

# Linearity-CGA Automation- Adding to Existing Systems

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# Linearities and CGAs

- What are these tests?
  - Quarterly Audits to challenge each Analyzer at low and mid concentration ranges.
  - Purpose is to verify that the analyzer is linear in the mid range.

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# Analyzer Test Gas Cylinder Ranges for Daily and Quarterly Quality Assurance

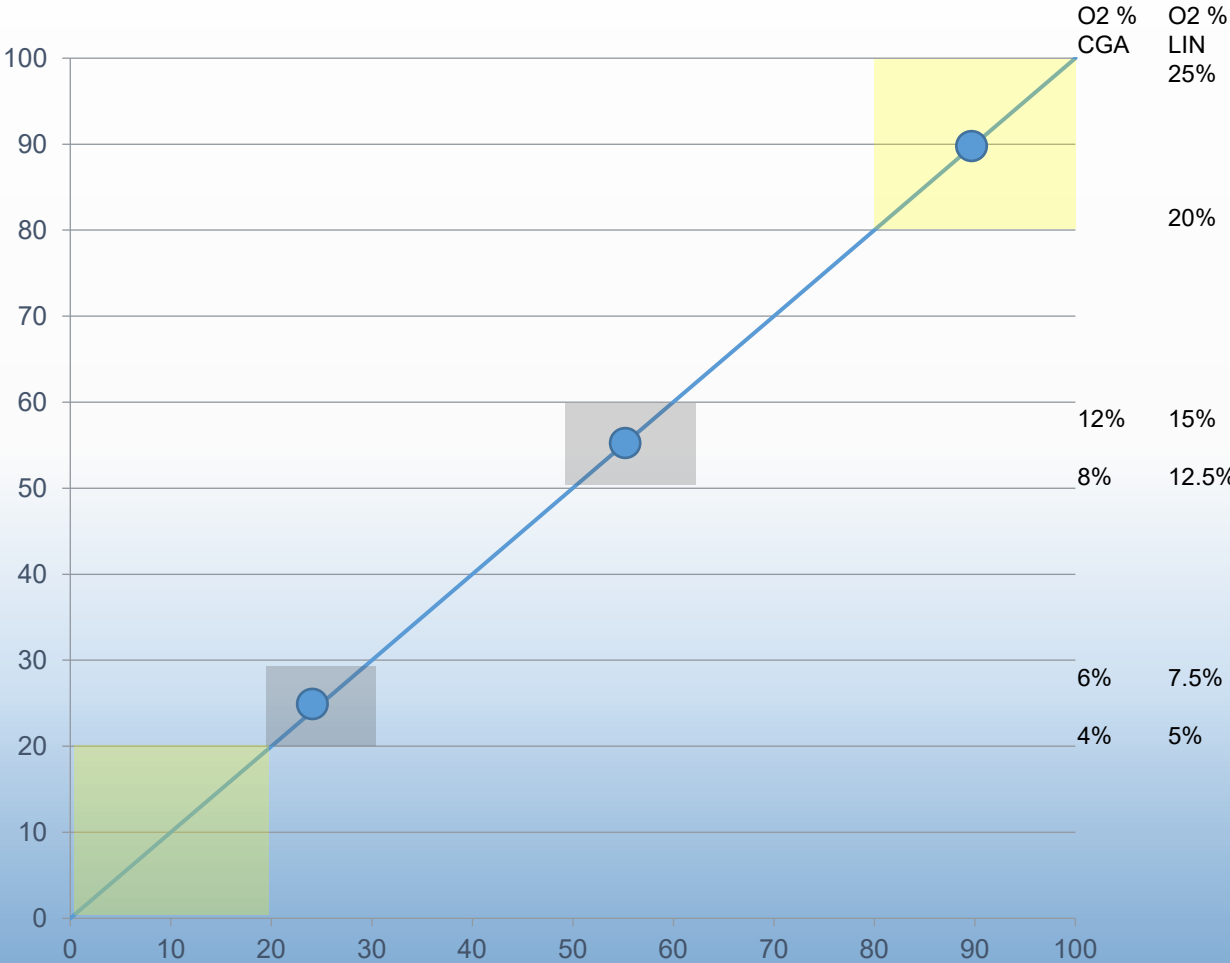
Cal Gas % of  
Analyzer  
Range

Daily Span &  
Lin Check 80%-  
100%

CGA/Lin MID  
50%-60%

CGA/Lin LOW  
20%-30%

Daily Zero  
Check 0-20%



Percent of Analyzer Range

# Basics about Audit Tests

- CGA
  - Cylinder Gas Audit.
  - Part 60 Requirement.
  - Uses Low and Mid Values of 20-30% and 50-60%.
- Linearity
  - Part 75 Requirement.
  - Uses the same Low and Mid as the CGA, but adds the High range as 80-100%.
- For simplification we call these tests “Audit Tests” and the gasses used as “Audit Gasses”.

