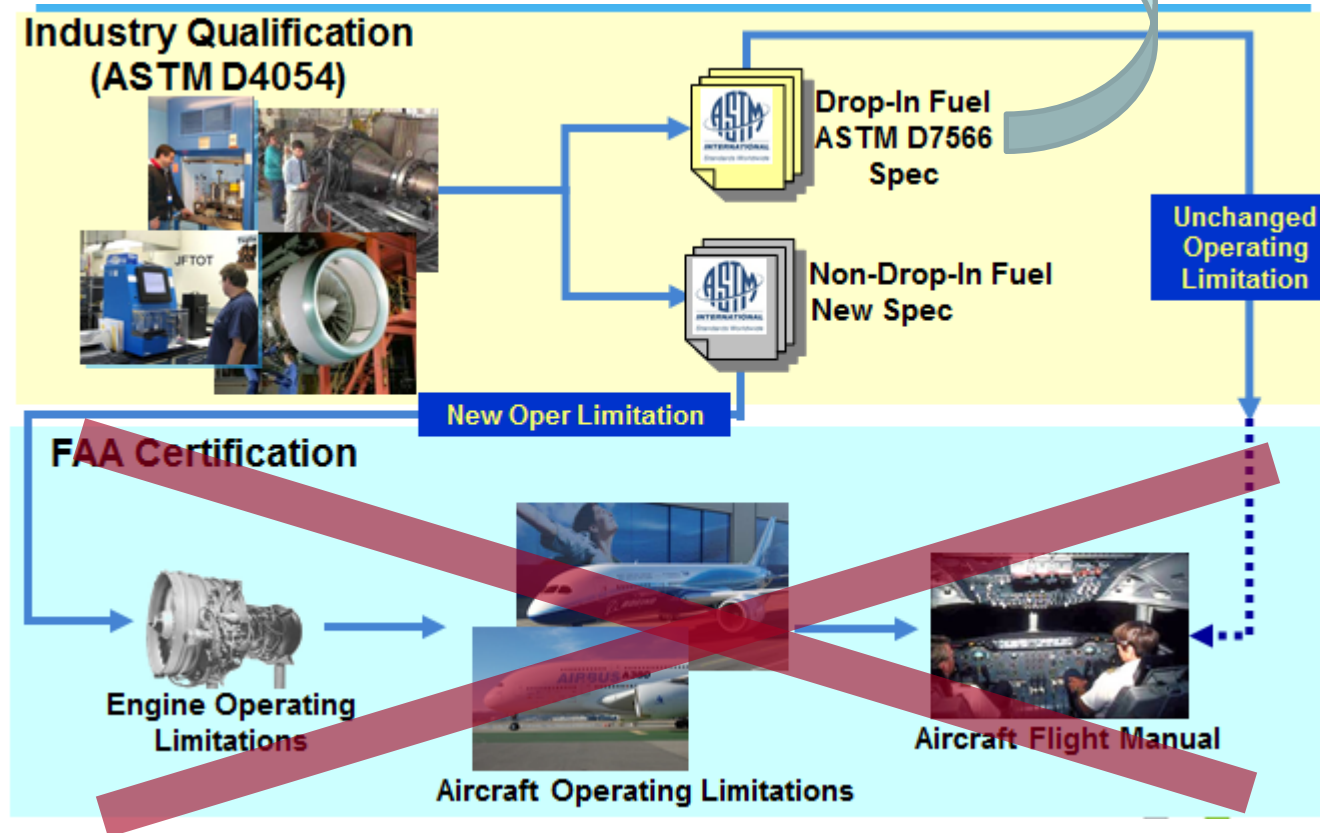
**Aircraft Operating Limitations**



