

# Alternative Fuels Quality and Oversight Program – Hydrogen Specifications and Analytical Results

Presented by:

Christina Daniels

California Department of Food & Agriculture, Division of Measurement Standards

3/7/2018

# Dispenser Requirements

- Certify retail hydrogen dispensers prior to use through the California Type Certification Program (CTEP).
- Conformance to California Code of Regulations (CCR) Title 4, Division 9 Section 3.39 Hydrogen Gas Measuring Devices is determined along with adopted portions of NIST Handbook 44.
- Must meet Acceptance Tolerance prior to being placed into commercial service. Registered Service Agents (RSA) can perform this work with County Official witnessing.
- Re-tested annually thereafter, Maintenance Tolerances are applied.

# Accuracy Classes of Motor Vehicle Fuel vs Hydrogen Fuel Dispensers

Accuracy Class	Acceptance Tolerance	Maintenance Tolerance
Hydrogen		
2.0	1.5%	2.0%
5.0	4.0%	5.0%
10.0*	5.0%	10.0%
Petroleum		
0.5 (1-30 gal/min)	0.03%	0.5%
0.3 (flow rate > 155 L/min)	0.02%	0.3%

\*No new installations after 2017. Existing installations allowed to operate until decommissioned.

# Weights and Measures

- California's expanded Accuracy Class 10 sunset on December 31, 2017. Per regulation, new commercial installations of devices with this classification are no longer permitted. Existing devices can remain in service provided maintenance tolerances are met during annual evaluations.
  - There are 2 dispensers that use accuracy class 10
  - All other dispensers are accuracy class 5
- A few dispensers met accuracy class 3, but they applied for class 5
- Department is developing 2018 regulatory language to adopt NIST HB 44 Section 3.39 single accuracy class for hydrogen gas measuring devices to harmonize specifications.

# Hydrogen Fuel Quality

- Chapter 14 of the Business and Professions Code requires the Division of Measurement Standards to establish and enforce quality specifications for transportation fuels in California.
- Quality Standards for hydrogen fuel were published in 2011 as SAE International's Surface Vehicle Standard J2719 – Hydrogen Fuel Quality for Fuel Cell Vehicles.
- SAE J2719 has been adopted by reference by the Department of Food and Agriculture in California Code of Regulations (CCR) Title 4, Division 9, Chapter 6, Article 8, Section 4181.
  - As SAE J2719 is updated or changed, the state automatically adopts the latest version.

# SAE J2719 Fuel Quality Specification

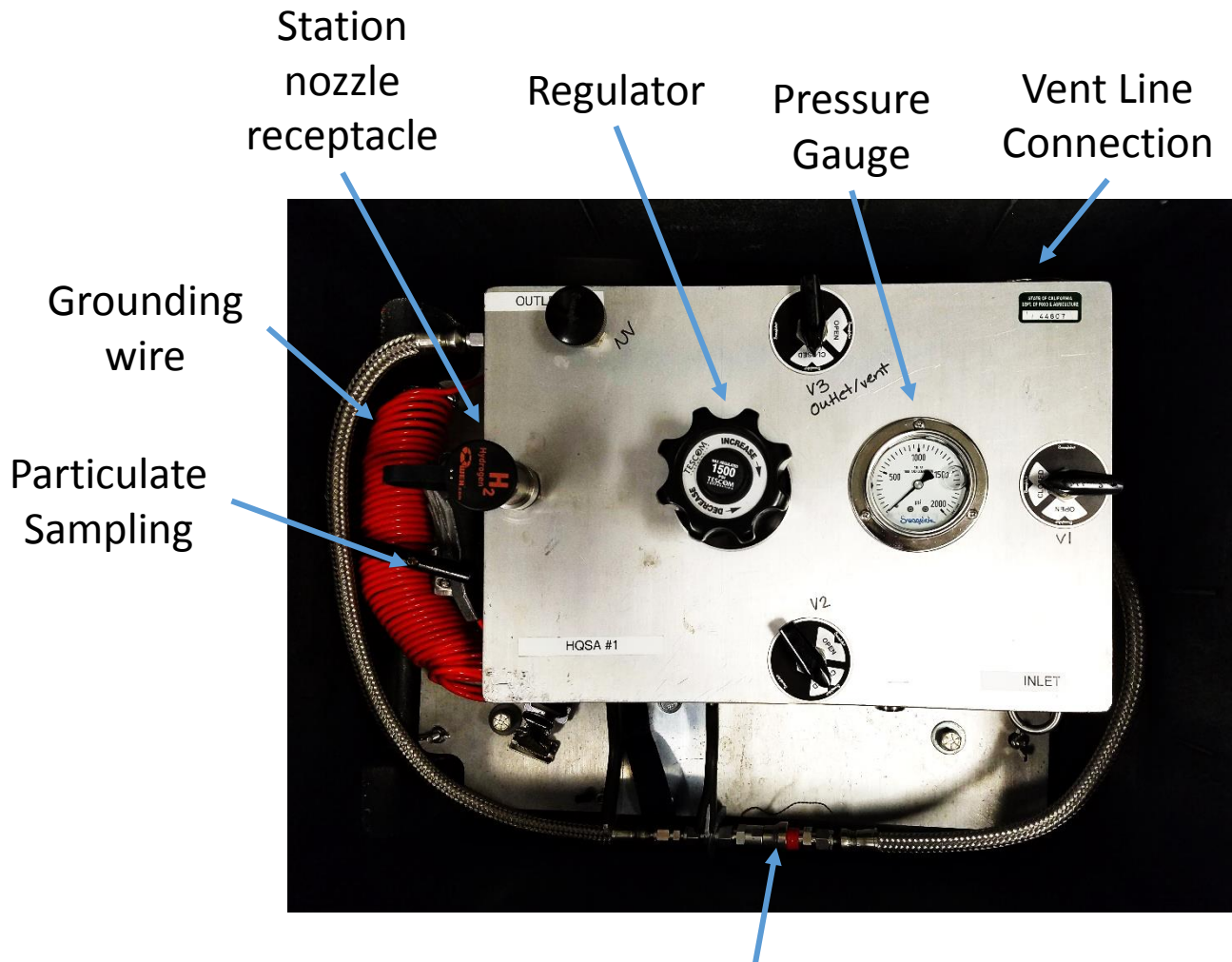
Specification	Value	CRDS	FTIR	GC System 1			GC System 2		
				ECD	MS	PFPD	FID	PDHID	TCD
Hydrogen Fuel Index (min, %)	99.97								
Total Gases (max, ppm V/V)	100								
Water (max, ppm V/V)	5	x	x						
Formaldehyde (max, ppm V/V)	0.01	x	x						
Formic Acid (max, ppm V/V)	0.2		x						
Ammonia (max, ppm V/V)	0.1	x	x						
Total Hydrocarbons (max, ppm V/V)	2						x		
Oxygen (max, ppm V/V)	5			x					
Helium (max, ppm V/V)	300								x
Nitrogen (max, ppm V/V)	100							x	
Argon (max, ppm V/V)	100							x	
Carbon Dioxide (max, ppm V/V)	2		x						
Carbon Monoxide (max, ppm V/V)	0.2		x						
Total Sulfur (max, ppm V/V)	0.004					x			
Total Halogenated Compounds (max, ppm V/V)	0.05				x				
Particulates Size (max, $\mu\text{m}$ )	10								
Particulate Concentration (max, $\mu\text{g/L @ NTP}$ )	1								

as of 03/06/2018

# Hydrogen Fuel Quality Enforcement

- Compliance to all specifications for hydrogen fuel quality identified in SAE J2719 is mandatory.
- Retailers dispensing, selling, or offering to sell hydrogen fuel that is out of conformance with specifications will have the nonconforming product immediately taken off-sale.
- The Division conducts random, routine, and compliant based sampling and testing of all retail motor fuels throughout the state.
- The Division will collect essential hydrogen fuel quality data throughout the state to support future decisions on hydrogen policies and processes.
- Hydrogen sampling is performed by ASTM D7606 – Standard Practice for Sampling of High Pressure Hydrogen and Related Fuel Cell Feed Gases.