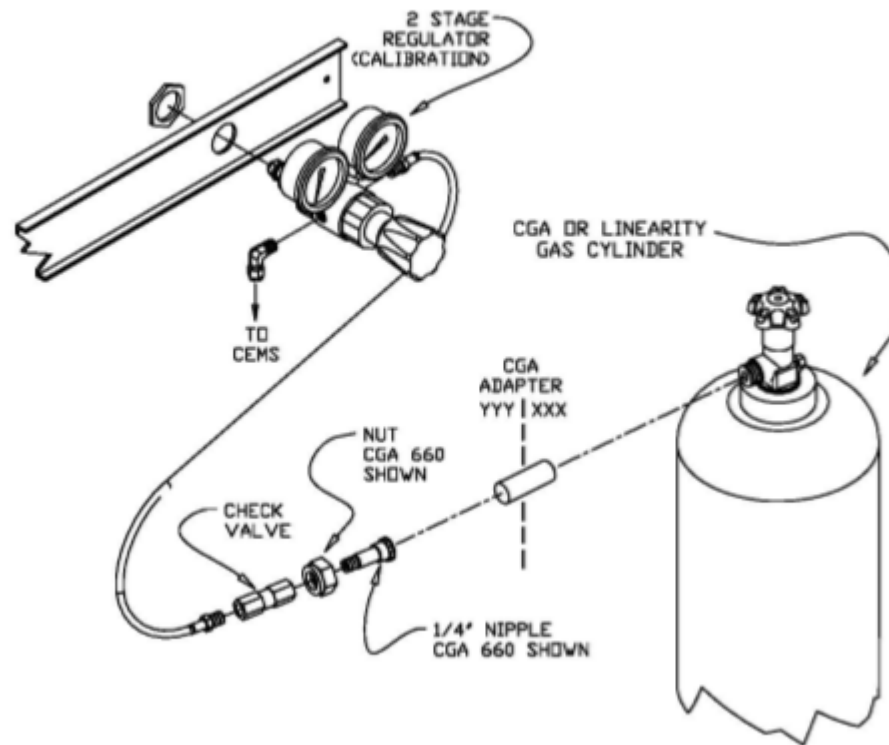
# Use of Blended Cylinders

- CiSCO recommends using blended cylinders to kill two Audits with one Button.
  - Examples: NO<sub>x</sub>/L & CO/L; NO<sub>x</sub>/H & CO/H, O<sub>2</sub> & CO.
  - Required to save space when using Automated Audit systems.

# Methods to Perform Linearity/CGA

- Use Daily Calibration Stations and adapt to the Audit Gasses
  - Does not require much additional hardware just CGA adapters.
  - Sequencing of Daily Cal Solenoids in certain orders.
  - Operator must know where to connect Audit cylinders (after disconnecting daily cal gas cylinders).
  - No place to safely locate and store Audit cylinders during the test.
  - Not a desirable method, has not been used by CiSCO in many years.

