ASTM Emerging Turbine Fuels Subcommittee Activities

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Vice Chairman, ASTM D.02.J

Aviation Fuel Subcommittee

Chairman, Emerging Turbine Fuels Section

ASTM International

- ASTM is an NGO
  - Quasi Governmental
  - Voluntary Consensus Standards
  - Balanced Representation
  - Volunteer Driven
- Aviation Fuel Subcommittee
  - Truly International in Scope
    - Manages IATA ISLG
    - Meet with IATA in May
  - Standards Adopted by ANSI

Aviation Turbine Fuel

- Jet A/A1 – Essentially One Fuel Worldwide
  - Airplanes Go Everywhere
  - Reliable Fuel Quality Essential
  - Multiple Tasks
    - Power, Cooling, Actuation

- Common Requirement
  - All Commercial Aircraft Recognize Two Specs:
    - ASTM D1655 and UK(MOD) DS91-91
      - Some Use Current
      - Some Approve by Year (ASTM) or Issue (MOD)
      - Some Translate to Local Version (Ex: Spain, China)

Two Main Specifications

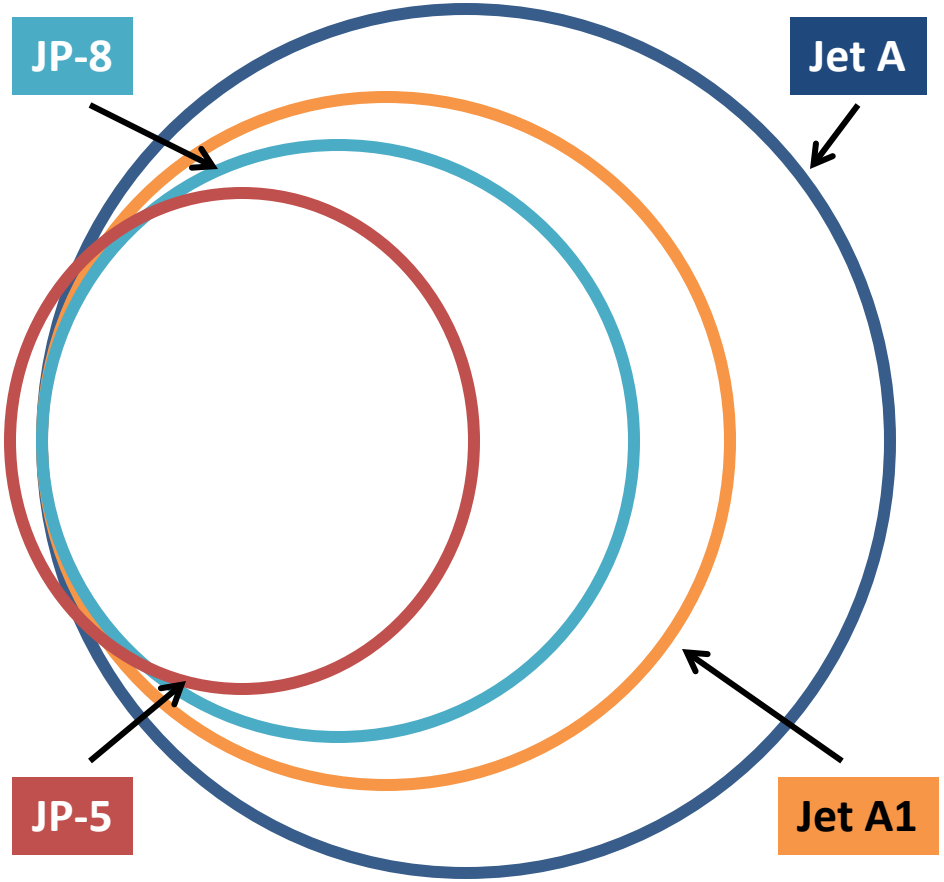
ASTM D1655 – Jet A/A1

- ASTM International
  - NGO that Develops Consensus Standards
  - Open Membership
    - Producer to User Balance
  - Subcommittee D.02.J on Aviation Fuels Writes Standards
  - Authority Derived from FAA