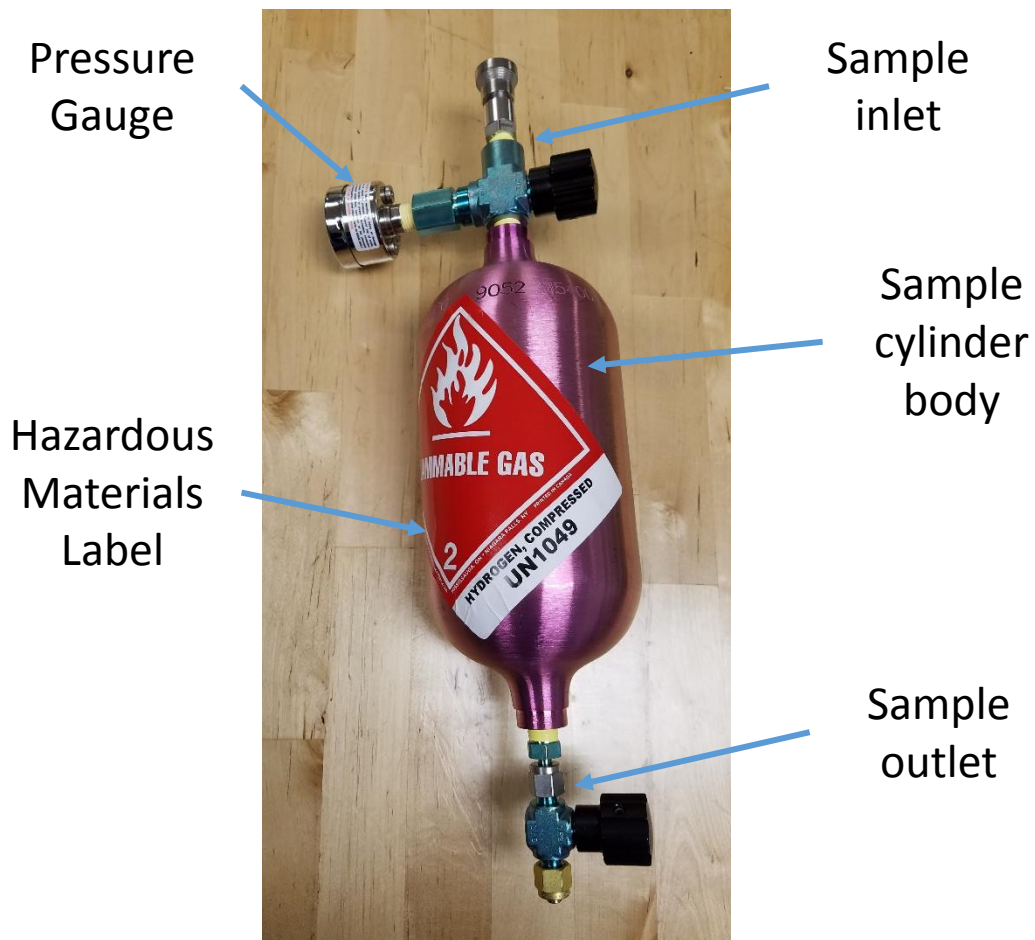
# Hydrogen Sampling Quality Apparatus (HQSA)



- Nozzle is connected to the HQSA and hydrogen is reduced from 10,000 psi to 1000 psi with the regulator.
- Fill 2 sample cylinders with 1 liter of hydrogen at 1,000 psi for a total volume of 70 L of sample.
- HQSA cost \$17,000 each.



# High Pressure Sample Cylinder (HPSC)

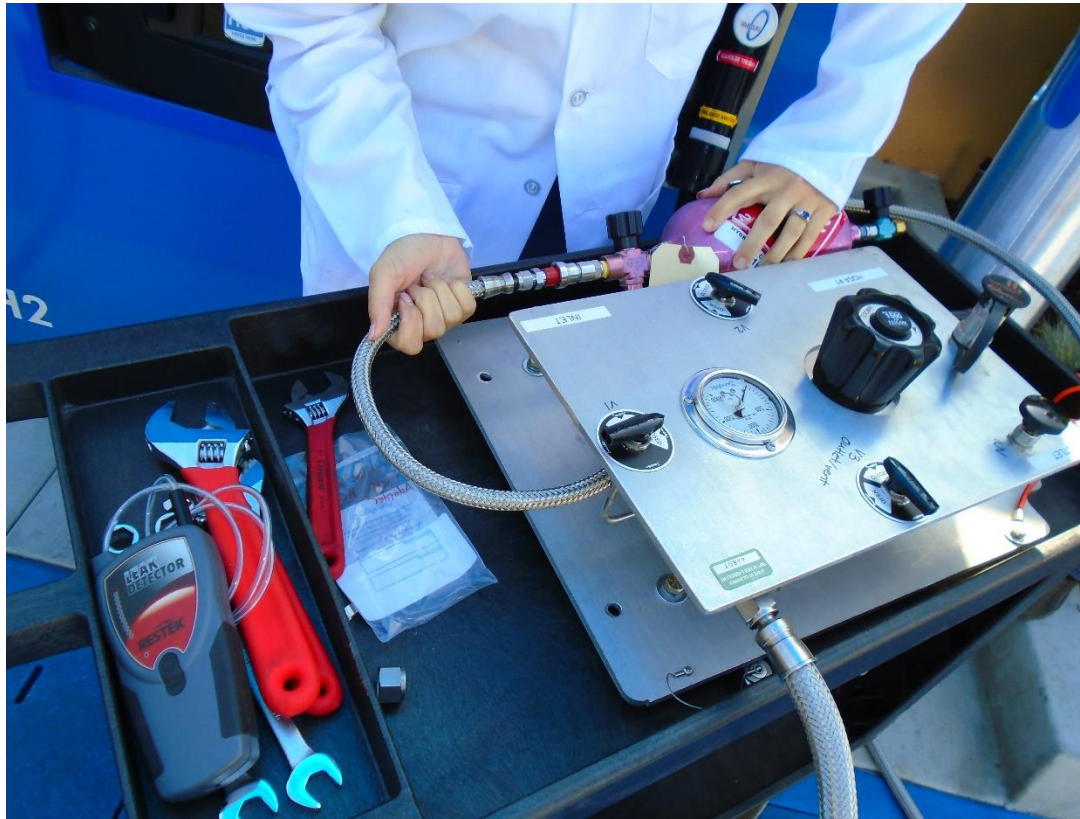


- Stores hydrogen for sampling in the laboratory.
- We take 2 samples. Samples should have comparable results.
- Vessels are specially coated.
- Cost \$1,000.

# Hydrogen Sampling



# Hydrogen Sampling



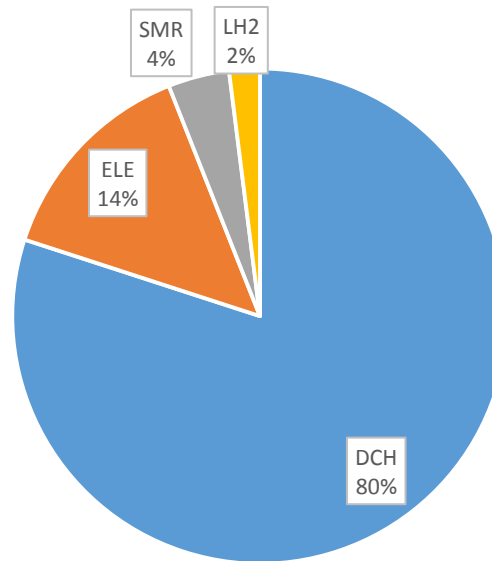
# Hydrogen Fuel Quality Laboratory



- Doubling our capacity by building a new lab in Anaheim.
- Striving to get our turn around time down to 2 days from sample arrival in the lab.

