Vaquero Uinta, LLC – Pumpjack Engine Emission Measurement Inspections – Uintah & Ouray Reservation and Utah State Lands – On-Site Partial Compliance Evaluations (PCE)

Inspection Date:	9/10/21
Inspection Report Date:	11/15/2021
Inspection Report Prepared By:	Cindy Beeler
Inspection Report Reviewed By:	Scott Patefield, Branch Chief SCOTT PATEFIELD Digitally signed by SCOTT PATEFIELD Date: 2021.11.15 12:22:52 -07'00'
EPA Inspectors:	Cindy Beeler Scott Patefield
Company Representatives:	John Busch, Operations Supervisor
Tribal Representatives:	Mike Natchees, Director, Air Quality Program, Ute Indian Tribe (UITAQ) Marie Kaufusi, UITAQ Monaco Weidner, UITAQ Lonnie Favel, UITAQ
State Representatives:	None
Parent Company Address:	4700 Stockdale Hwy, Suite 120 Bakersfield, CA 93309
Facilities County/State Location:	Uintah/Utah
EPA Region:	Region 8
Specific Facility Information:	See Table 1

Inspection Information

As part of a regional effort to better characterize emissions from pumpjack engines, United States Environmental Protection Agency (EPA) and Ute Tribal Air Program inspectors visited several Vaquero Uinta wellpads in the Uinta Basin in Utah. The objective of the testing is to verify point source pollutant levels used for air quality modeling and emission inventories, assess the effectiveness of engine emission regulatory limits, and evaluate the emissions maintenance practices of individual operations. The engine emission tests were conducted by a third-party contractor, Alliance Source Testing (AST).

In the aggregate over three weeks, the EPA and its contractor conducted testing at 61 engines with seven operators. The sample population was created to reflect the universe of almost 3,400 pumping spark-ignition engines as provided in the 2017 Uinta Basin Emission Inventory – by operator, by engine make and model, by age of engine, and by jurisdiction. The aggregate results are shown below:

# Engines Tested:	61			
	AST g/hp-hr (11/1/21)			
	CO	NOx	CH4	NMHC
Average:	92.9	1.8	1.5	34.0
Median:	72.5	0.29	0.0013	30.4

Table 1 lists the Vaquero sites inspected, their location, the dates of inspection, and the start time of each test run. In facility name, TR refers to Three Rivers Federal.

Table 1 – Sites Inspected

facility_name	facility_latitude	facility_longitude	facility_county	Date_insp	Run_start Time
TR 35-11-720	40.172504	-109.63956	Uintah	9/10/2021	9:46
TR 35-43-720	40.167004	-109.62861	Uintah	9/10/2021	11:31
TR 35-442-720	40.167009	-109.62877	Uintah	9/10/2021	12:20
TR Federal 33-11-720	40.172504	-109.63956	Uintah	9/15/2021	15:55

The inspection team adhered to the following approach for the engine measurements:

1) At the beginning of the day, EPA met Vaquero, AST, and other agency personnel offsite and shared a list of geographically clustered Vaquero wellpads with engines. On 9/10/21, EPA inspectors Cindy Beeler and Scott Patefield met at Jensen's Hitchin Post - 6451 S Highway 88, Randlett and the Ute Indian Tribe Air Quality program personnel accompanied the inspections. From Vaquero, John Busch accompanied us throughout the day.

   With input from Vaquero, we proceeded to a subset of sites on the list where engines were gas-powered and operating, testing as many engines as possible in the day.

2) AST positioned their testing trailer to be a safe distance from the process equipment.

3) AST began set up and conducted the calibration of the analyzers at the first site each day. The analyzers were kept running between sites with (1) a generator in the bed of the truck; and (2) power conditioned/battery back-up - so they could hold a calibration for the remainder of the day. Following the calibration, and at succeeding sites, AST ran the pre-bias check, a 21-minute measurement with pollutants recorded each minute, and the post-bias check.

4) EPA photographed the site sign.

5) EPA asked questions to describe the operating parameters of the engine, the associated equipment around each engine, and the maintenance schedules as well as taking numerous photographs. Table 3 summarizes the information collected.

Testing Information

Testing was conducted to determine the emission rates of nitrogen oxides (NOx), carbon monoxide (CO) and non-methane hydrocarbons (NMHC) from the engine exhausts.

