RNG GAS QUALITY & HYDROGEN

Western Gas Measurement Short Course

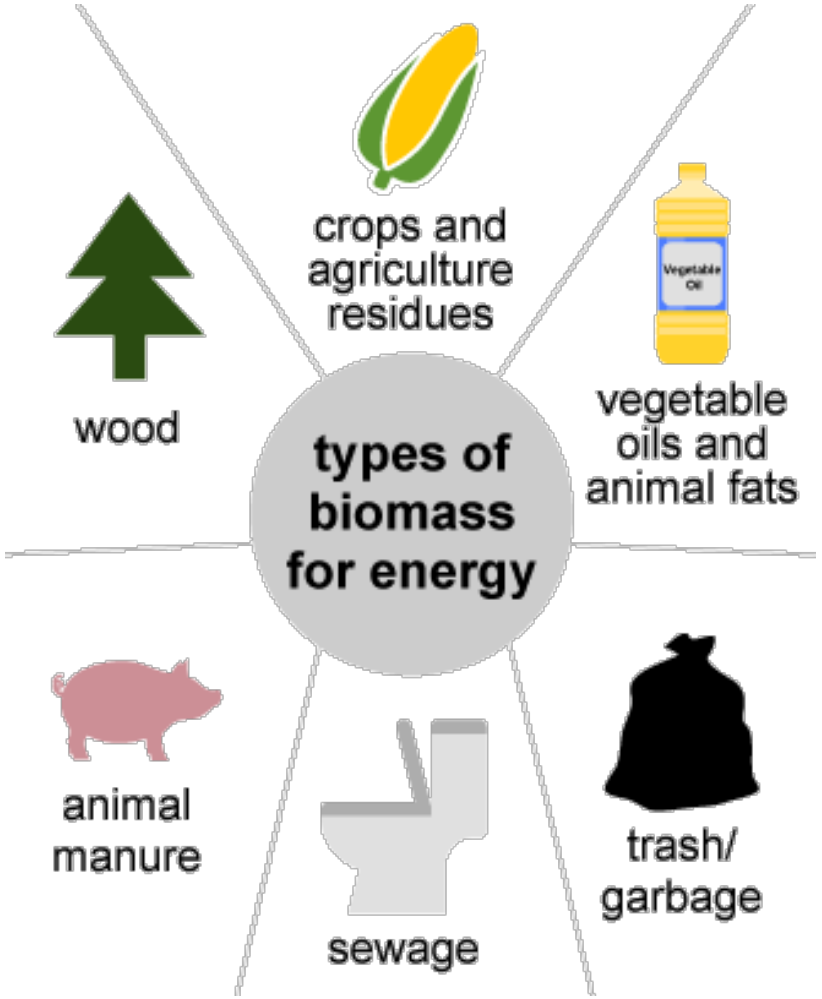
SoCalGas™

Overview

- What is RNG
- RNG Gas Quality
  - Pipeline Gas Quality Specifications
  - Rule 45
    - Trigger Level & Action Levels
    - Health Protective Constituents
    - Integrity Protective Constituents
    - Examples
- Hydrogen
  - As a constituent
  - New Analyzer Evaluation

What is RNG

- Biomethane
  - Made from organic bio stock
  - Produced from the accelerated decomposition of organic matter
    - Anaerobic Digestion
    - Thermal Gasification
  - Same energy density as traditional NG.



RNG Site

RNG Site

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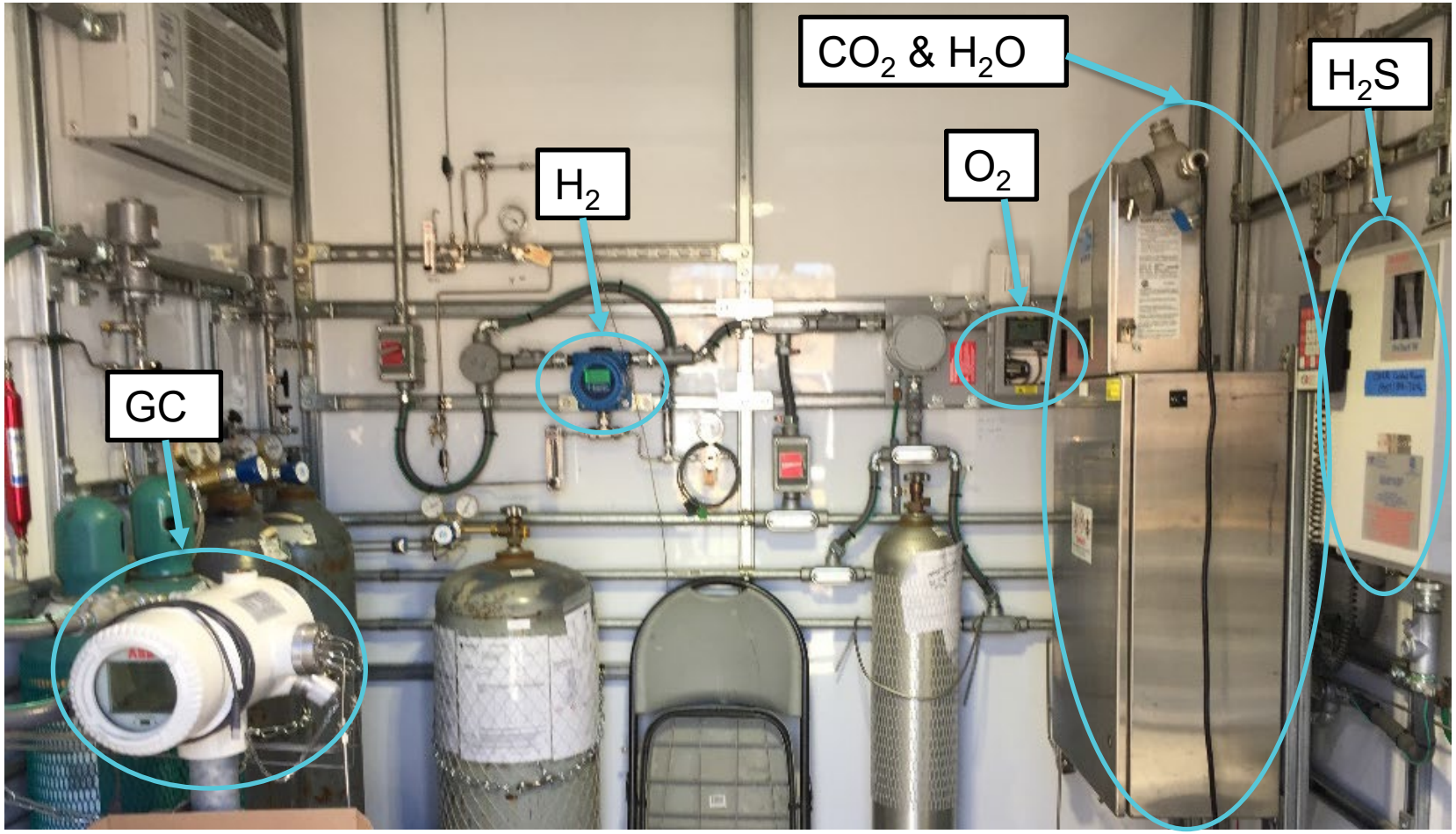
Rule 30 Pipeline Gas Quality Specifications

