

California
Department of Food and Agriculture
Division of Measurement Standards
Petroleum Products Program
Fuels and Lubricants Laboratory

Development of Fuel Quality Specification for Ammonia
NH₃ Fuel Association
The Eleventh Annual NH₃ Fuel Conference
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Des Moines, IA
Allan Morrison

Presented by Bill Ayres, Renewable Solutions, LLC



Reasons for a Fuel Quality Standard

- Establishes minimum specification for OEM's
- Establishes minimum specification for fuel providers
- Identifies contaminants that cause harm to engines
- Provides specifications for regulator agencies to use for fuel quality enforcement
- Establishes consensus test methods

First Steps

- Do we need a ammonia fuel standard?
 - Yes A fuel quality standard is a must
- Identify stakeholders
 - OEM's with an interests in NH3 fueled engines
 - Potential NH3 Fuel Providers
 - Regulators including Air Pollution Districts
- Choose an organization to work with

Ammonia Fuel Quality Standard

- What are the possible fuel uses
 - Spark ignition or compression ignition engines?
 - Fuel Cells
 - Turbines
 - Boilers
- Specifications can accommodate different grades

Current Specification

- Agricultural Grade
 - limit on water
- Industrial or Commercial Grade
 - Limits on water and oil
- Refrigerant Grade R717
 - Limits on water, oil and gases

Ammonia Grades

Chemical Analysis			
Grade	Agricultural	Commercial	R717
Ammonia wt %	99.5 to 99.8	99.5 to 99.8	>99.98
Water wt%	<0.5	< 0.5	<0.00025
Oil ppm	Not controlled	<0.5	0.003
H ₂ ,N ₂ , O ₂ , Methane	Not controlled	Not controlled	Tightly controlled

Refrigerant Grade R 717*

Composition	Units	Value
Ammonia	wt.-%	min. 99,98
Water	wt.-%	max. 0,003
Oil	wt.-%	max. 0,00025
Impurities in gas phase		
H2	ppm	27.5
N2	ppm	11
Methane	ppm	9
Ar	ppm	2.5
O2	ppm	-
Impurities in liquid phase		
H2	ml/100ml NH3	0.9
N2	ml/100ml NH3	0.7
Methane	ml/100ml NH3	0.2
O2	ml/100ml NH3	0.0
*ARI 700-99 Specifications for Fluorocarbons and Other Refrigerants		

OEM's

Not just for Motor Vehicles

- Ammonia can be a fuel for:
 - Stationary engines
 - Fuel Cells
 - Specialized agricultural engines
 - Grid energy storage systems
 - Isolated or remote power needs
 - Marine engines
 - Rail locomotion

Ammonia Fuel Providers

- Agricultural Ammonia Producers
- Chemical Producers
- Stranded Energy
 - Natural Gas and Electricity
- Renewable Energy
 - Wind
 - Solar
 - Waste

Regulators Protect

- The Public
- Consumers
- Distributors
- Producers
- OEM's
- Environment



Grrrrrrrrrrrrrrrrrrrr

Consensus Organizations with Fuel Standards

- ASTM International supports participation of a wide range of producers, users, and general interest. Voting is open to all members.
- SAE International is an engineering focused organization. Voting is open to all members.
- ISO supports participation by a wide range of producers, users, and general interest. Voting is open only to member countries.

Recommend ASTM Committee D03 on Gaseous Fuels

Scope : ASTM Committee D03 on Gaseous Fuels is committed to the promotion of knowledge and the development of terminology definitions, specifications, classifications, recommended practices, and methods of sampling, analysis and testing relating to gases used as commercial fuels including but not limited to natural gas, reformulated natural gas, hydrogen, fuel cell gases and other miscellaneous gaseous fuels.

Committee D03 Contacts

ASTM Staff Manager: [Brian Milewski](mailto:bmilewski@astm.org)

610-832-9619

E-Mail: bmilewski@astm.org

Chairman: Raul Dominguez

909-396-2225

E-Mail: RDominguez@aqmd.gov

Vice-chairman: Daniel Bartel

847-2640408

E-Mail: Daniel.Bartel@airgas.com

New Standard Activity

ASTM Committees

- Determine if new standard is needed
- Identify key stakeholders
- Identify Committee and Subcommittee
- Have participants join the Committee
- Register a Work Item
- Prepare the standard
- Ballot the standard
- Standard approved

Establish Scope of the Standard

- Fuel Standards for different types of uses
 - Internal combustions engines
 - Ammonia as a stand alone fuel
 - Mixed fuel vehicle
 - Gas Turbines
 - Fuel Cells

Establish Specification Parameters

- Need for different grades?
- Minimum constituent levels
 - % NH₃
- Maximum contaminate levels
- Establish Test Methods
 - Adopted current test methods
 - Identify needed test methods
 - Interface with test method sub-committees
- Safety and handling information

What does “Work Item” mean

- ASTM establishes Work Item number
- A working group is established to develop the specifications
 - Consist of interested parties
 - Try to indentify all stakeholder concerns
 - Develop specifications
 - Prepare Ballots
- Submit ballot to sub-committee for vote

What does a ASTM vote mean

- Members vote affirmative negative or abstain.
- Comments are required from negative voters
- All negatives and comments must be addressed
- Negative normally mean the ballots are withdrawn, rewritten and balloted as new ballots
- Negatives can be found non-persuasive by a majority vote of official voting members
- Ballot is sent to the main committee for vote
- Passed ballot receive an editorial review
- Ballot becomes part of a new standard

Lots of Committee work



Finished Standard



Designation Dwxyz-16

Standard Specification for Ammonia for Fuel
Purposes

What Else Does a New Fuel Need?

- Emission profiles studies
- Carbon intensity calculations
- Energy Security benefits
- Fuels impact on public resources, human health and the environment.
- Labeling Requirements & Method of Sale
- Dispenser Type Approvals

How Can California Department of Food and Agriculture, Div of Measurements and Standards help?

Work with Ammonia champions to develop an ASTM fuel specification.

Keep Ammonia as a fuel on the agenda as a potential alternative fuel in California agencies

Provide a Development Fuel Variance for fuel use in California to promote the development of an ammonia fuel standard.

Contact Information

Allan Morrison, Senior Environment Scientist
Fuels and Lubricants Laboratory
Division of Measurement Standards
California Department of Food and Agriculture
6790 Florin Perkins Rd, Suite 100
Sacramento, CA 95828
916-229-3046
Allan.Morrison@cdfa.ca.gov