**SPL Response to CARB Proposed Rule and the Proposed Appendix C**

**“Test Procedure for Determining Annual Flash Emission Rate of Methane from Crude Oil, Condensate and Produced Water”**

My name is Joe Landes, and I am the Executive Vice-President of Technical Services for SPL, Inc. I am currently the Chairman of GPA Technical Section B, “Analysis”, as well as a member of ASTM committees and the API Committee on Liquid Measurement.

SPL, formerly known as Southern Petroleum Laboratories, has been in business for over 70 years, providing measurement and analytical services to the upstream, midstream and downstream sectors of the oil and gas industry. We have extensive experience in hydrocarbon and environmental testing, analyzing thousands of samples each month, many of which are pressurized crude oil, condensate and produced water.

SPL is working on an on-going study to evaluate sampling and analytical methods for pressurized hydrocarbon liquids, and, based on our years of experience as well as study data and findings to date, we have the following suggestions and recommendations regarding the proposed test procedure.

**Section 3**

 **3.5**

The double valve (i.e., constant volume (CV)) cylinder is not viable for sampling produced water, since the displacement fluid is normally either water or glycol. We only use Piston (i.e., constant pressure (CP)) Cylinders for sampling produced water. In the study that we are participating in, double valve cylinders are being utilized in simultaneous sampling events of pressurized condensate with Piston Cylinders. The data does not indicate significant differences in analytical results for CV and CP cylinder samples.

**3.9**

To avoid confusing the gas-to-oil ratio used by producers to quantify the ratio of gas production to oil production from a well, “GOR” should be named FGOR (i.e., flash gas-to-oil ratio) and should be expressed in “Standard Cubic Feet per Storage Tank Barrel”.

 $FGOR=\frac{Volume of Flash Gas (scf)}{Volume of Post-flash Oil (bbl)}$

Many producers do not have meters on the separator (or if they do it is likely they are not reliable) and will report oil production volume based on the post-flash oil in the storage tank. If you do not make this correction, the FGOR and reported emissions will likely be low.

 **3.10**

FGWR should be expressed in “Standard Cubic Feet per Storage Tank Barrel”.

 $FGWR=\frac{Volume of Flash Gas (scf)}{Volume of Post-flash Water (bbl)}$

If you do not make this correction, the reported FGWR and reported emissions will likely be low.

 **3.16**

If the separator to tank liquid flows continuously, the operators would not be allowed to use snap-acting dump valves (which is typical operating practice), and could only use throttle dumps. We believe that the use of the term “Steady State conditions” is misleading. In our study, (the results of this work will be published) we are seeing data that indicates that this statement is incorrect (i.e., separators are dynamic systems and the operating pressure will vary with the pressures of adjacent processes and equipment such as sales gas pipeline pressure).

 **3.16 - 3.21**

A general comment regarding the various definitions for separators, pressure separators, tanks, separator and tank system, etc. is that it should be clear to the tester that the pressurized sample should be collected from the separator that is immediately upstream of any storage tank that has the potential to vent gas to the atmosphere. Some production sites have multiple stages of separation in series before the storage tanks, and the sample should be collected from the last separator prior to flashing at the storage tank.

**Section 4**

**4.5**

Pressure gauges and thermometers should be recertified annually as a best practice and verified more frequently.

**Section 5**

**5.1** And **5.2**

It is also our recommendation that the accuracy of the pressure gauge is + 0.1%.

**5.3**

It is our recommendation that the accuracy of the thermometer is + 0.5°F.

**Section 8**

**8.1**

See comment in **3.5**. Does data exist to substantiate the statement “The double valve cylinder sampling method is … not applicable for collecting samples of condensate”? Our data conflicts with this statement and does not indicate significant differences in analytical results for condensate samples collected simultaneously in Double Valve and Piston cylinders.

**Figure 1**

There should be a valve on the sample probe before the thermometer and pressure gauge.

**8.10**

This section states that the recommended rate of filling the pressurized liquid sample container is 150 - 200 milliliters per minute (3 drips per second). SPL’s comment is that this sample rate is too rapid and is likely to cause flashing in the sample cylinder. The goal is to not flash the sample. SPL typically recommends that you displace the water at a rate as low as 20 milliliters per minute (ml/min.), and preliminary data indicate that sample rates greater than 60 ml/min may compromise a pressurized condensate sample. The method should also state that the fill rate should be determined by the line pressure and that care should be taken not to flash the sample.

This section states that the sample container should be filled to 80-95%. It is SPL’s experience that you should fill to 80% and take outage of about 10% to accommodate for thermal expansion. Depending on the amount of light hydrocarbons in the liquid sample, you could get an increase is sample pressure of 30-50 psi per degree of temperature increase. For instance, if your sampling pressure is 300 psi, thermal expansion is 50 psi per degree, and you have a 30 degree rise in temperature, you would likely blow the sample cylinder pressure relief valve (rated at 1800 -10%, or 1620 psi).

Samples with outage are re-pressurized in the laboratory to at least 200 psi above sampling pressure, and we have data in our study that indicates that this does not cause sample distortion.

Note: DOT states in 49 CFR 173.40 regarding outage requirements, “Sufficient outage must be provided so that the cylinder will not be liquid full at 55oC (131oF).”

 **8.11**

 See comment on **3.16** and delete the words “Steady State”.

**8.16**

The reference to **Section 12** should be to **Section 10**.