Parameter	Limits
High Heating Value	970 – 1150 BTU/cf
Water	7 lb/MMscf or 20°F @ P > 800 psig
Hydrogen Sulfide	0.25 gr. H2S/Ccf (4 ppm_v)
Mercaptan Sulfur	0.3 gr. S/ Ccf (5 ppm_v)
Total Sulfur	0.75 gr. S/ Ccf
Carbon Dioxide	3 vol %
Inerts	4 vol %
Oxygen	0.2 vol %
Hydrocarbons	45°F at 400 psig for P ≤ 800 psig 20°F at 400 psig or P > 800 psig
Interchangeability	1279-1385 Wobbe Number AGA 36 Lifting, Flashback, Yellow Tipping
Temperature	50-105 °F

Online Analyzers



Rule 45

Trigger Levels

Concentration of measured value of a consitutuent requiring periodic testing and analysis

Lower Action Level

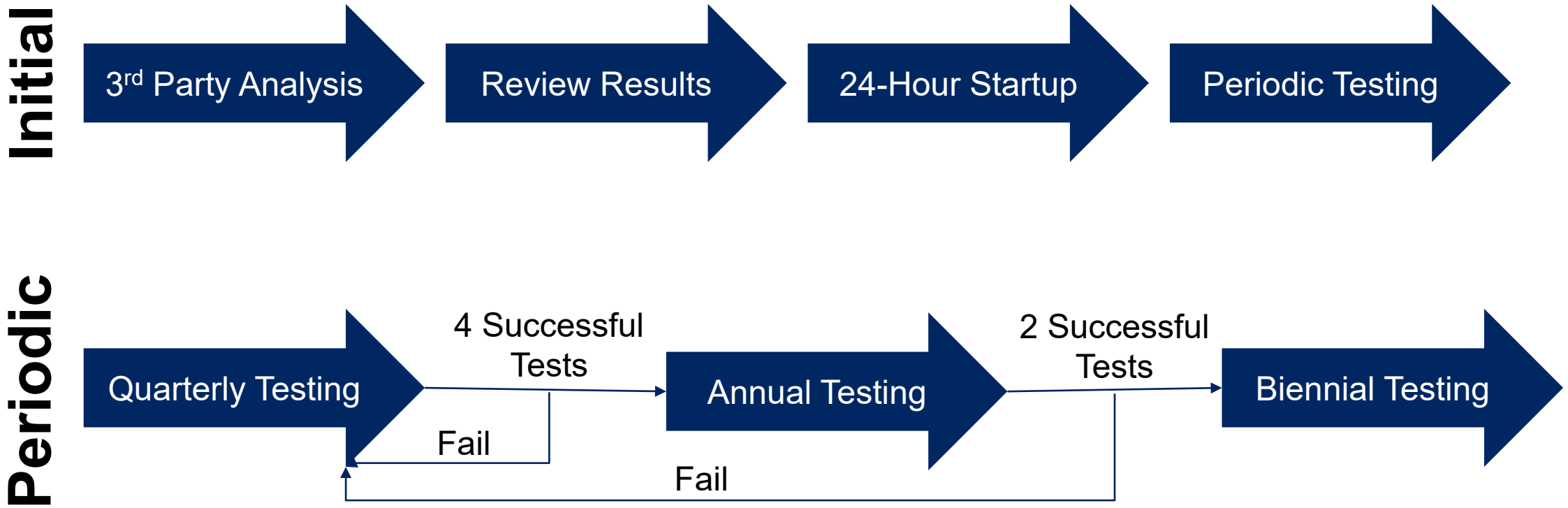
Concentration of of measure value of a constituent requiring periodic testing and analysis

Required supplier shut-off if exceeded > 3 times in 12-month period

Upper Action Level

Concentration of measured value of a constituent requiring immediate shut-off of supplier

Testing Schedule



24 Hour Startup

RNG Source Categories

- Not all RNG sites require testing of all components
- Based on what is most likely to be found within each source