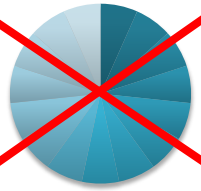
UK(MOD) DS91-91 – Jet A1

- United Kingdom (Ministry of Defence)
  - Aviation Fuel Committee
    - Provides Advice to MOD
    - Membership by Invitation
  - MOD Authored
  - Direct Government Authority

The Reality of Kerosene Jet Fuel



Specifications vs. Fit for Purpose



Acidity	Aromatics	Sulfur
Distillation	Flash Point	Density
Freeze Point	Viscosity	Heat of Combustion
Smoke Point	Corrosion	Thermal Stability
Existent Gum	MSEP	Conductivity

Specifications	Fit for Purpose	Material Compatibility	Engine/Component Tests
Composition	**Chemistry**	**Additive Compatibility**	**Hot Section Corrosion/Erosion**
Acidity	Hydrocarbon Type	FSII	Metallurgy
Aromatics	Aromatics	CI/LI	Coating
Sulfur	**Trace Materials**	SDA	**Component Testing**
Volatility	Organics	AO	Fuel System
Distillation	Inorganics	MDA	Fuel Pump
Flash Point	Metals	**Fuel to Fuel Compatibility**	Fuel Control
Density	**Bulk Property**	**Non Metallic Materials (37)**	Fuel Nozzle
Fluidity	Precision Distillation	Adhesives	Combustor Rig Testing
Freeze Point	VapP vs T	Bladders	Cold Start, SL to 10,000 ft
Viscosity	Deposition Characteristics	Aircraft Coatings	Lean Blowout
Combustion	Lubricity/CI Response	Bulk Tank Coatings	Aerial Restart
Heat of Combustion	Vis vs T	Sealants	TIT Distribution
Smoke Point	Spec Heat vs T	Composite Materials	Combustor Efficiency
Corrosion	Density vs T	Foams	Carboning/Coking
Thermal Stability	Surf Ten vs T	O-rings	Emissions
Contaminates	Bulk Modulus vs T & P	Nitrile	APU Altitude Start
Existent Gum	T Cond vs T	Fluorosilicone	**Engine Test**
MSEP	Water Sol vs T	Fluorocarbon	
Additives	Flash Point	Gaskets	
Conductivity	Freeze Point	Fuel Hose	
	Electrical Properties	Teflon	
	Dielectric vs Density	Nylon	
	Conductivity/SDA Response	Polyethylene	
	Handling and Safety	Kapton	
	Effect on Clay	Potting Compound	
	Filter Separator Efficacy	**Metals/Metal Coatings (31)**	
	Monitor Performance	Al-Cr Anodize	
	Storage Stability	Sulfuric Anodize	
	Peroxides over time	Chromate Conversion	
	Potential Gum	Wrought Aluminun	
	Toxicity	Cast Aluminum	
	LEL & UEL	CuNi	
	AIT	Solder	
	HSIT	Austentic Stainless Steel	
		Non-Aus SS	
		Titanium Alloys	
		IVD Coating	
		Fasteners	
		CPM	
		InCo	
		Nitralloy	
		Monel	
		Waspaloy	
		Lead	
		Brass	
		Wire	

Crude Oil → Refining → Jet Fuel

Specifications are the <u>Minimum</u> Analysis Needed to Prove a Product Derived from a <u>Given Source</u> is Fit for Purpose

ASTM INTERNATIONAL

100+ FFP Items?