# Hydrogen Data Collection

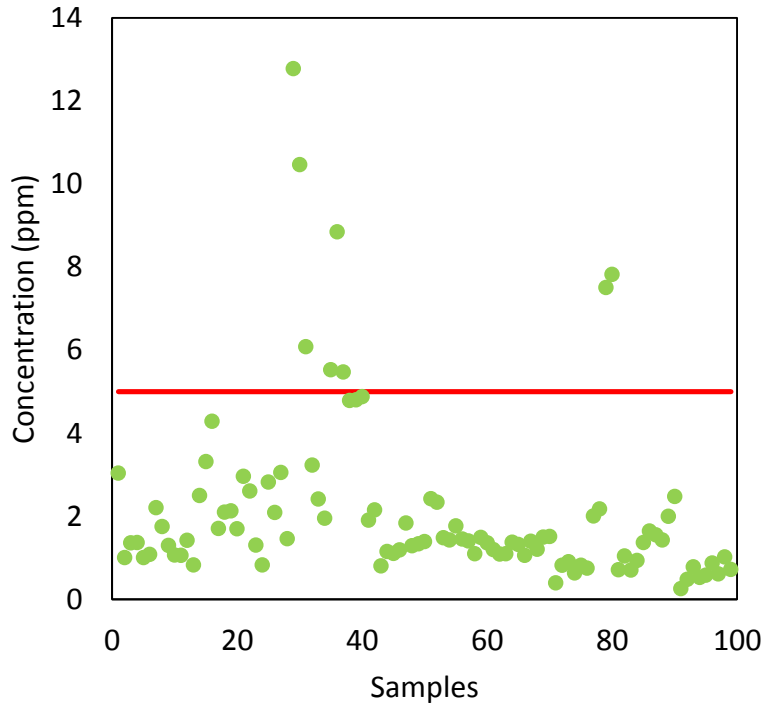
- Data collected between November 2016 – December 2017
- All samples were taken in duplicate
- There are a total of 100 samples taken from 50 stations
- Fuel source type:



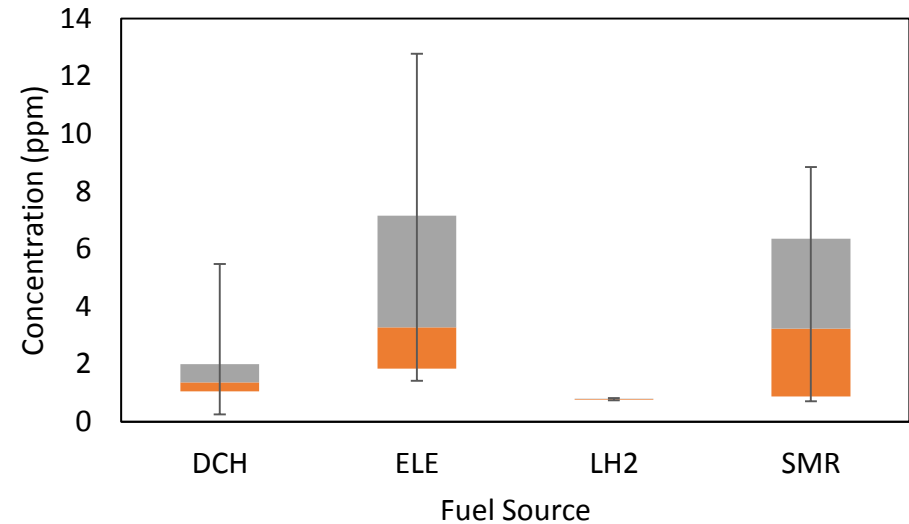
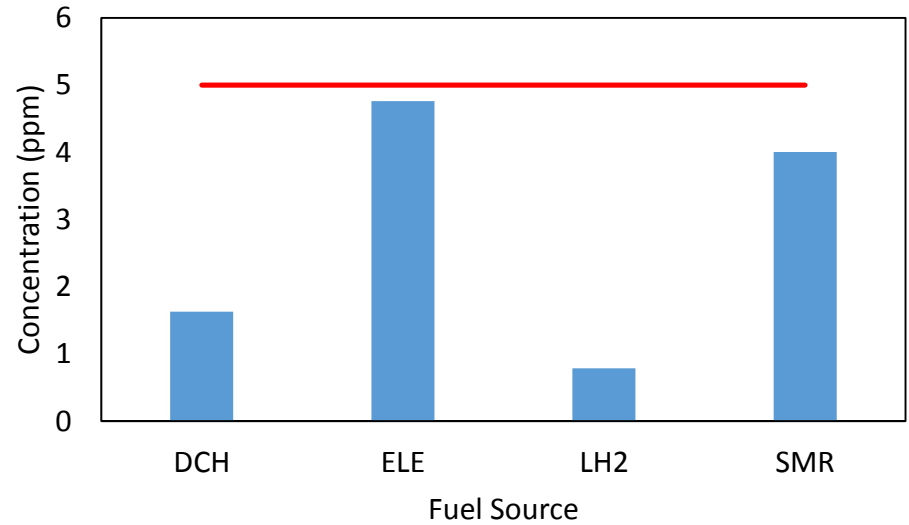
# Hydrogen Data Collection

- Nozzle pressure dispensed:
  - 70 MPa – 46 stations
  - 35 MPa – 4 stations
- Ammonia, carbon monoxide, formic acid, and argon we have never detected above our reporting limit
- We are not currently analyzing for oxygen and particulates
  - We plan to begin this year