# A. Typical Linearity Test Gas Cylinder CGA Adapter Installation and Cross Reference Charts



# Position Audit Cylinders in correct Daily cylinder stations

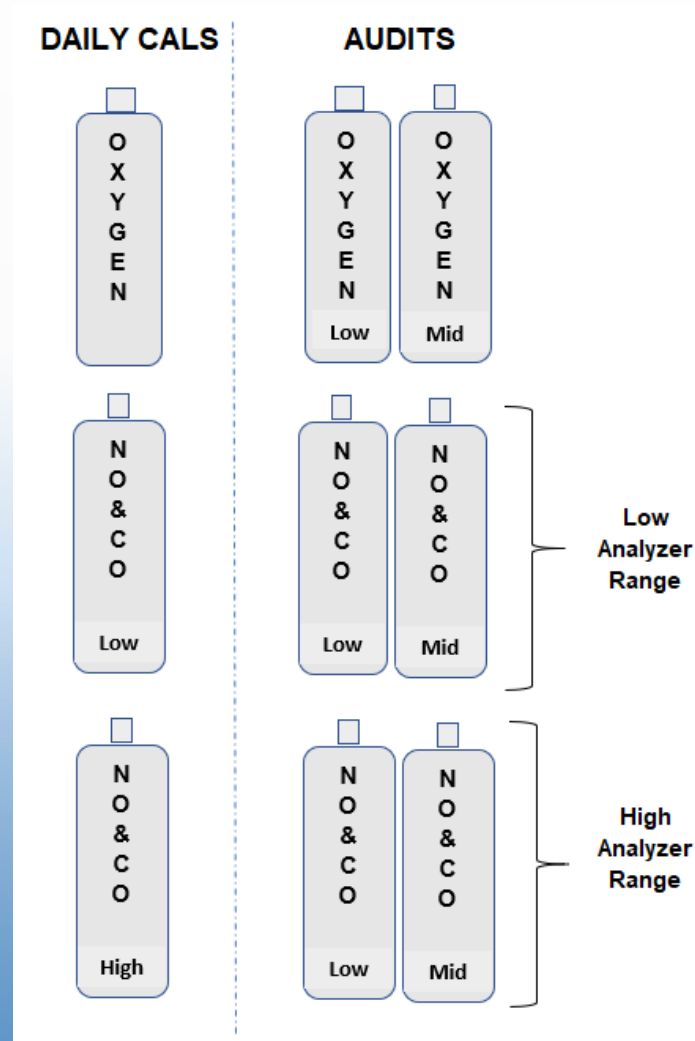
LINEARITY / CGA REFERENCE TABLE				
ANALYZERS		LOW RANGE (20-30%)	MID RANGE (50-60%)	HIGH RANGE (80-100%)
NO <sub>H</sub> (0-200 ppm), CO <sub>H</sub> (0-1000 ppm) & NH <sub>3</sub> /H (0-200 ppm)	Adapters →	-	-	660-590
	Range of Test Gas →	2.0-3.0 ppm NO & 2.0-3.0 ppm CO	5.0-6.0 ppm NO & 5.0-6.0 ppm CO	8.0-10.0 ppm NO & 8.0-10.0 ppm CO
	Position →	NO <sub>L</sub> & O <sub>2</sub>	NO <sub>x</sub> /H & CO <sub>H</sub>	O <sub>2</sub>
NO <sub>L</sub> (0-10 ppm), CO <sub>L</sub> (0-10 ppm) & NH <sub>3</sub> /L (0-10 ppm)	Adapters →	-	-	660-590
	Range of Test Gas →	40-60 ppm NO & 200-300 ppm CO	100-120 ppm NO & 500-600 ppm CO	160-200 ppm NO & 800-1000 ppm CO
	Position →	NO <sub>L</sub> & CO <sub>L</sub>	NO <sub>H</sub> & CO <sub>H</sub>	O <sub>2</sub>
O <sub>2</sub> (0-20.9%)	Adapters →	590-660	590-660	-
	Range of Test Gas →	4.2-6.0%	10.5-12%	18%
	Position →	NO <sub>L</sub> / CO <sub>L</sub>	NO <sub>H</sub> / CO <sub>H</sub>	O <sub>2</sub>