FUEL

Hero's Engine

Calories, MJ/kg

Ignition Characteristics

Low Temp Performance

Heat Transfer

Hydraulic Power

Lubricity

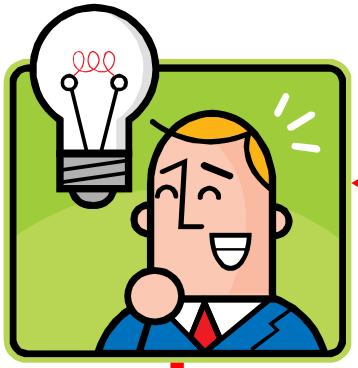
Modern Turbofan

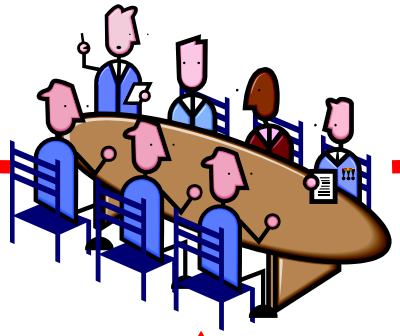
Alternative Sources

- **ASTM D1655** Standard Specification for Aviation Turbine Fuels
  - Point Sources from UK(MOD) DS91-91
  - Fuel Made to D7566
- **ASTM D7566** Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons
  - Alternative Fuel Produced by D7566 Can Be Used Directly as D1655 or DS91-91 Fuel
  - **ASTM D4054** Standard Practice for Qualification and Approval of New Aviation Turbine Fuels and Fuel Additives

Big Picture

FAA/OEM Panel





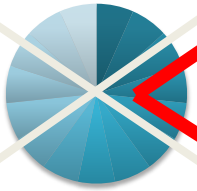
ASTM MOD

D7566 Annex

1. Concept
2. Fit for Purpose
3. Performance

D4054 Research Effort

Specifications vs. Fit for Purpose



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Freeze Point
Smoke Point
Existent Gum
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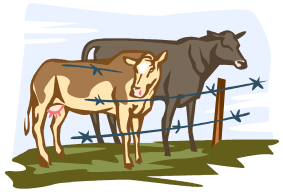
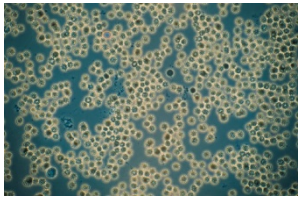
		Lead	
		Brass	
		Wire	

D7566 **Annex**





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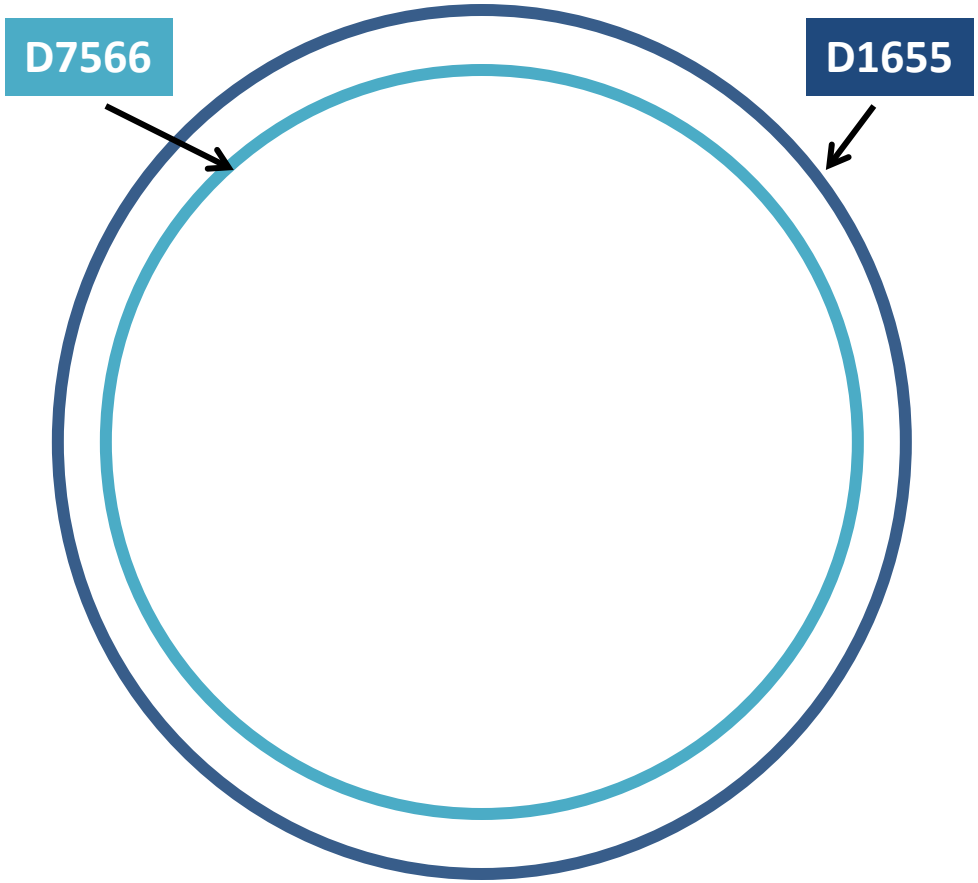