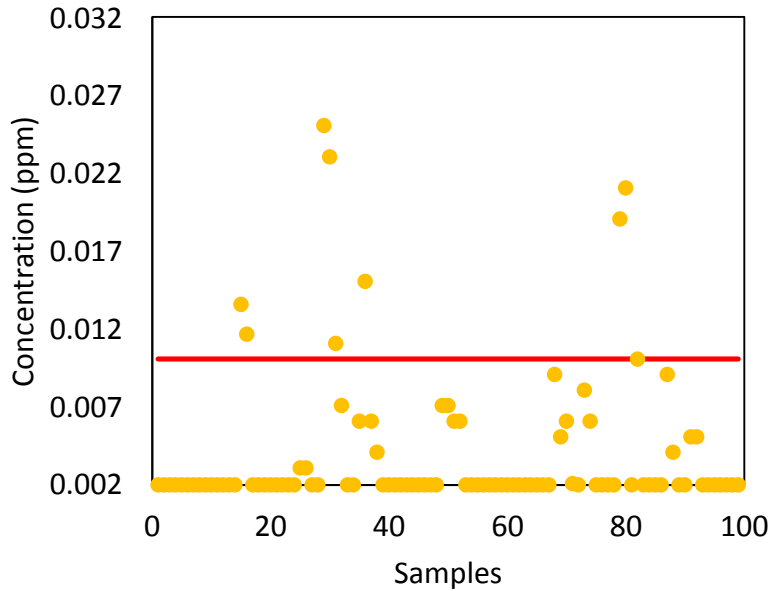
# Water



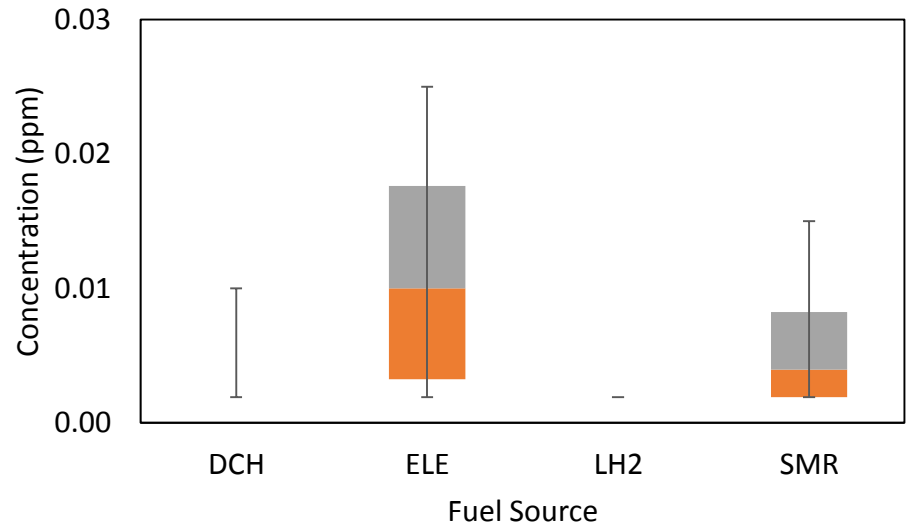
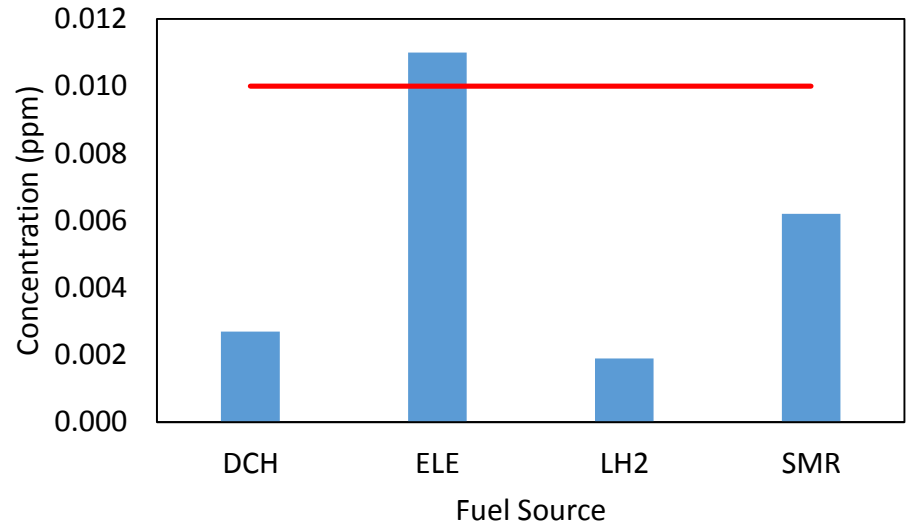
Red line indicates SAE J2719-2015 specification



# Formaldehyde

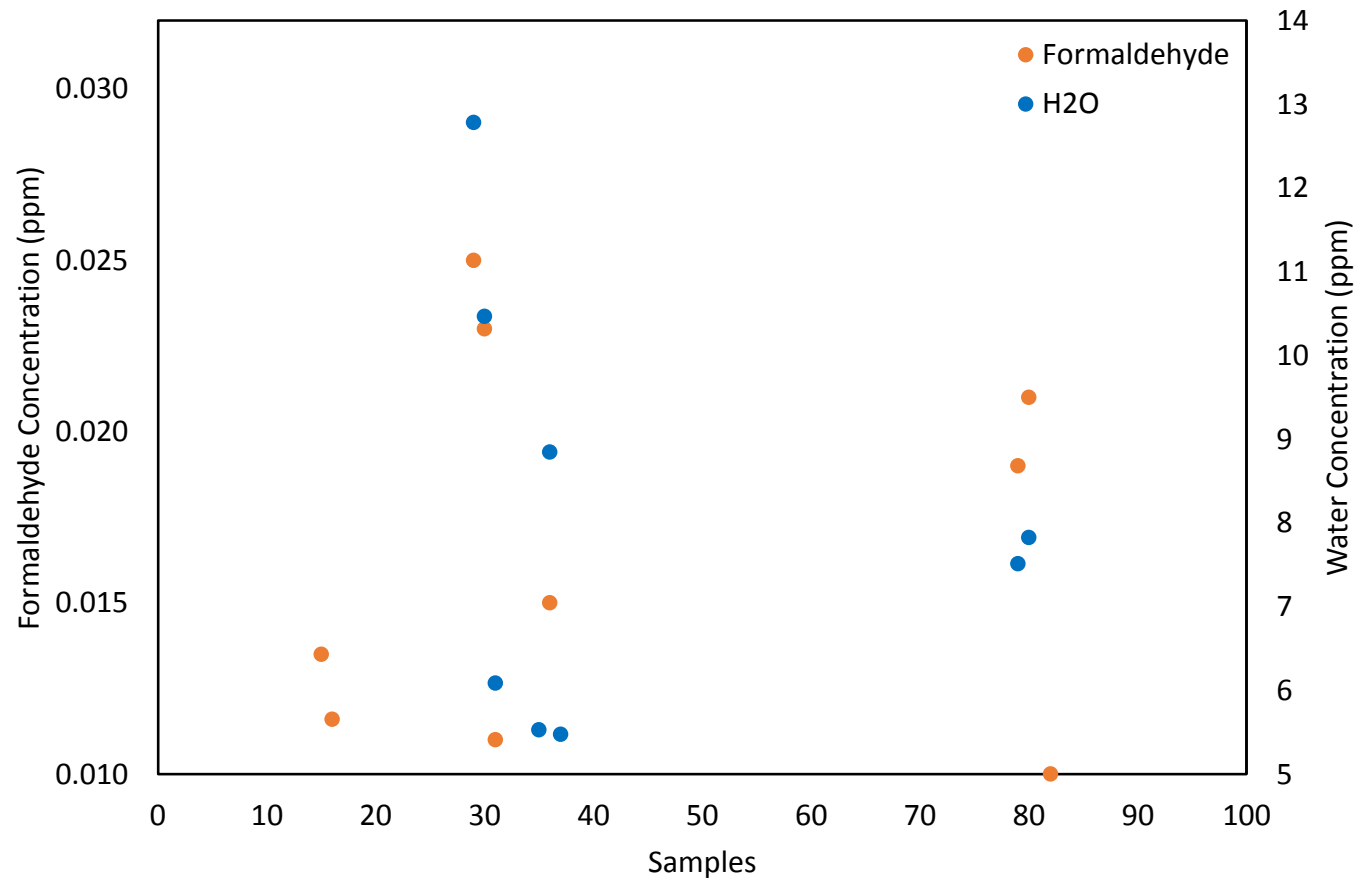


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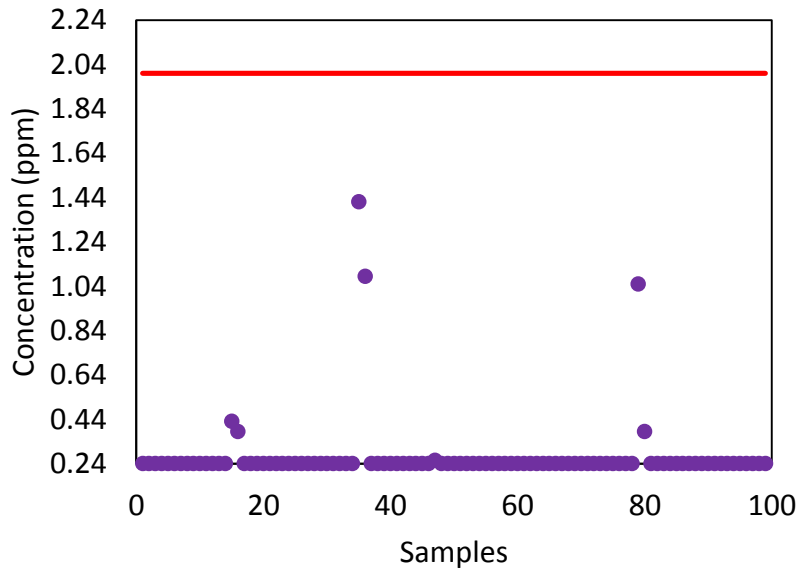