# Methods to Perform Linearity/CGA

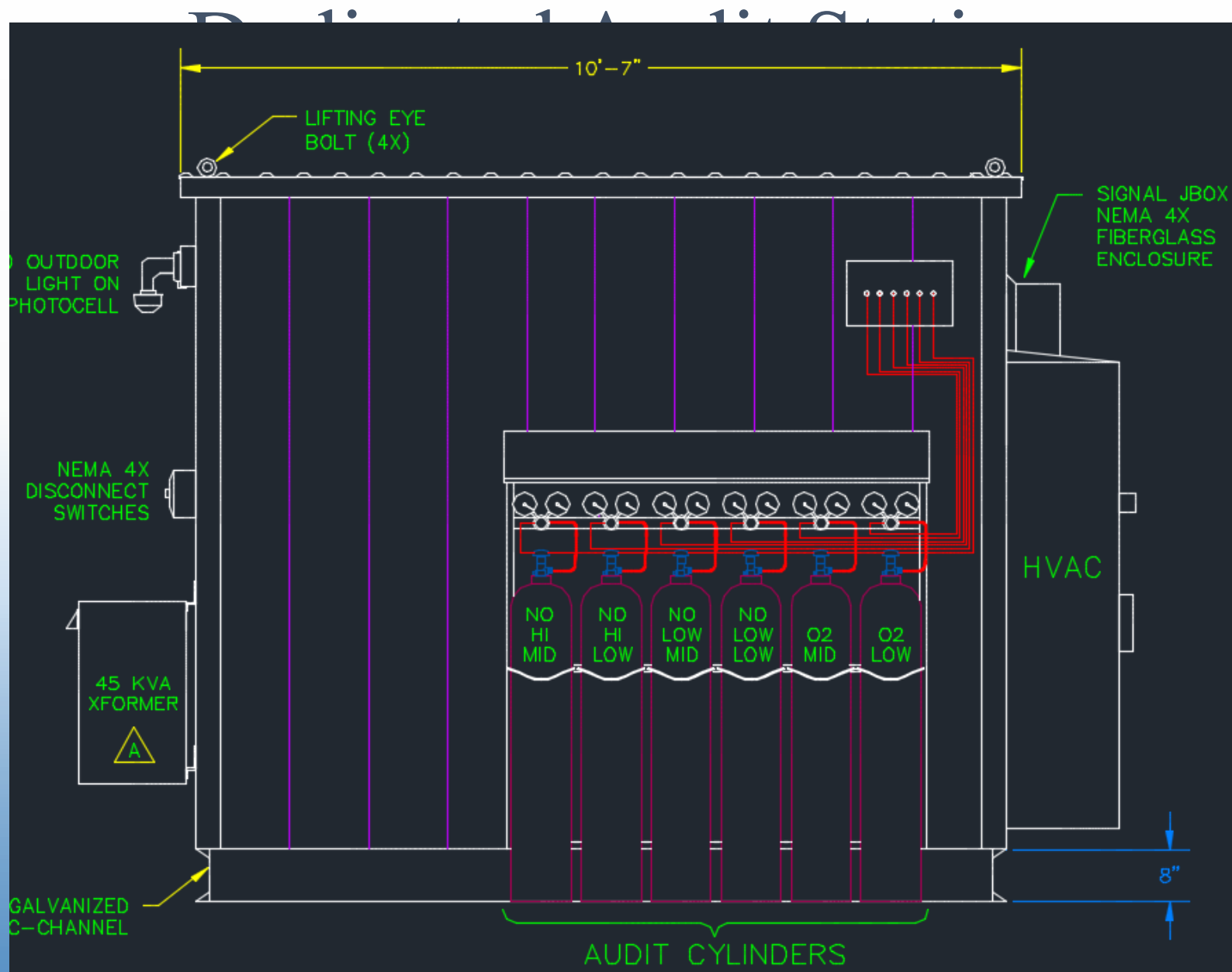
- **Dedicated Audit Low and Audit Mid Ports**
  - Ports connect to calibration manifold and use dedicated solenoid valves automated by the PLC.
  - High Span is same as Daily High Span gas for Linearities.
  - Daily Cal gasses do not need to be disconnected with possible exceptions such as NH<sub>3</sub>(NO<sub>x</sub>) Linearity per PADEP requirements.
  - Still need to get Audit Cylinders in place to perform tests, and cylinders are rotated in and out for each test.
  - No place to safely locate and store Audit cylinders during the test.

# Standard Automated Audit Blended Gas Configuration



# Methods to Perform Linearity/CGA

- **Dedicated Audit Cylinder Station**
  - 6-position Cylinder Rack complete with 6 Regulators and Solenoid valves.
  - Provides complete automation of all Audit Tests for typical Part 60/75 sites.
  - Cylinders do not need to be moved around to perform tests. Cylinders may remain stationary for years.
  - Can be Permanently mounted to shelter or as a stand alone rack close to the shelter.



# Field Modifications

- Rack may be mounted to an open side of shelter.
  - Solenoids/tubing manifold are built into a control box mounted to rack.
  - Only one tube required to feed back inside shelter.
  - Control wires for solenoids need to be run to control box.









Technical Specifications  
Model: L807418  
Voltage: 24V  
Current: 1.5A  
Power: 3.6W  
Weight: 0.5kg  
Dimensions: 100x100x50mm  
Manufacturer: ABC Company

# Requirements

- Space on Outside of Shelter if dedicated station is to be mounted.
- Typically 6 PLC outputs for Low and Mid for each test. The daily cal span used for the High.
- Blended Audit Cylinders to allow NOx & CO (for example) tests to be done at one time.
- Verification of the Number of Cylinder Stations required. Depends on Gas Cylinder Blends and types of test.



# Portable Rack Option

- Cylinder Rack with Fork Holes
  - Can be simple version where each gas set is connected manually for one test only.
  - Can be fully Automated for all tests.
- Only one set of Cylinders required.