Emission rates were calculated using the Wyoming Analyzer Protocol, Page 25, Section 10.1.2. Where manufacturer-specified Brake Specific Fuel Consumption (BSFC) in BTU/HP-hr and nameplate horsepower were available, those were used in calculations for emission mass rates. For site-rated hp, nameplate was adjusted to 5,000 elevation. Where they were not available, the Wyoming Analyzer Protocol default value of 9,400 BTU/hp-hr was used. Where manufacture year or horsepower were not available on the engine nameplate, or there was no nameplate, the year and horsepower noted were identified by the EPA relying on emission inventory data submitted by Vaquero (or its predecessor, Ultra Petroleum).

.

The emission testing program was conducted in accordance with the test methods listed in Table 2. Method descriptions are provided in Attachment A - AST Test Report.

Table 2 - Source Testing Methodology

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Oxygen / Carbon Dioxide	3A	Instrumental Analysis
Nitrogen Oxides	7E	Instrumental Analysis
Carbon Monoxide	10	Instrumental Analysis
Volumetric Flow Rate	19	Fuel Factors / Heat Inputs
Non-Methane Hydrocarbons	25A	Instrumental Analysis
Gas Dilution System Certification	205	--

Other Field Notes

Maintenance practices – John Busch said Vaquero conducted scheduled maintenance on the engines every 90 days. He was not sure on Arrow's recommended engine maintenance. All engines tested were Arrow engines.

The inspector was able to observe the fuel gas pressure entering the engine at TR 35-11-720 – a pressure gauge read 5.0 ounces/in^2. At TR 35-43-720 the inspector noted a fuel gas pressure of 11 inches w.c. (6.5 oz/in^2).

At TR 35-11-720 there was an ABB, XRC^{G4} *TOTALFLOW* Measurement & Control System data monitoring control box with different screens that could be accessed for historic and current status of various operational parameters.

The engines tested were running on dry, processed gas from Three Rivers Compressor Station. John Busch said that wellpad engines would only rely on field gas in emergency situations (e.g., compressor station down) and from an engine maintenance perspective their preference is to run the engines on dry, processed gas. This statement conflicted with an email on 8/5/21 from John Busch to Michael Anderson and others in Vaquero recommending, "I would think it would pay us until they are through testing to switch back to operating on dry fuel gas as we will have fewer emissions. I'll pick some of the of our most concerning engines and replace seals, etc." During the inspection, John Busch pointed out a piping manifold just off the wellpad site where dry processed gas entered in a riser from the compressor station, wet field gas came in another riser from the wellpad, and both risers linked to the fuel gas piping going into the wellpad site. The valve on the dry gas line was opened and the valve on the wet field gas line was in the closed position, demonstrating that the wellpad site was using dry processed gas for running the engines (and supplying other fuel demands on-site). No car-seal locks on these valve positions were observed.

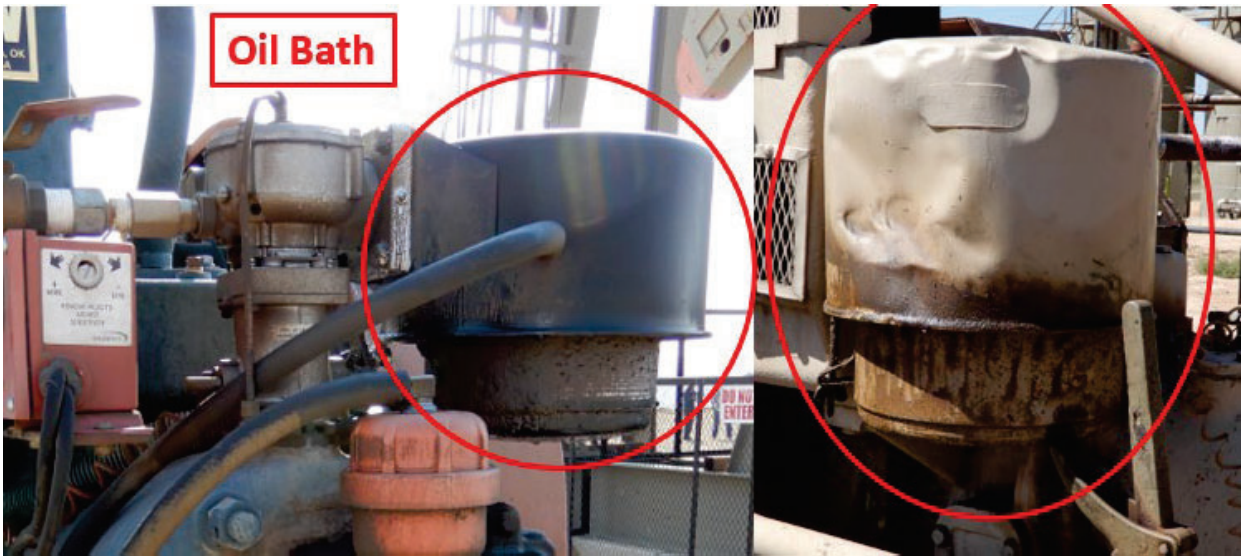
The engines run continuously, even if the pumpjack is not pumping, when this can be referred to as "clutched" or idled" while the engine continues to run to power a heat trace circulation pump that provides a heated medium throughout the wellpad (tank heaters, heater treater, heat trace along piping, etc.).