Consituents of Concern	Landfills	Dairies	Sewage Treatment	Food/ Green	Other
1,4-Dichlorobenzene	x	x	x	x	x
Alkyl Thiols (mercaptans)	x	x	x	x	x
Antimony	x				x
Arsenic	x				x
Cadmium		x	x		x
Chlorocarbons (as Cl)	x	x	x	x	x
Chromium	x		x		x
Ethylbenzene	x	x	x	x	x
Fluorocarbons (as F)	x			x	x
Hydrogen Sulfide	x	x	x	x	x
Lead	x		x		x
N-nitroso-di-n-propylamine		x			x
Silicon Compounds (as Si)	x	x	x	x	x
Sulfur compounds (as S)	x	x	x	x	x
Vinyl Chloride	x	x	x	x	x
Ammonia	x	x	x	x	x
Carbon Monoxide					x
Hydrogen	x	x	x	x	x
Mercury	x	x	x	x	x
Siloxanes (as Si)	x	x	x	x	x
Biologicals	*Pre-injection or Startup only*				

Health Protective Constituents (Carcinogenic)

Component (mg/m^3)	Trigger Level	Lower Action Level	Upper Action Level
1,4 - Dichlorobenzene	4.3	42	100
Arsenic	0.002	0.004	0.01
Cadmium	0.002	0.0032	0.008
Chromium	0.002	0.0048	0.012
Ethylbenzene	20	190	490
n-Nitroso-di-n-propylamine	0.028	0.24	0.61
Vinyl Chloride	0.63	6.3	15

Health Protective Constituents (Toxic)

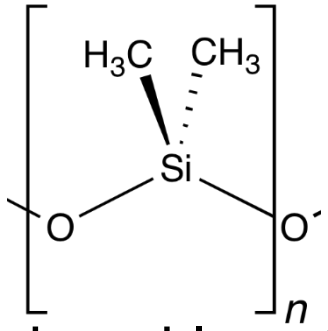
Component (mg/m^3)	Trigger Level	Lower Action Level	Upper Action Level
Alkyl Thiols (Mercaptans)	17 PPM_V	170 PPM_V	860 PPM_V
Antimony	0.062	0.62	3.1
Chlorocarbons (as Cl)	4.9	50	250
Fluorocarbons (as F)	7.4	75	370
Hydrogen Sulfide	63	860	4300
Lead	0.047	0.47	2.3
Silicon Compounds (as Si)	0.49	5	25
Sulfur Compounds (as S)	13	130	640

Integrity Protective Constituents

Component	Trigger Level	Lower Action Level	Upper Action Level
Ammonia	0.0004 %	0.001 %	0.0025 %
Carbon Monoxide	0.03 %	TBD	TBD
Hydrogen	0.1%	1%	5%
Mercury	0.08 mg/m^3	TBD	TBD
Siloxane (mg Si/m^3)	0.05	0.1 mg	0.3
Biologicals	0.2 micron		

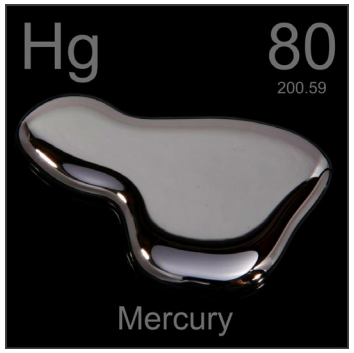
Examples

Siloxane



- Made into high and low viscosity fluids, gums and elastomers.
  - Added by producers through processing equipment
- Found in beauty products
- Oxidized to silicon dioxide upon combustion
  - Can damage I.C. Engines and turbines
  - Can foul burner tips
  - Can deactivate catalyst

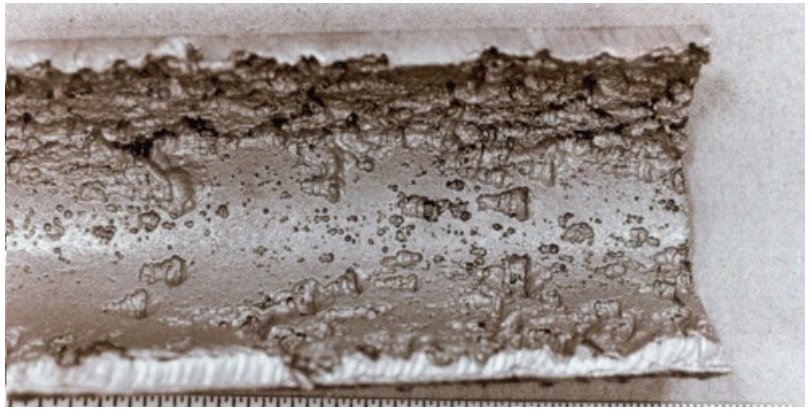
Mercury



- Occurs naturally in gas and oil deposits
- Is contained in waste streams used for RNG
  - Pesticides, electronic waste, thermometers, paints
- If found in LNG can lead to failure of aluminum heat exchangers.
  - Mercury embrittlement
- Human exposure