D7566 Alternative Fuel Status

- Generic Synthetic Jet Fuel has been Approved!
  - FT SPK: Synthetic Paraffinic Kerosene generated through the use of a Cobalt or Iron Catalyzed Fischer Tropsch System.
  - HEFA SPK: Synthetic Paraffinic Kerosene generated by hydro processing Organic Fats and Oils.
- Used for Both ASTM D1655 and UK(MOD) DS91-91
  - New Version of D7566 Coming with IP Methods Included
- Renewable?
  - Renewability is governmental issue, the specifications deal with technical requirements

Alternative Approaches

Status	Class	Process	Feedstock
Completed			
Annex A1	FT SPK	Fischer Tropsch (FT) derived SPK	Coal, Natural Gas, Biomass
Annex A2	HEFA SPK	Hydroprocessed Fats and Oils (HEFA) derived SPK	Triglyceride Oils
In the Approval Process			
	FT SKA	FT derived SKA	Coal, Natural Gas, Biomass
	ATJ SPK	Fermentation alcohol, oligmerized and hydrotreated (ATJ) derived SPK	Sugar, Alcohol
In Development			
	ATJ SKA	ATJ derived SKA	Sugar, Alcohol
	CH SKA	Hydrothermal Cracking and Cyclization derived SKA	Triglyceride Oils
	CRJ SPK	Catalysis, oligermerized and hydrotreated derived SPK	Sugar, Alcohol
	DSHC SPK	Direct Fermentation to SPK	Sugar
	HEFA SKA	HEFA derived SKA	Triglyceride Oils
	HDCJ SKA	Hydroporcessed Depolymerized Cellulose derived SKA	Lignocellulose
	SAK	Catalysis to SAK	Sugar, Alcohol

SPK Synthetic Paraffinic Kerosene
SKA Synthetic Kerosene with Aromatics
SAK Synthetic Aromatics, Kerosene boiling range

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Only Hydrocarbon Fuel?

- As A Drop In Replacement? Yes
  - Single Fuel Worldwide Drives This
- A Regulatory Prohibition? No
  - Ex: BioKerosene or High Flash Alcohol
  - Compatible?
    - Yes – A/C can use interchangeably with Jet A/A1
    - No – Specific Application
  - Very Long Road
    - Sasol FT, Concept to Use – About Two Decades

Alternate Fuel Concerns

- **Hubris**
  - Know It All
- **Ignorance**
  - Cannot Bother to Learn
- **Carelessness**
  - Failure to Grasp the Concept

- This is Why D7566 Includes the Same Use Information as D1655

- It is the User's Responsibility to be Sure Fuel is Right
  - Make Sure Projects Include Jet Fuel Experts

Regulations

- FAA/CAA Type Certificates
  - Legal Requirement to Follow
  - Airplanes Too Expensive to Experiment
- Informal Requirements
  - Joint Inspection Group (JIG)
  - Airlines for America (A4A)
- International Civil Aviation Organization
  - Concerned by Incidents
    - Surabaya Incident Led To Act
  - ICAO 9977 - Manual on Civil Aviation Jet Fuel Supply

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