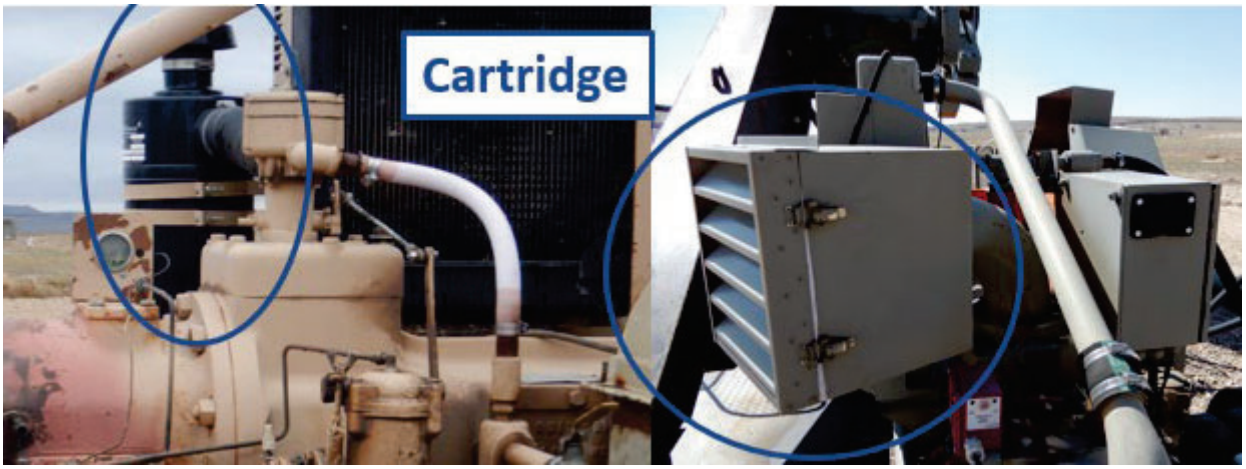
Seeking Vaquero Review and Input

The EPA would like to better understand what could influence pumpjack engine emissions and so seeks Vaquero's review and input on the equipment associated with each engine. From observations and conversations with operators, engine manufacturers, and experienced engine stack testers, the EPA offers descriptions and photos of our understanding of nomenclature around equipment associated with the engine. In addition to the following questions, the EPA requests Vaquero's confirmation of the engine parameters and configurations listed for each engine in Table 3, below.

1) Confirm the engine Make/Model, nameplate HP, serial #, and engine category (e.g., 2-Stroke Lean Burn [2SLB], 4SRB).

2) Confirm the manufacture year of each engine with particular attention to whether, and when, the engine may have been reconstructed, remanufactured, reconditioned, rebuilt, refurbished, or modified.