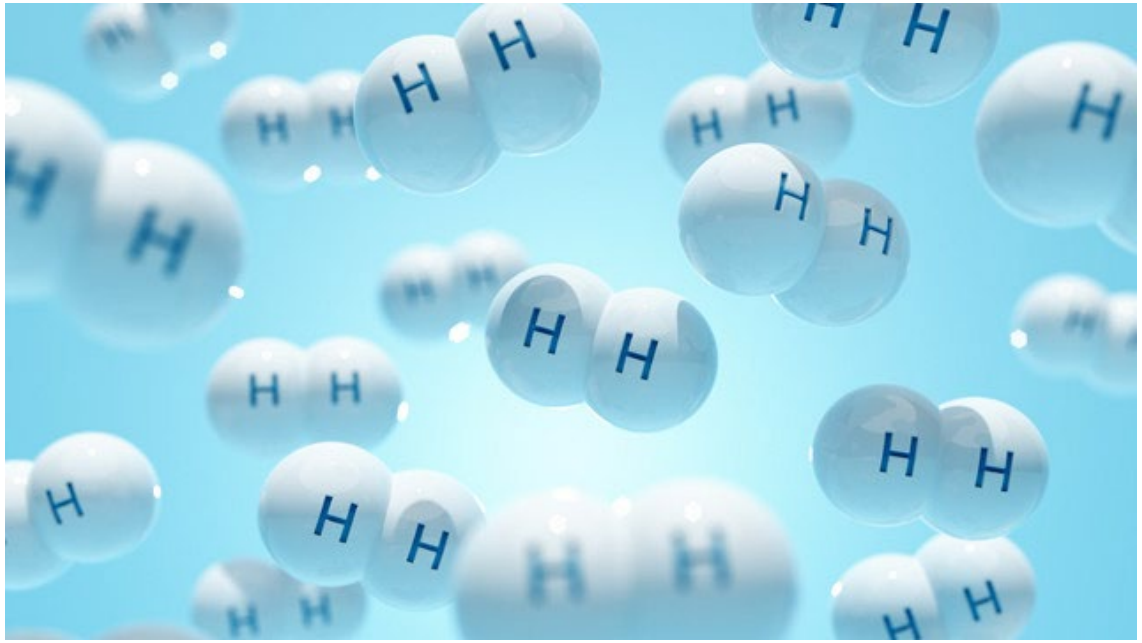
H_2S

- Created and accumulated as part of the digestion process.
- Highly Corrosive
  - Can weaken and damage pipelines, valves and other equipment
- Health Effects
  - Headaches, skin complications, respiratory complications
  - Can be lethal at high concentrations



Hydrogen

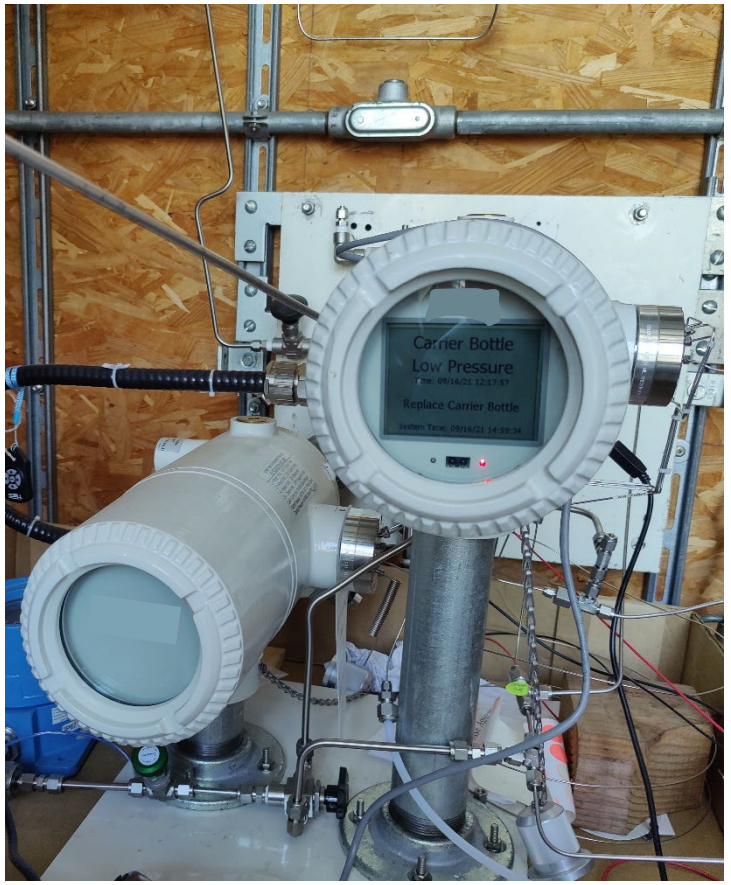
- Currently considered a contaminant
- Can be purposely blended with NG to decarbonize the fuel.
  - Still being studied
  - 325 BTU/ft^3
  - Only byproduct of combustion is water
- Manufactured
  - Steam Methane Reforming (SMR)
  - Electrolysis



Analyzers

Standalone

Gas Chromatographs



Testing

Lab Testing

- Environmental Chamber
  - Effect of ambient conditions
    - 20°F to 120 °F
  - Linearity Check
  - Stability Check
  - C6+ separation

Field Testing

- Two sites chosen
  - RNG site
    - Known to produce Biomethane with H2
  - Transmission pipeline
    - Regular system gas
  - Compare analysis to existing approved analyzer.