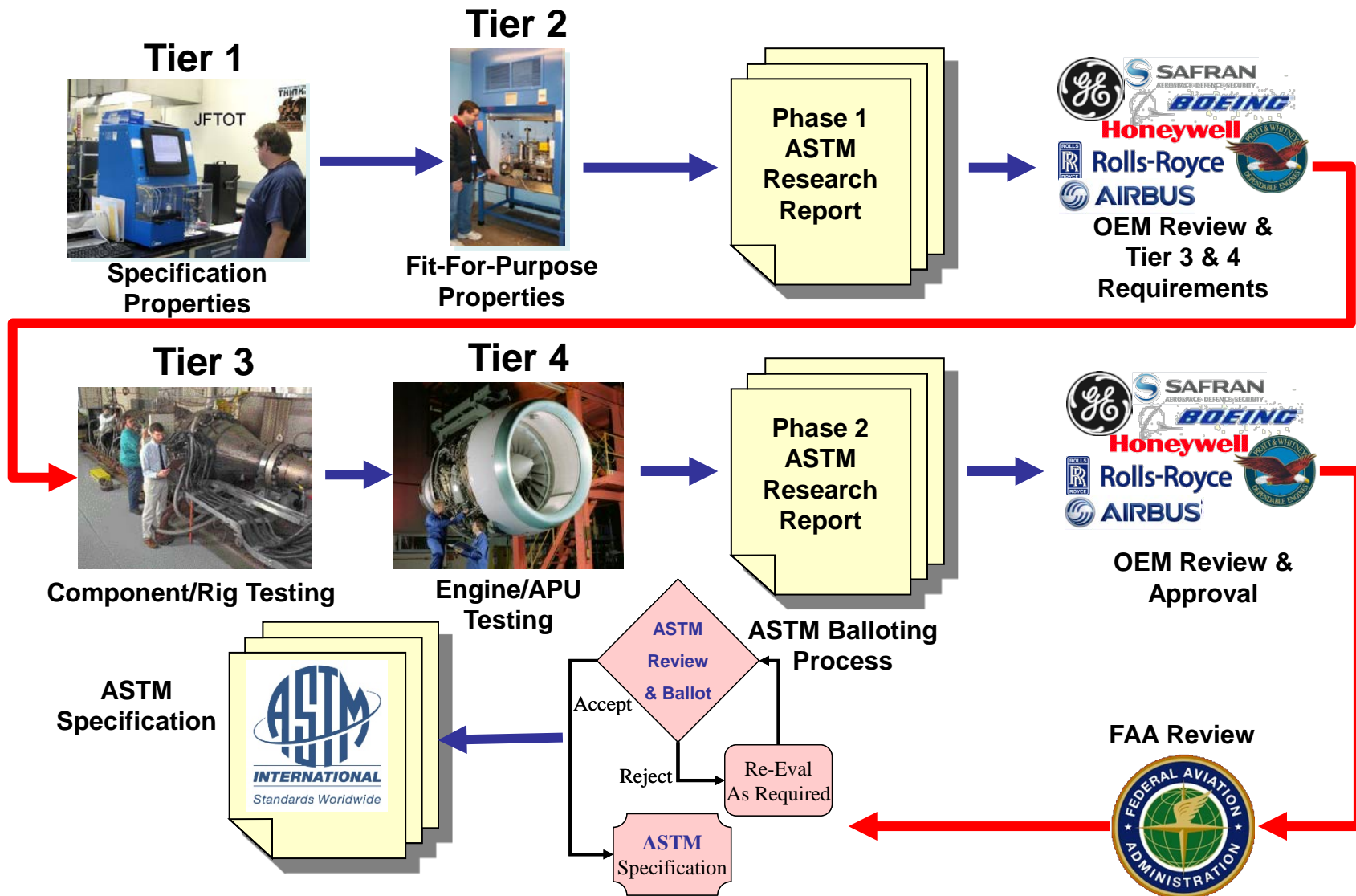
**Aircraft Flight Manual**

# For Drop-in Fuels...