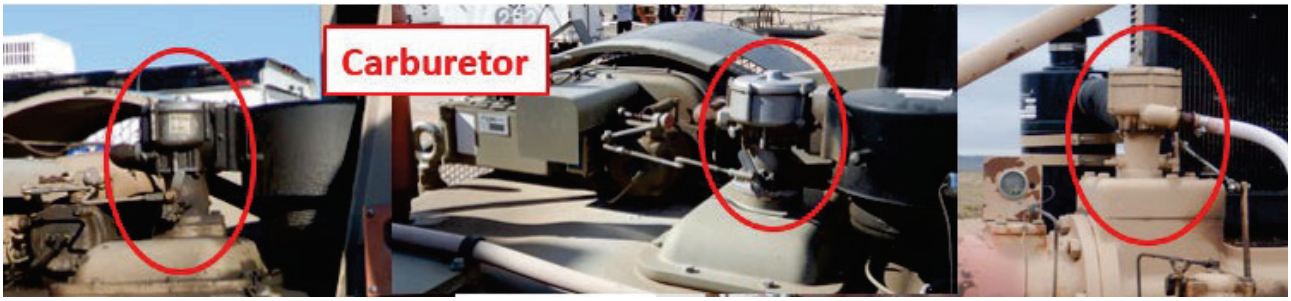


4) Knock-Out (KO) Scrubbers – Inspectors noted whether there was a single KO scrubber on the fuel gas entering the engine, or sequential dual KO scrubbers.

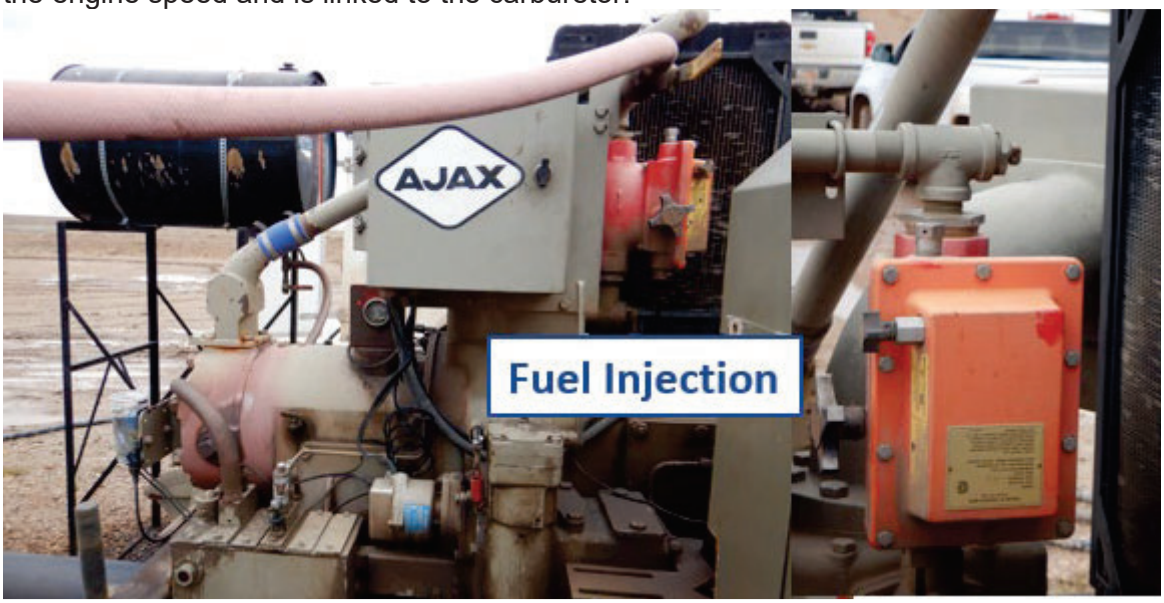
5) Fuel Gas Source – Casing free gas (gas from the annulus on the backside of the production tubing, direct from the well casing), separator gas (the associated gas with oil production that comes off the wellpad's separator or heater treater), or dry processed gas (piped in from a neighboring compressor station). Noted during inspection was EPA's understanding of the fuel gas source used by the engine during testing relying on walking the lines with the operator. EPA understands that the fuel gas source can be changed at each site. For example, if dry processed gas is distributed to wellpads from a compressor station and the pipeline should freeze, or the compressor station is down, the wellpad could switch to either casing free gas or gas from the separator on-site.

   What records does Vaquero keep regarding the source of fuel gas being used on-site?