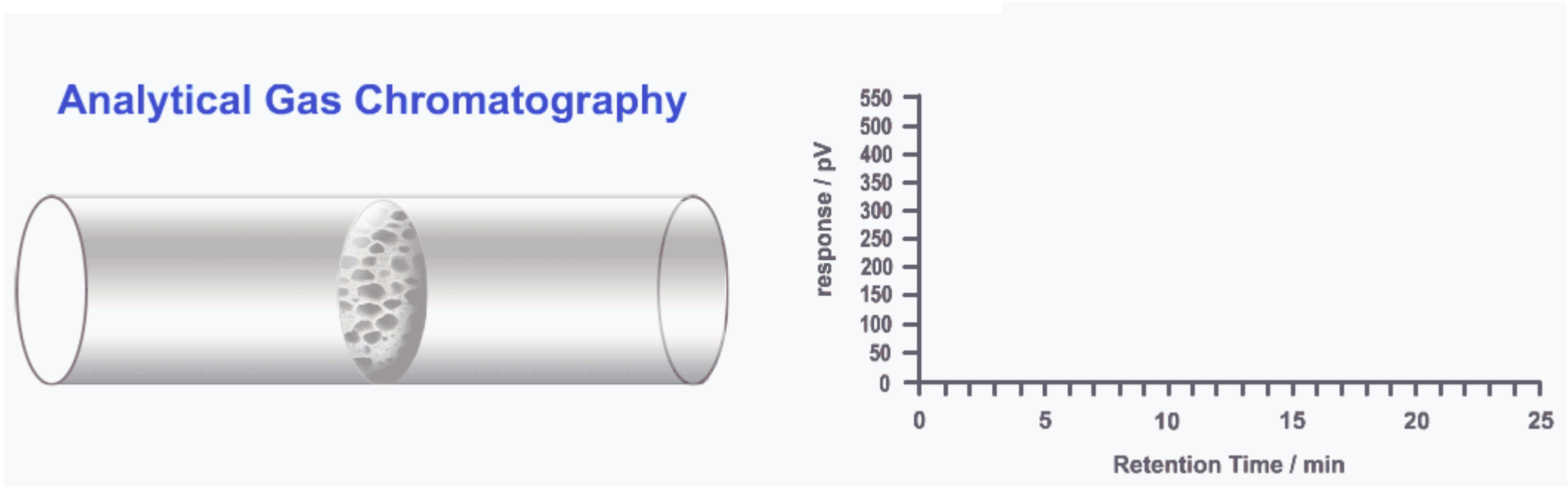
Lab Testing

Environmental Chamber

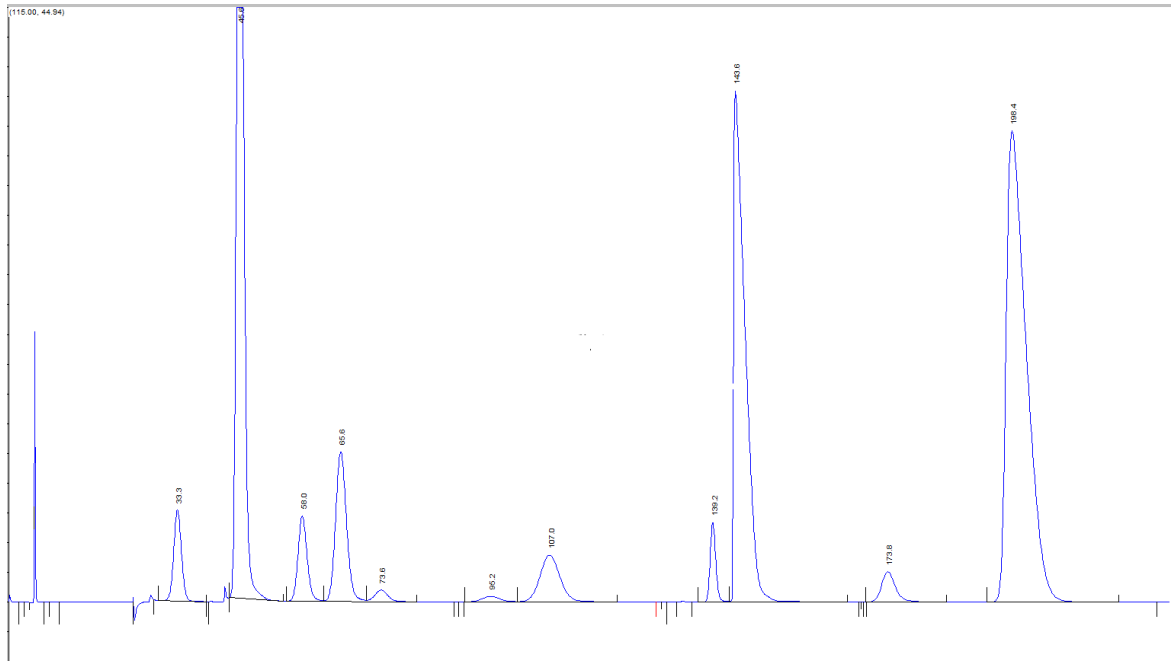
Simple Standards

Methane	Ethane	Propane	Hydrogen	HHV
Mole %				BTU
79.9	0.02	0.01	20.07	876
89.9	.06	0.3	10	945
94.6	0.2	0.1	5.1	1012
96.6	2	1	0.4	1042
87.9	8	4	0.1	1137

How A Gas Chromatograph Works



Gas Chromatograph Testing



GC Standards

Component	Calibration	C6+ Valve Cut	Min. Detection Limit
Methane	87.98	79.76	88
Ethane	5	10	5
Propane	1	3	1
i-Butane	0.3	0.3	0.3
n-Butane	0.3	0.6	0.3
i-Pentane	0.1	0.03	0.1
n-Pentane	0.1	0.3	0.1
neo-Pentane	0.1	0.03	0.1
n-Hexane	0.07	0.1	0.07
Nitrogen	2.5	5	2.5
Carbon Dioxide	2	0.5	2
Helium	0.05	0.03	0.01
Hydrogen	0.5	0.25	0.1
2,2-dimethylbutane	0	0.1	0