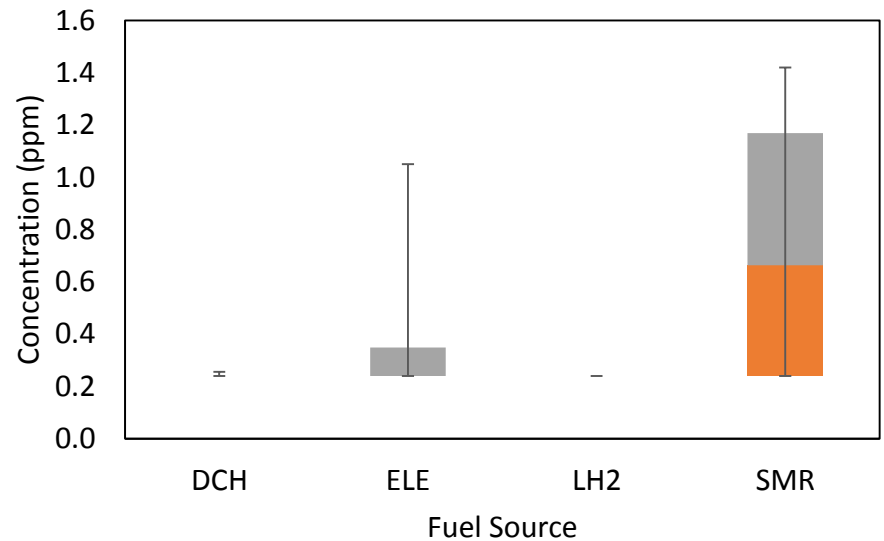
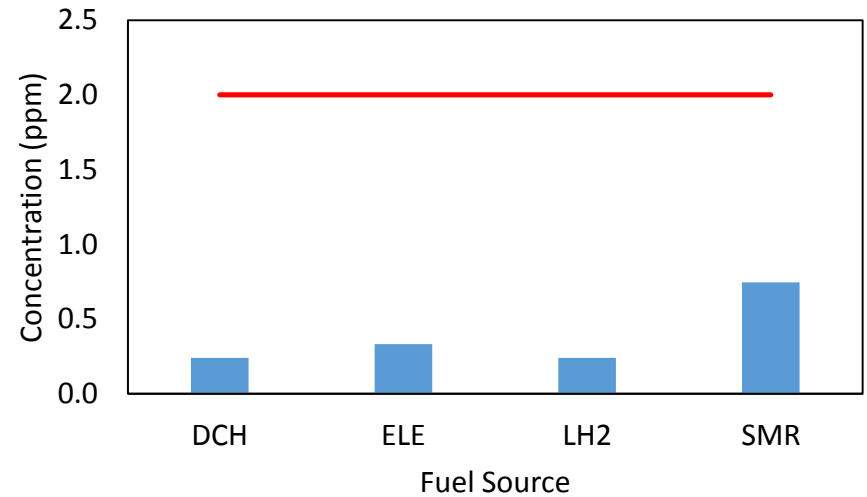
# Formaldehyde and Water