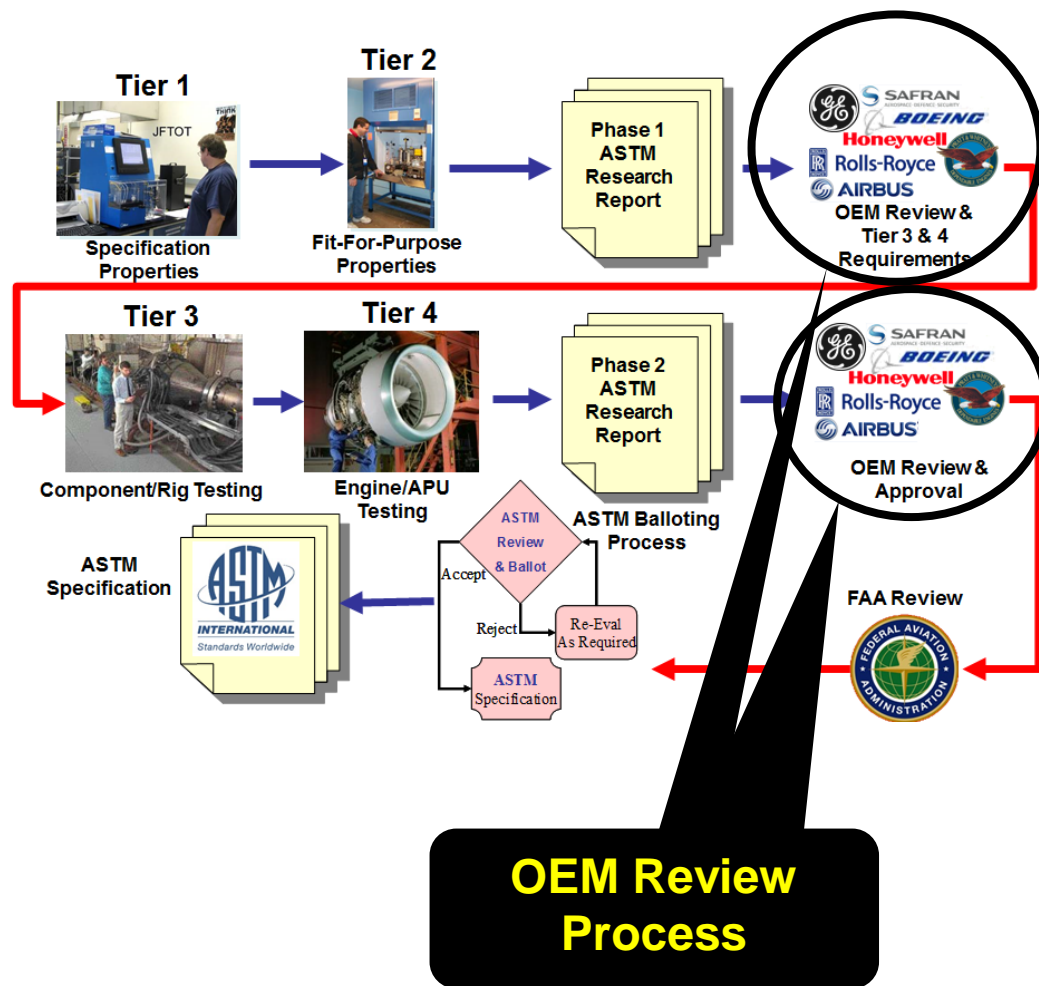
***ASTM Qualification = FAA Certification***