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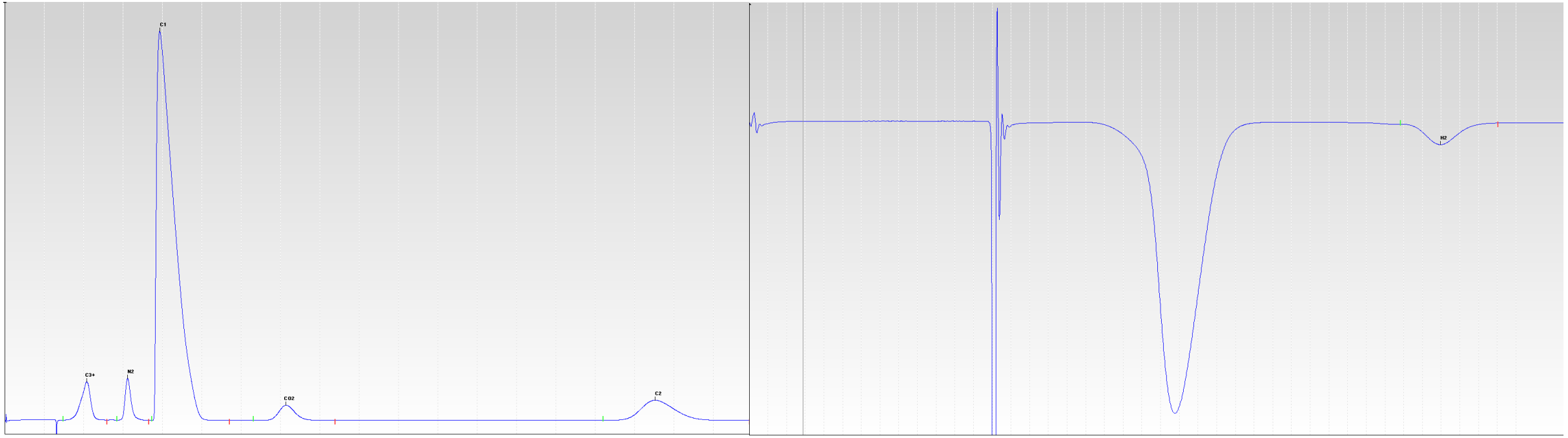
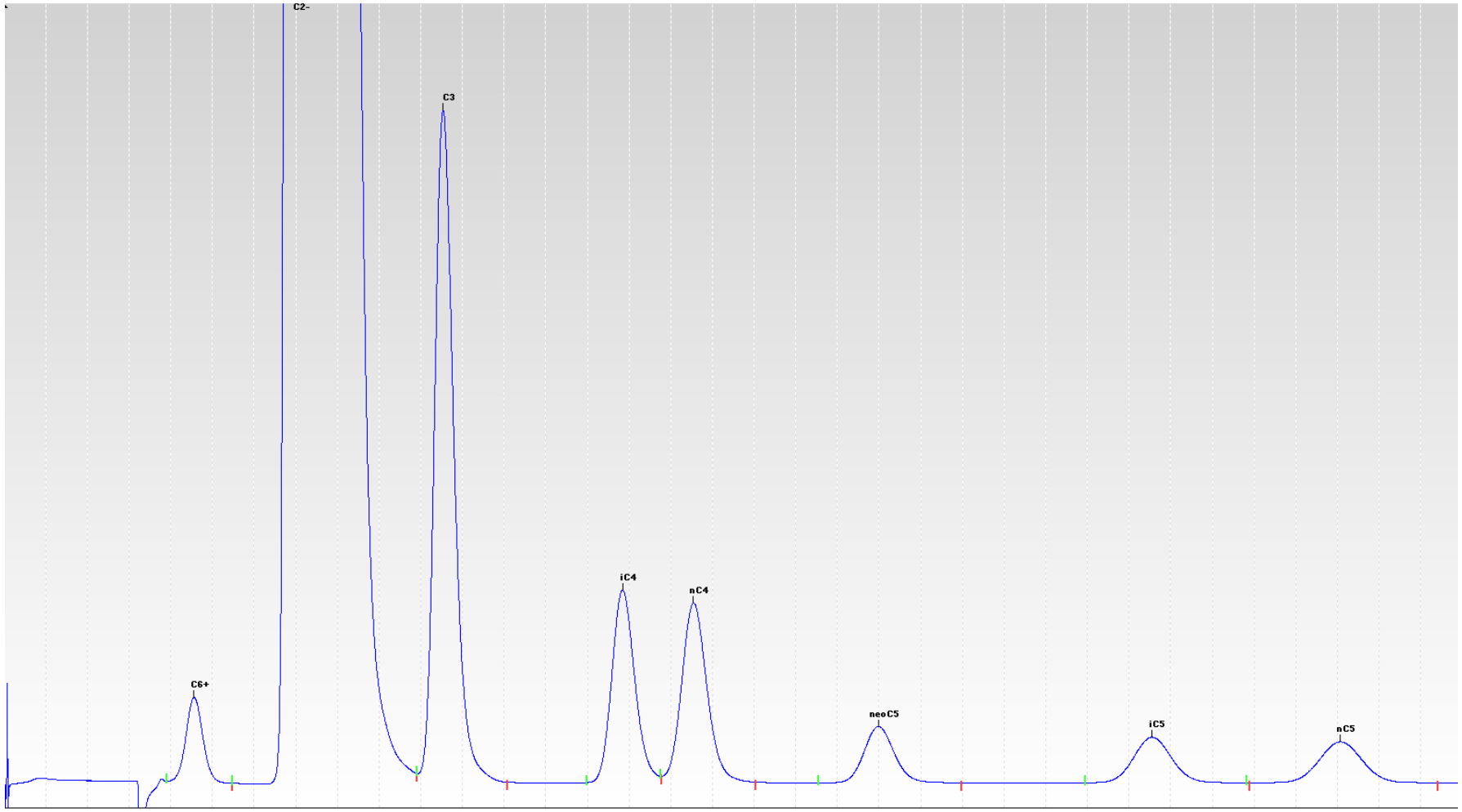
Chromatograms

Lights (N2, CO2, Methane, Ethane)