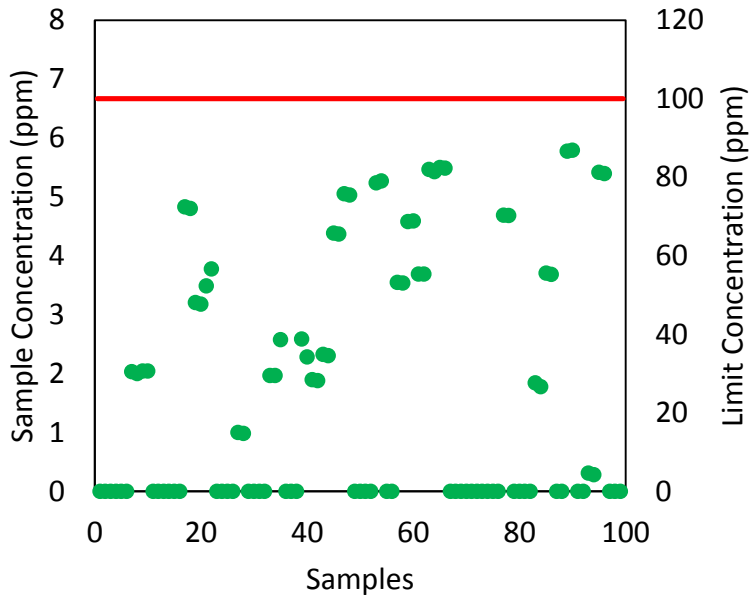
# Total Hydrocarbons minus Methane



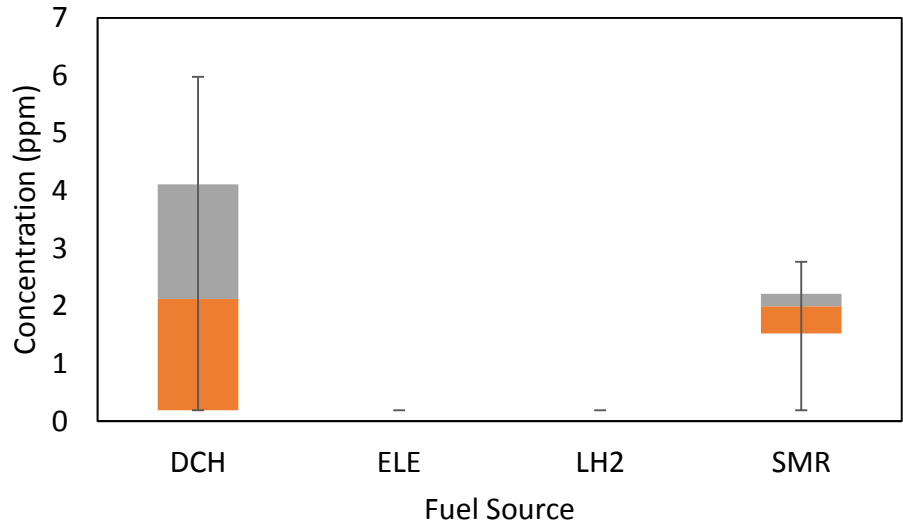
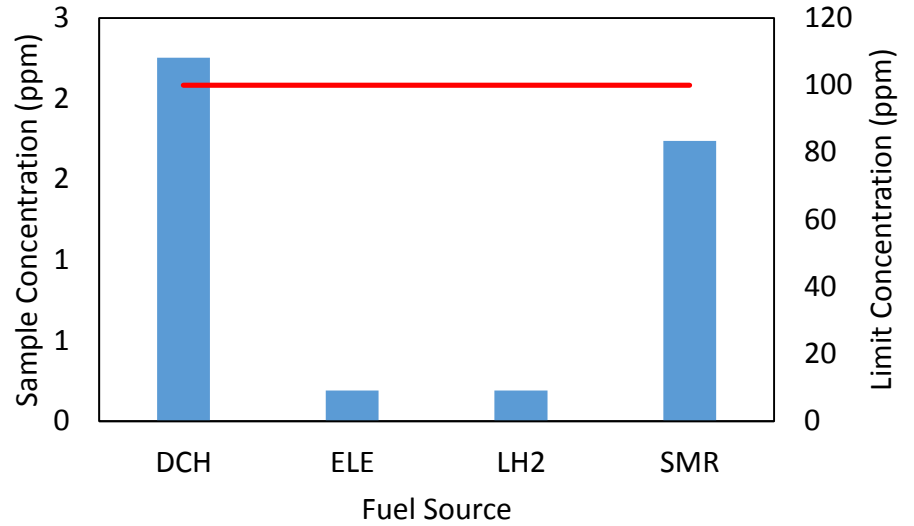
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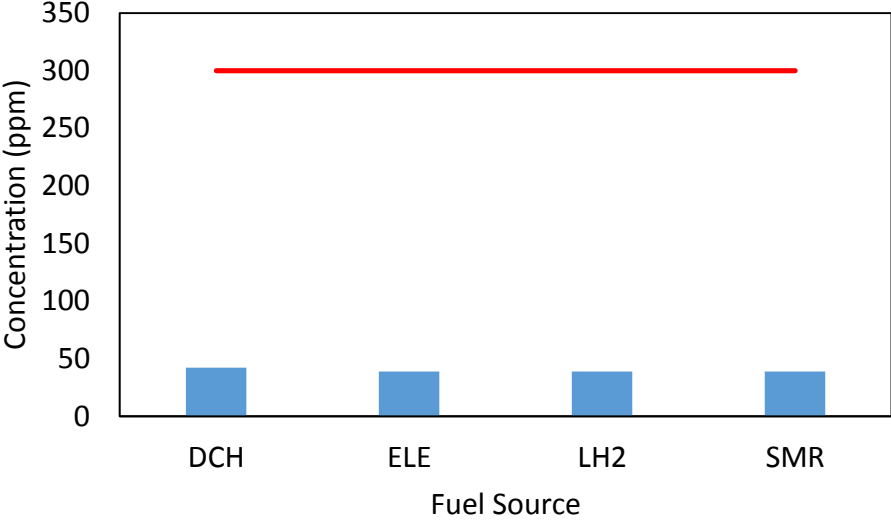
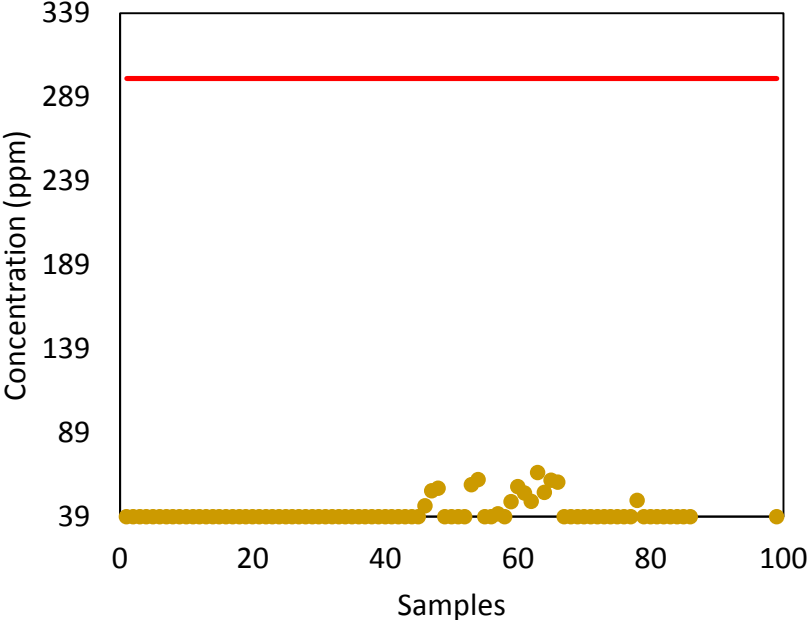
# Methane



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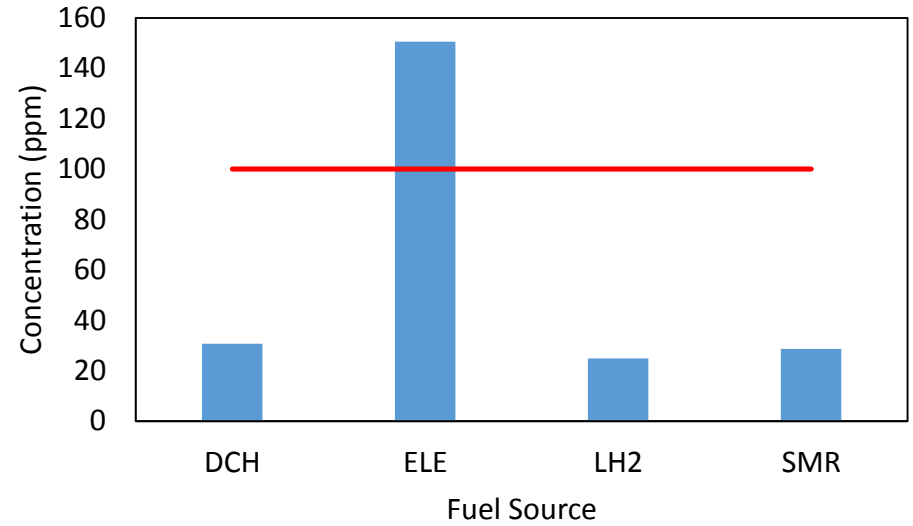
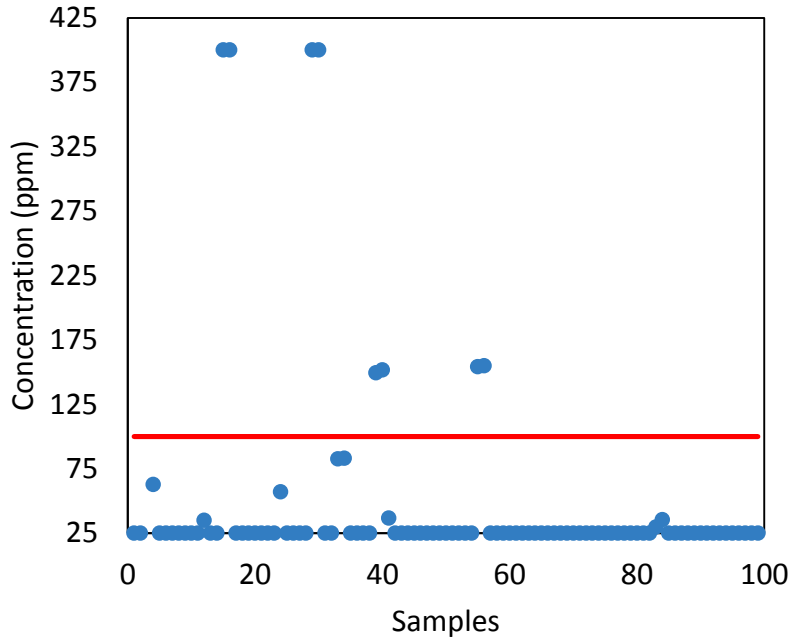