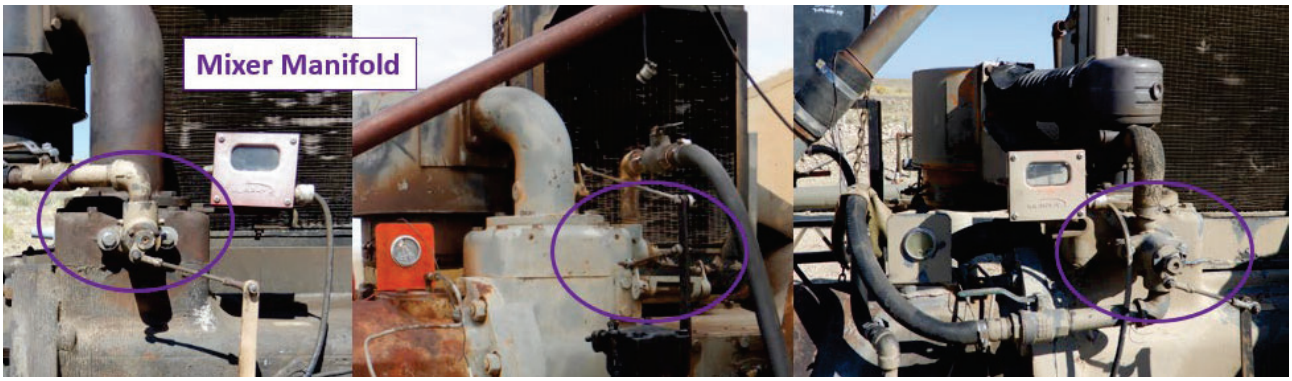
6) Air Fuel Control – carburetor, fuel injection, mixer manifold, or Air Fuel Ratio Control (AFRC). From conversations with operators, engine manufacturers and experienced engine stack testers, EPA's understanding of various air fuel control systems present in the field are described with photos as the examples shown below:



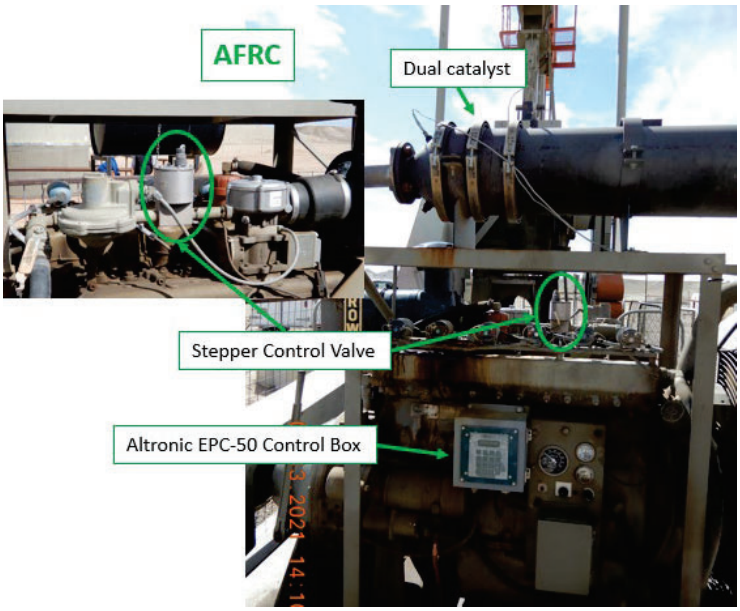
The fuel gas is routed to the carburetor where the air intake is also routed. The governor controls the engine speed and is linked to the carburetor.



The "AJAX" control box + the red Murphy fuel control valve to the right of the AJAX box = fuel injection system.