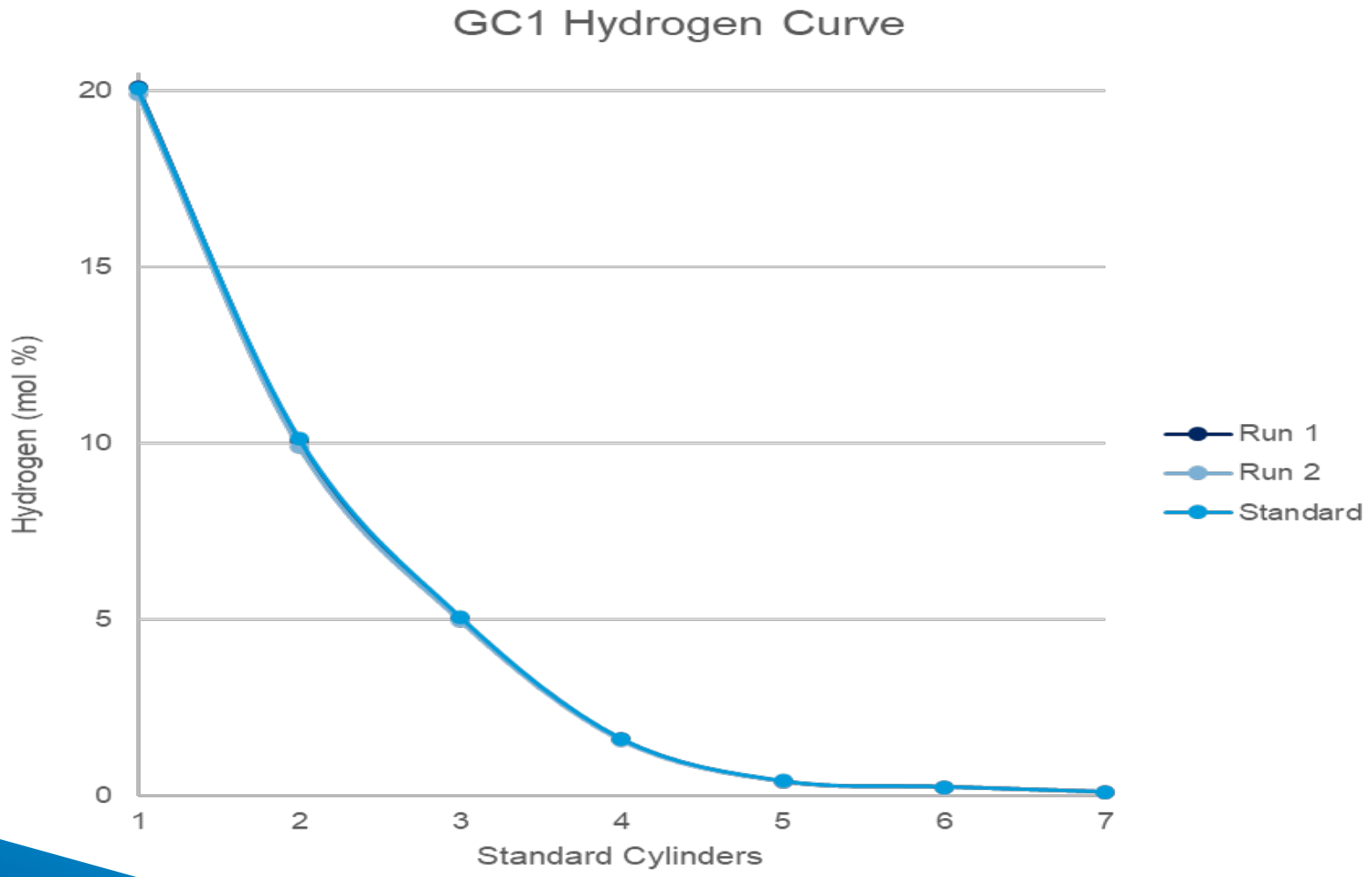
Hydrogen



Heavies (C3 and above)