# Fully Automated Portable Rack

Solenoid  
Enclosure  
allows PLC  
to control  
gas flow for  
all  
cylinders.  
(capacity of  
eight  
shown)



Two hose  
connections to CEMS  
Bulkhead

Solenoid  
control  
Connector  
attaches to  
each  
CEMS  
Bulkhead

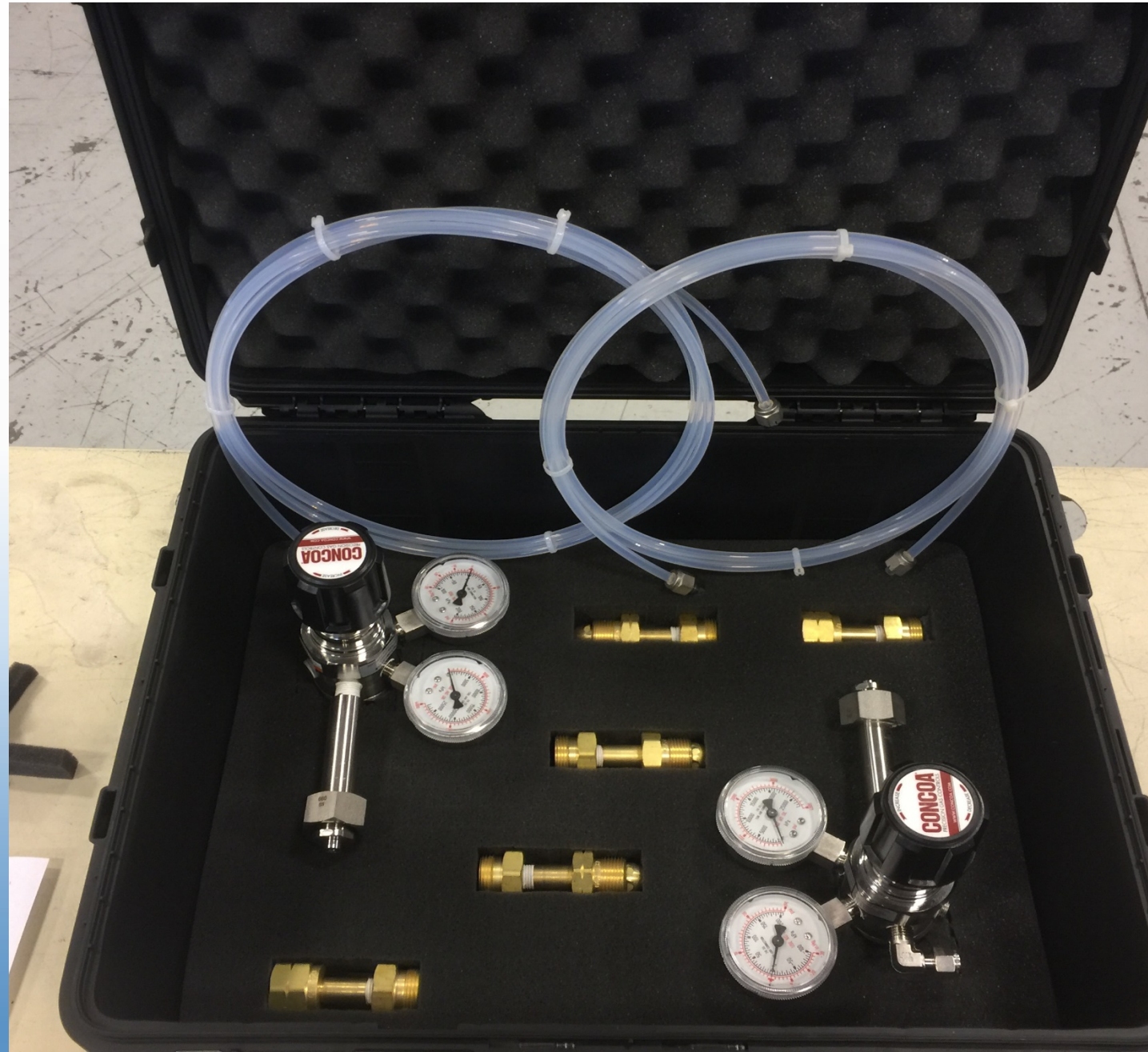


# Portable Lin/CGA Regulator Set

- Two Regulators and CGA Adapters
  - Inexpensive solution.
  - Requires Audit Cylinder to be transported to each shelter.
  - Can only connect one set for 1 Audit Test at a time.
  - Single Audit test may include Dual Analyzers when using Blended Cylinders.



# Linearity/CGA Portable Regulator Set



# What's Next

- Questions and General Discussion