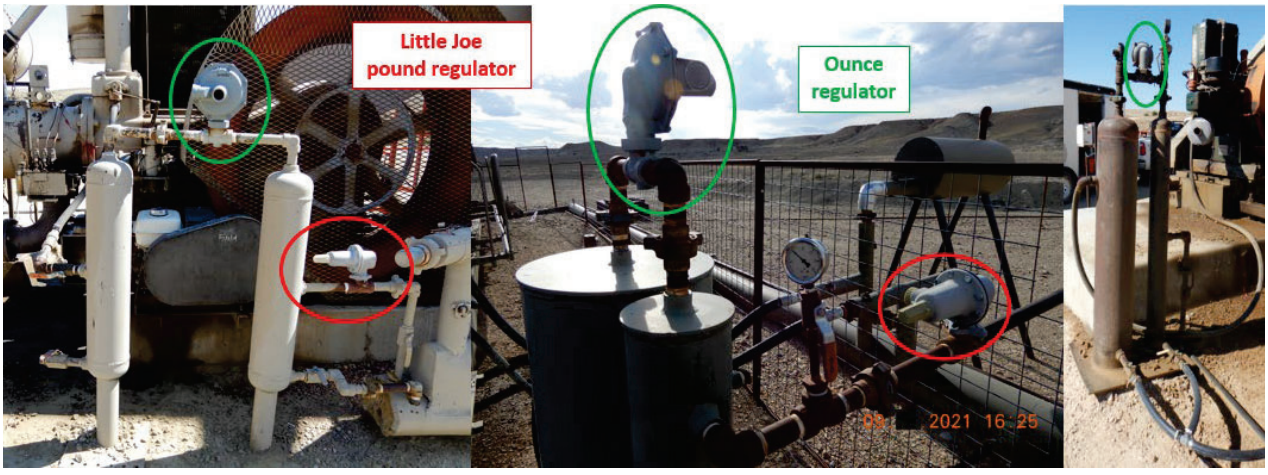


The fuel gas is routed to the mixer manifold where the air intake is also routed. The governor controls the engine speed and is linked to the mixer manifold.



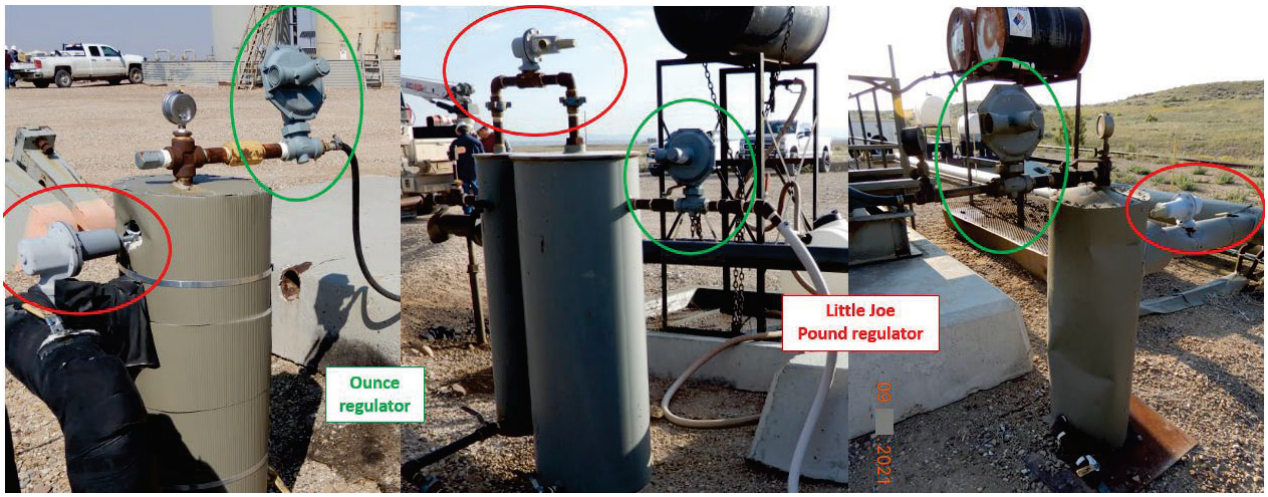
Dual catalyst chamber on the engine exhaust. The Stepper control valve is to the right of carburetor (visible in the background) and shown zoomed in from another perspective. On the bottom is an Altronic EPC-50 control panel (CD1 digital ignition, electronic governor, O2 sensors, voltage signal to Stepper valve to control fuel flow, cam/crank sensors). EPA's understanding is the combination of this equipment is an Air Fuel Ratio Control (AFRC) system.

7) Fuel Gas Volume Capacity – Yes or No. A gas volume tank provides a reservoir of pressurized fuel gas to meet engine demand. Without a gas volume vessel, the available reservoir capacity is in the piping conveying the fuel gas to the engine.