# Helium



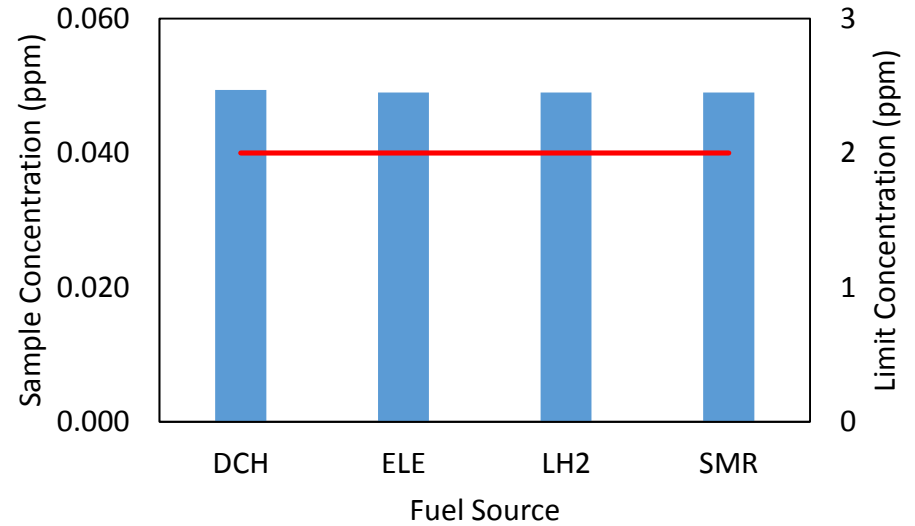
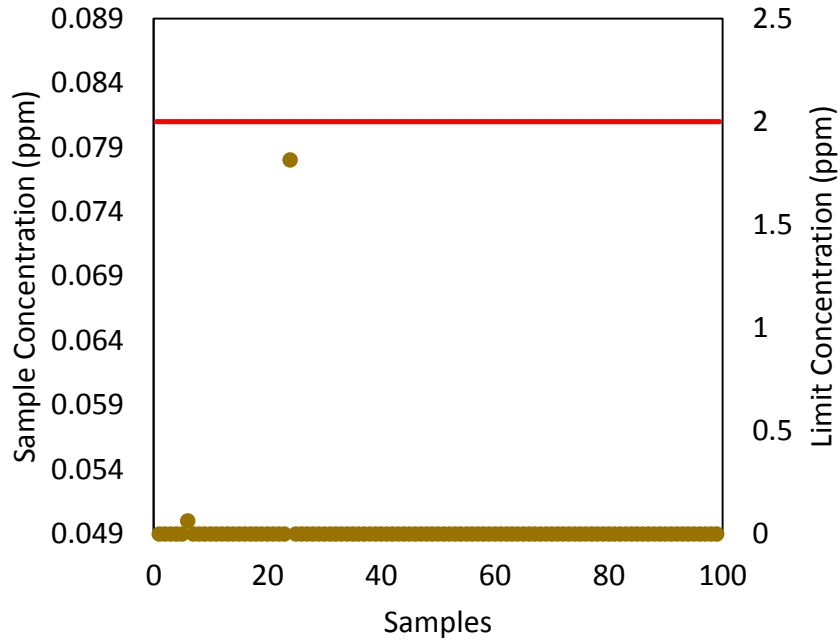
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# Nitrogen



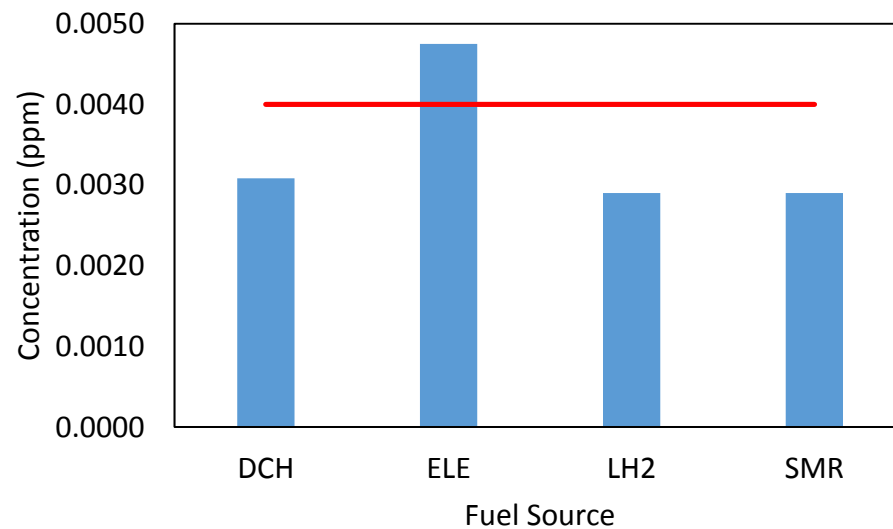
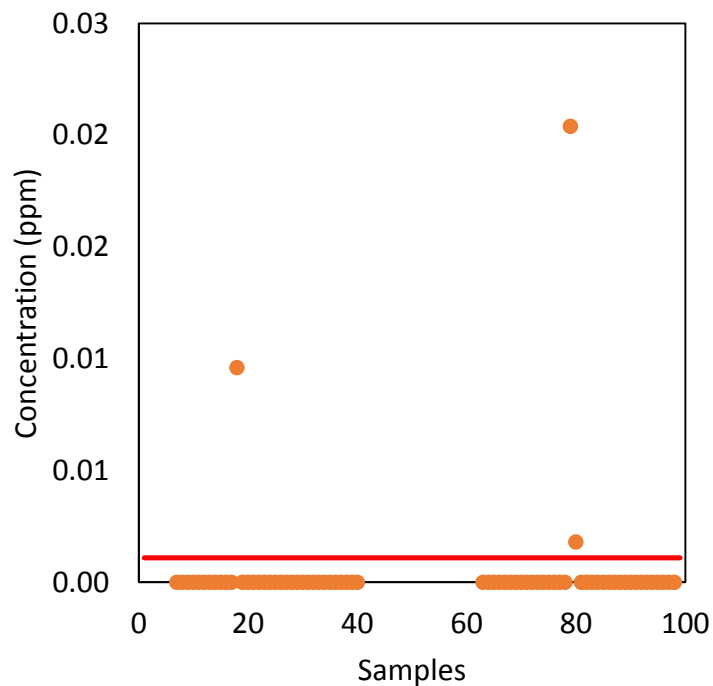
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# Carbon Dioxide



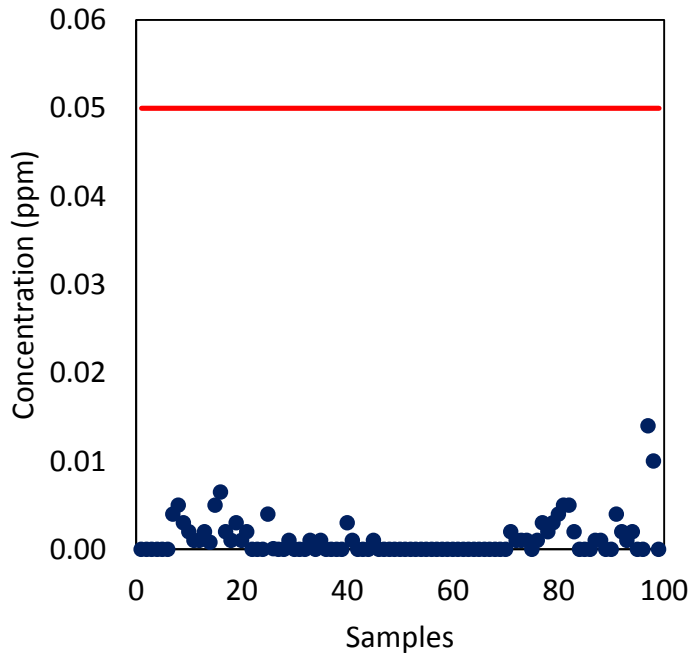
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# Total Sulfur