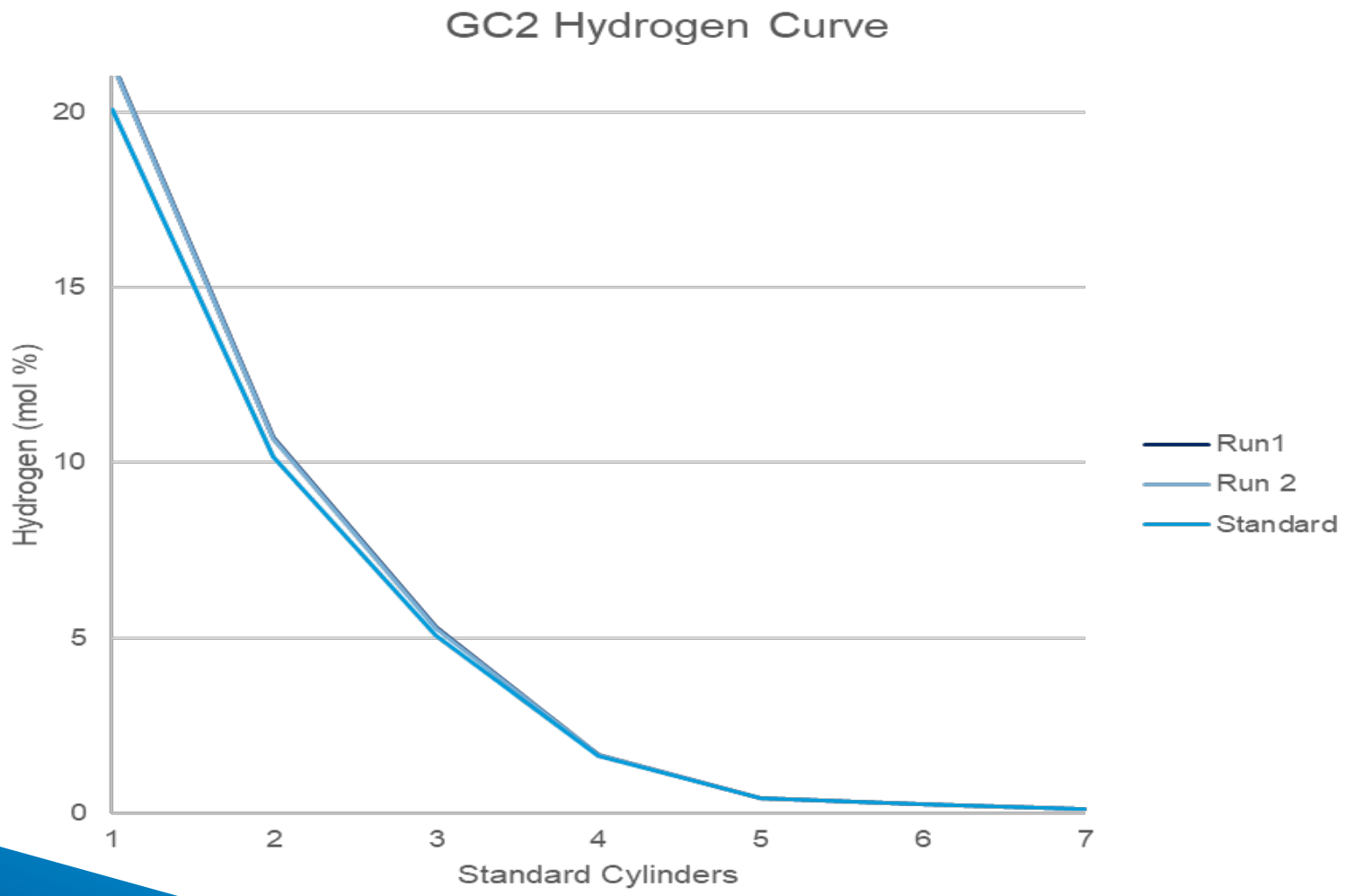


GC 1 Results



ID	Hydrogen
1	20.07
2	10.15
3	5.08
4	1.616
5	0.4188
6	0.25
7	0.1053

GC 2 Results



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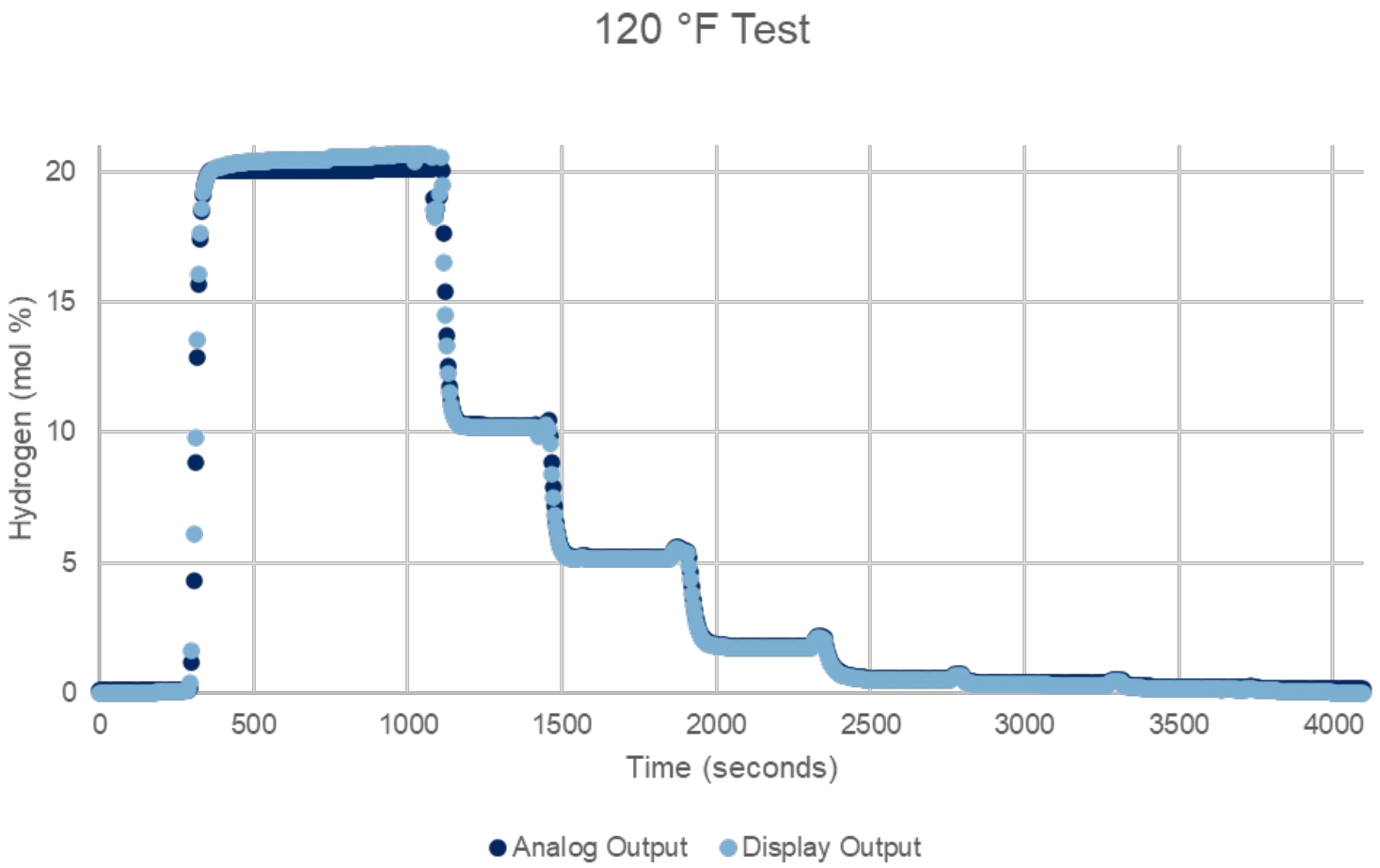
Stand-alone Hydrogen Analyzer



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Questions?