# D4054 Qualification Process

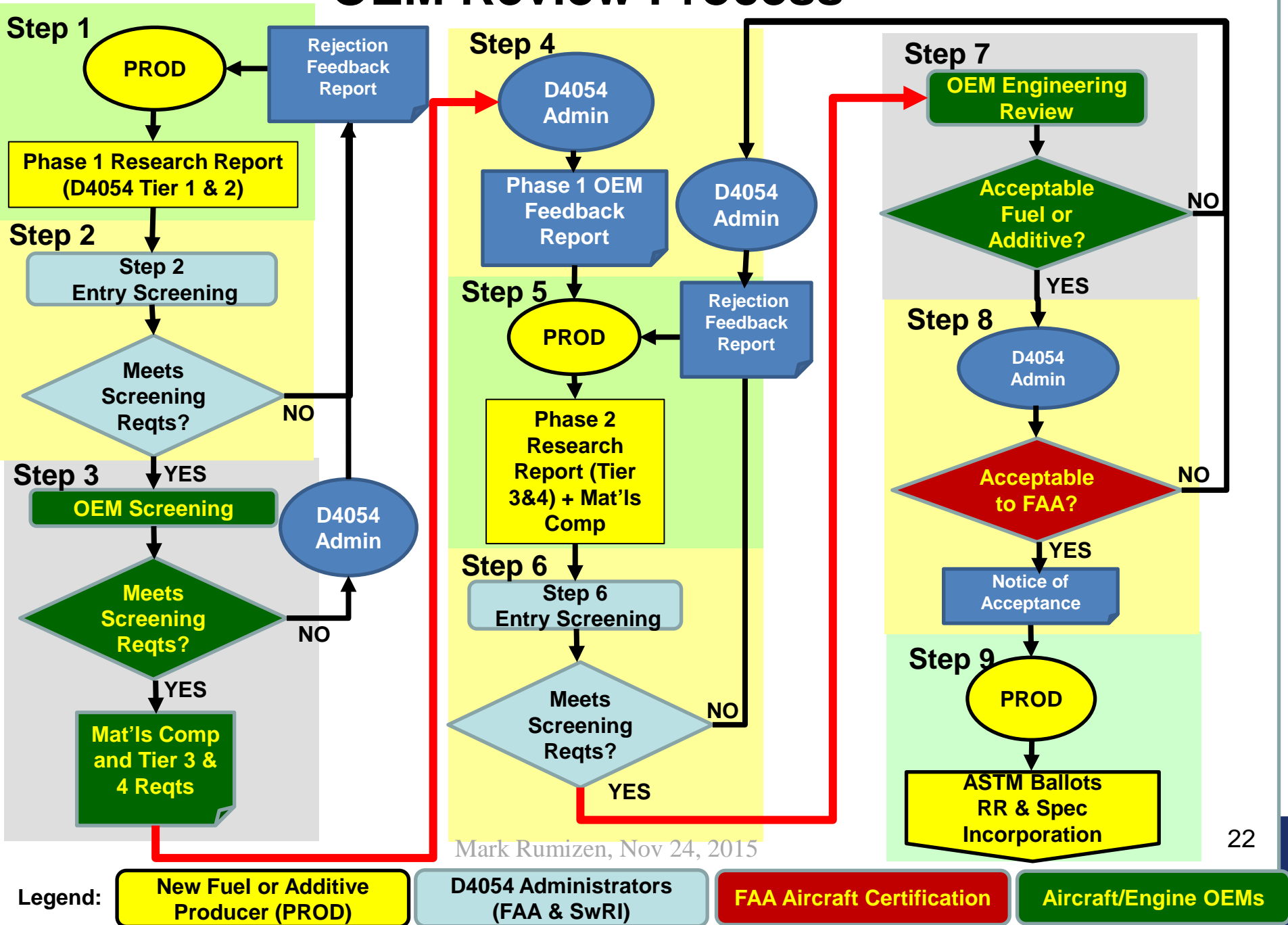


# OEM Review Process



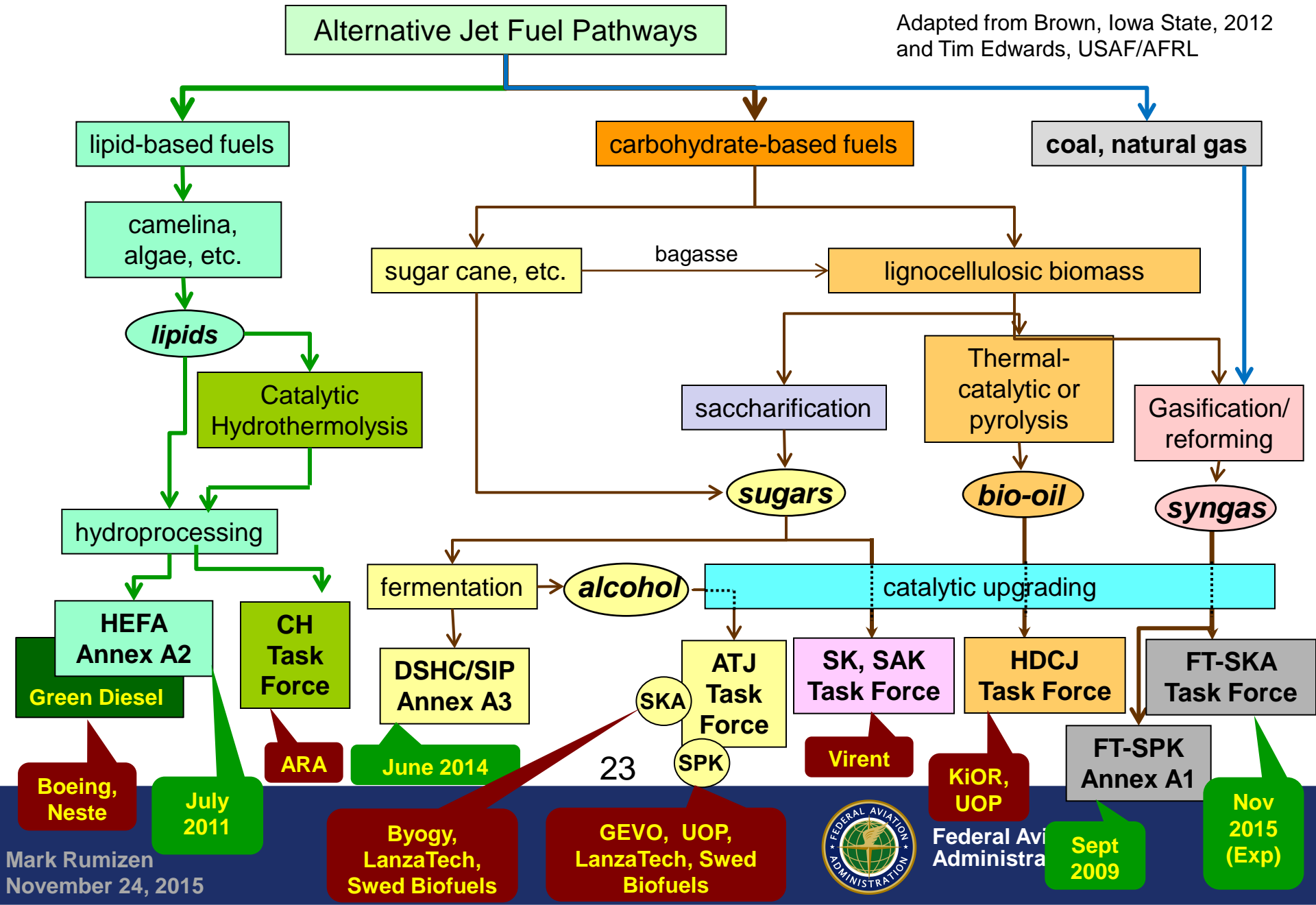
- Provides Feedback on Suitability of Product for Use on Aircraft/Engines/APUs
- Necessary for FAA to Make a Determination that D1655 will Continue to Provide Airworthy Fuel
  - Certification Basis is Maintained on All Aircraft/Engines
- Required for Proposed Alternative Fuel to Advance to ASTM Balloting