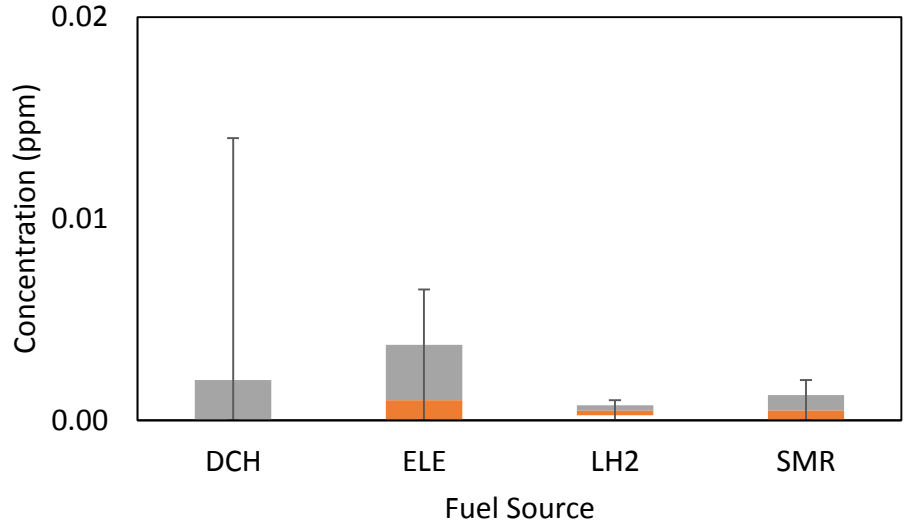
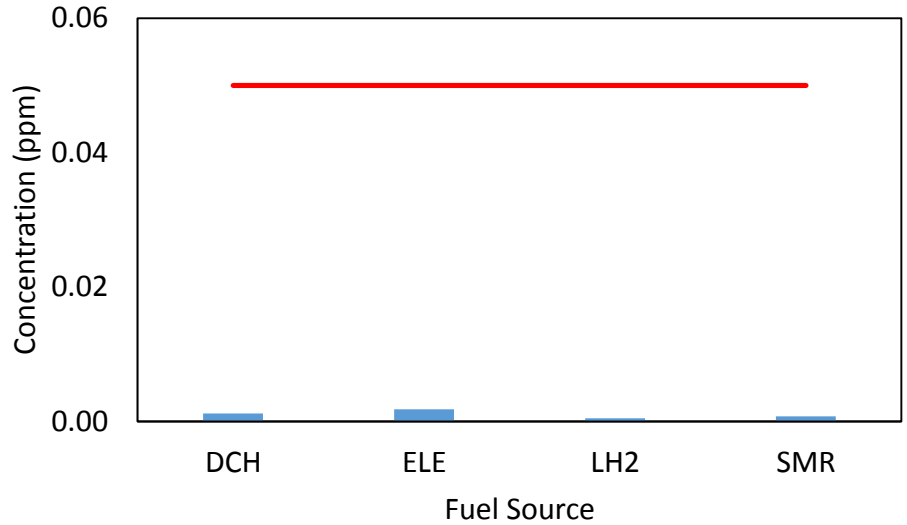


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# Total Halogenates



Red line indicates SAE J2719-2015 specification





# Summary

- More data is required to get a better idea of trends in the data.
- Most compounds are not detected in levels above the reporting limit.
- Plan to increase sample frequency going forward once the Anaheim laboratory is operational.

# Contact Information

## Hydrogen Program Questions and Fuel Quality Testing:

### Anaheim:

Christina Daniels                      714-680-7850                      [Christina.Daniels@cdfa.ca.gov](mailto:Christina.Daniels@cdfa.ca.gov)

### Sacramento:

John Mough                              916-229-3054                      [John.Mough@cdfa.ca.gov](mailto:John.Mough@cdfa.ca.gov)

### Program Manager:

Kevin Schnepf                              916-229-3458                      [Kevin.Schnepf@cdfa.ca.gov](mailto:Kevin.Schnepf@cdfa.ca.gov)

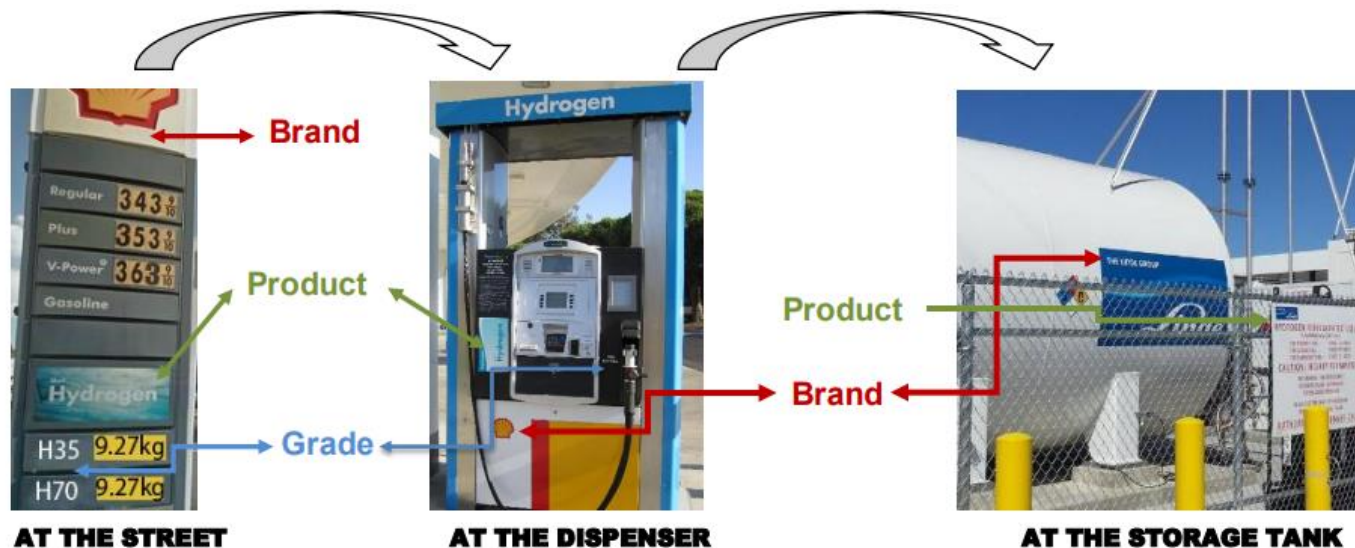
### Type Evaluation and Device and Testing:

Norman Ingram                              916-229-3016                      [Norm.Ingram@cdfa.ca.gov](mailto:Norm.Ingram@cdfa.ca.gov)

# Method of Sale, Advertising, and Labeling Requirements

- AB 808 enacted January 1, 2016 – CDFA adopts by reference NIST HB 130 method of sale for hydrogen and codifies legal requirements.
- All provisions specified in CCR Title 4, Division 9, Chapter 1, Article 1, Section 3.39 Hydrogen Gas Measuring Devices apply.
- Conformance to requirements is evaluated during type evaluation process, during initial accuracy assessment of newly installed type-certified dispensers, and any routine/complaint testing.

# California Hydrogen Fuel Advertising and Labeling



- BRAND** Placement, Size, Appearance - Needs to **match** the wording on street and all other "Advertising", "Pump/Dispenser" and "Storage Tanks". Examples: Chevron, Mobil, Shell, No Brand, Unbranded, etc.
- PRODUCT** Placement, Size, Appearance - Needs to **match** the wording on street and all other "Advertising", "Pump/Dispenser" and "Storage Tanks". Examples: Hydrogen, or H.
- GRADE** Placement, Size, Appearance - Needs to **match** the wording on street and all other "Advertising" and "Pump/Dispensers". Hydrogen is not stored in various grades, so storage tanks should only indicate product and brand. Examples: **H35**, or **H70**

<https://www.cdfa.ca.gov/dms/hydrogenfuel/hydrogenfuel.html>

# Street Sign Advertising



- Brand or trademark not less than 1/3 the size of the price numerals
- The word "Hydrogen" or "H" not less than 1/3 the size of the price numerals
- Price per kg (kilogram) numerals (price numerals) not less than 6 inches in height. Note: full cent pricing = no "tenths"
- Grade of the motor fuel in letters not less than one-sixth the size of the price numerals. For Hydrogen the grade is the selling/service pressure displayed as H35 or H70

<https://www.cdfa.ca.gov/dms/hydrogenfuel/hydrogenfuel.html>