If the Ounce regulator is BEFORE the last KO scrubber and the engine, then fuel gas volume capacity IS available to the engine, equal to the volume of the 2nd KO scrubber (Y). The pressure of the fuel gas is adjusted by springs within the regulator - if spring is all the way out → discharge

pressure is the minimum pressure of range of the regulator. If spring is all the way in → discharge pressure is the maximum pressure of range of the regulator.



If the Ounce regulator is between the KO scrubber and the engine, then there is NO fuel gas volume capacity available for the engine (N), besides within the fuel gas line running to the engine. The pressure of the fuel gas is adjusted by springs within the regulator - if spring is all the way out → discharge pressure is the minimum pressure of range of the regulator. If spring is all the way in → discharge pressure is the maximum pressure of range of the regulator.

8) EPA requests the most recent fuel gas analyses available for each fuel gas source available for use on each site – casing gas, separator gas and dry processed gas.

9) Maintenance Practices – EPA requests a summary of the manufacturer recommended maintenance and servicing for each engine make/model listed in Table 3 and a table showing the maintenance performed by Vaquero on each engine from 1/1/2019 to now.

make	model	manufacturer_year	horsepower	engine_category	Serial #	facility_name	AST_CO_g_hphr	AST_NOx_g_hphr	AST_CH4_g_hphr	AST_NMHC_g_hphr	AST_02_%dry	BSFC_BTU/hphr	air_filter_type	KO_Scrubbers	fuel-source	air_fuel_control	fuel_gas_volume_capacity
Arrow	L-795	2012	65	2SLB	AEL795019	TR 35-11-720	29.6	2.0	0.00090	26.2	10.85	12081	Oil bath	Dual	Processed gas	carburetor	Y
Arrow	L-795	not on nam	65	2SLB	AEL795004	TR 35-43-720	182.8	0.14	0.0013	43.9	13.51	12081	Oil bath	Dual	Processed gas	carburetor	Y
Arrow	L-795	2012	65	2SLB	no nameplate	TR 35-442-720	143.9	0.30	0.0012	49.1	11.48	12081	Oil bath	Dual	Processed gas	carburetor	Y
Arrow	L-795	not on nam	65	2SLB	AGL795013	TR Federal 33-11-720	159.6	0.24	0.000	43.1	12.16	12081					

Areas of Concern

Test data has identified certain engine emissions in exceedance of the limitations found in the New Source Performance Standards, Subpart JJJJ - Standards of Performance for Stationary Spark Ignition Internal Combustion Engines:

> §60.4233(d) Owners and operators of stationary SI ICE with a maximum engine power greater than 19 KW [25 HP] and less than 75 KW [100 HP] . . . must comply with the emission standards for field testing in 40 CFR 1048.101(c)
>
> §1048.101(c) Standards for field testing. Starting in 2007, exhaust emissions may not exceed field-testing standards, as follows:
> (2) The HC + NOX standard is 3.8 g/kW-hr [2.83 g/hp-hr] . . . For natural gas-fueled engines, you are not required to measure nonmethane hydrocarbon emissions or total hydrocarbon emissions for testing to show that the engine meets the emission standards of this paragraph (c); that is, you may assume HC emissions are equal to zero
>
> §1048.101(c)(2) . . . and the CO standard is 6.5 g/kW-hr [4.85 g/hp-hr].
>
> §60.4230(a)(4)(iii) . . . the requirements of subpart JJJJ apply to engines manufactured on or after July 1, 2008, if they are <500 HP.

The Three Rivers Federal 33-11-720 facility was not listed in the triennial Uinta Basin Emission Inventory for 2017 reporting year (UBEI2017). The well (API well ID 4304753944) associated with the wellpad has been producing since 1/1/2015 and so this facility should have been reported in the UBEI2017.

The Three Rivers Federal 35-43-720 facility was not listed in the triennial Uinta Basin Emission Inventory for 2017 reporting year (UBEI2017). The well (API well ID 4304753918) associated with the wellpad has been producing since 7/1/2014 and so this facility should have been reported in the UBEI2017.

Attachment A - AST Test Report

File: 21-2251-004 ERG Vaquero Uinta PJ Engine Testing_DraftR1.pdf