# 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

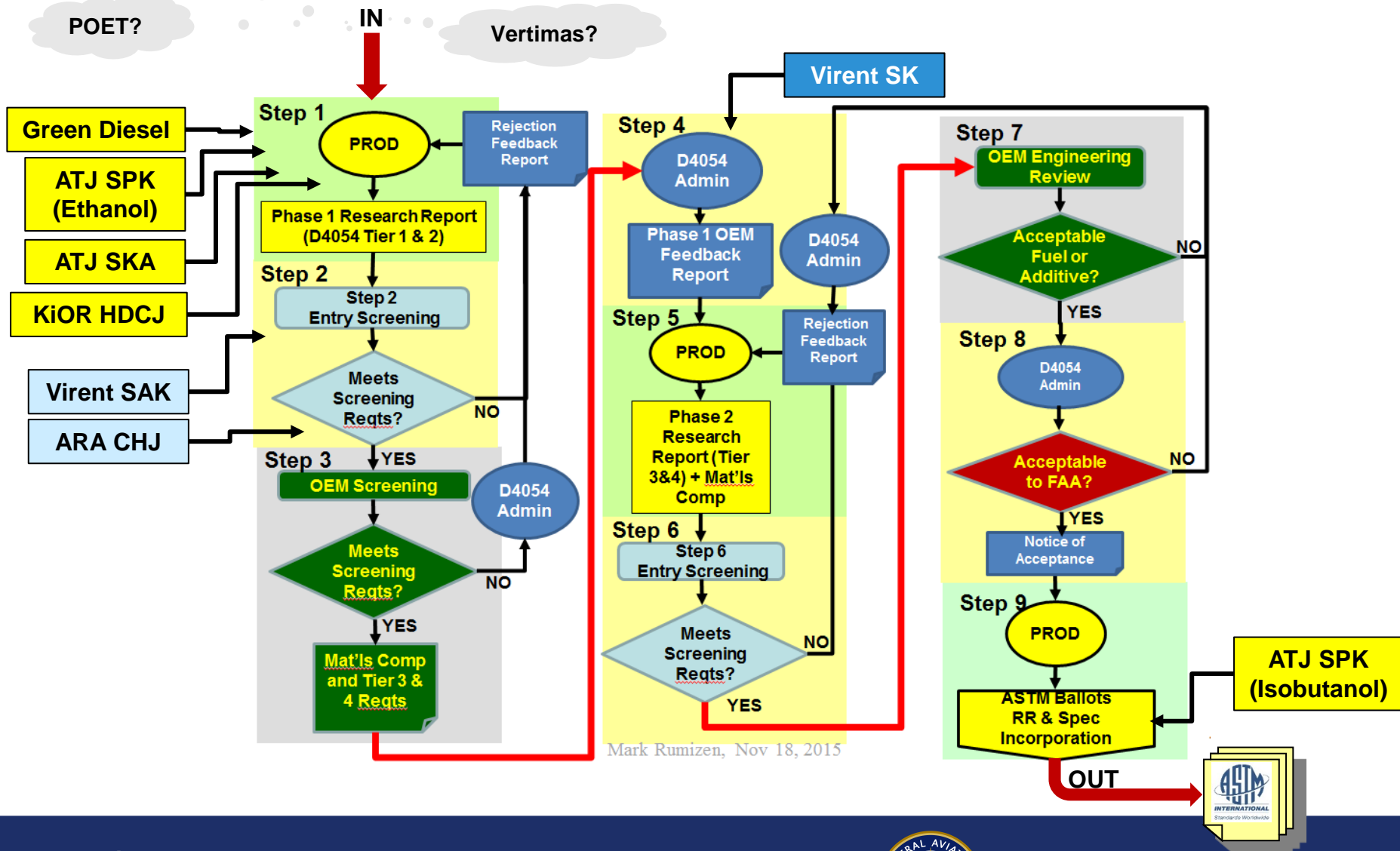
SAK: Synthetic Aromatic Kerosene

SK: Synthetic Kerosene

SPK: Synthetic Paraffinic Kerosene

SKA: Synthetic Paraffinic Kerosene with Aromatics

# Status of Alternative Jet Fuels



# Thank You



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