**Section 9**

**9.1**

Sampling at 15 psig may not be possible without using a syringe-type cylinder or a pump. Typically, a piston cylinder requires between 30-40 psid for the piston to move properly.

**Figure 3**

There should be a valve on the sample probe before the thermometer and pressure gauge.

**9.7**

This section states that the recommended rate of filling the pressurized liquid sample container is 150 - 200 milliliters per minute. SPL’s comment is that this sample rate is too rapid and is likely to cause flashing in the sample cylinder. The goal is to not flash the sample. SPL typically recommends that you displace the water at a rate as low as 20 milliliters per minute (ml/min.), and preliminary data indicate that sample rates greater than 60 ml/min may compromise a pressurized condensate sample. The method should also state that the fill rate should be determined by the line pressure (higher line pressures require slower fill rates) and that care should be taken not to flash the sample.

This section states that the sample container should be filled to 80-95%. It is SPL’s experience and manufacturer’s recommendations that you should fill to not more than 80% to accommodate for thermal expansion. Depending on the amount of light hydrocarbons in the liquid sample you could get an increase is sample pressure of 30-50 psi per degree of temperature increase. For instance, if your sampling pressure is 300 psi, thermal expansion is 50 psi per degree, and you have a 30 degree rise in temperature, you would likely blow the pressure relief valve (rated at 1800 -10%, or 1620 psi). The sample is re-pressurized in the laboratory to at least 200 psi above sampling pressure, and we have data in our study that indicates that this does not cause sample distortion.

**9.13**

The reference to **Section 12** should be to **Section 10**.

**Section 10**

This draft would benefit the readers if it was re-written to reduce ambiguity. We recommend GPA 2103 for analysis of pressurized oil or condensate samples, since it is an industry recognized reference method for this type of analysis.  GPA 2186 is an appropriate analytical method for lighter NGL samples, and method modifications to eliminate normalization can improve analytical results for heavier condensate and oil samples.  There is not a reference (e.g., GPA, ASTM, or EPA) method for flash liberation, and flash liberation is typically documented as an SOP for an individual lab; thus, flash liberation methods and practices can vary widely depending on the lab.  It would be expected that the variations in results from flash liberation analyses could make it difficult to demonstrate a consistent estimation of emission rate as described in Subchapter 10, Article 3, Section 95213 (C). We have data from our study that will be published where these methods are compared.

**10.1 (c)**

Operational performance checks to evaluate and validate pressurized hydrocarbon sampling and analysis results are not listed in the document. At a minimum, we would suggest a comparison of Bubble Point Pressure (at sample collection temperature) to Separator Pressure. We are currently working on a study that will soon be published and we are evaluating several means to validate pressurized hydrocarbon liquid sample analyses.

**10.2 (d)** and **10.3 (a)**

Heating liquid samples can pose a safety risk, related to the comments on **Section 8.10** and **9.7.**

**10.2 (g)**

GPA 2174 is a sampling document.  GPA 2261 and GPA 2177 are analytical procedures. None of the dates listed are current, GPA 2174-14, GPA 2261-13 and GPA 2177-13 are the most recent revisions to those standards.

**10.3 (a)**

Heating liquid samples can pose a safety risk, related to the comments on **Section 8.8** and **9.7.**

**10.4 (a)**

**Equation 4** should read as follows:

$$ Volume\_{Vapor Std}= Volume\_{Vapor Lab}×\frac{459.67+60°F}{459.67+T\_{Lab}°F}×\frac{P\_{Lab} psia}{14.696 psia}$$

**10.4 (b)**

**Equation 5** should read as follows:

$$Volume\_{Liquid Std}=\frac{Mass\_{Liquid Lab}}{Density\_{60°F}×42×3785.412}$$

**10.4 (c)**

**Equation 6** should read as follows:

 $FGOR=\frac{Volume of Flash Gas (scf)}{Volume of Post-flash Oil (bbl)}$

Or

$$ FGWR=\frac{Volume of Flash Gas (scf)}{Volume of Post-flash Water (bbl)}$$

**10.4 (c) Note:**

See comments in **3.5** and **8.1**.

**10.5 (a)**

GPA 2286-14, ASTM D-1945-14 are the most current versions of these standards. ASTM D-1945 is the technical equivalent of GPA 2261.  Either of these can be used as the “TCD” portion of GPA 2286, which is an extended analysis method.

ASTM D3588-98 is a document used for calculation of properties of gaseous mixtures, similar to GPA 2172-09, which is more recent. Regardless of which calculation routine is used, it is necessary to reference GPA 2145-09 (GPA 2145-16 will likely be available by the release of this document and should be referenced when it becomes available. For that matter, all reference methods should reference the most current revision.)

 “*ASTM D-2597 is being balloted for withdrawal. Gas Processors Association (GPA) recently completed a significant study to update the GPA equivalent method, GPA 2177, and update the precision. Rather than spend considerable time to totally revise D2597 to align with GPA 2177, and since D2597 is not quoted in any ASTM product specifications, Subcommittee H leadership recommends that D2597 be withdrawn, with the withdrawal notice directing people to GPA 2177, a more up-to-date test method for the determination of the same components.*” – copied from ASTM website.

**Section 11**

 **11.1**

It should be clarified that the FGOR and FGWR be calculated per “Storage Tank Barrel” and not per “Separator Barrel” and that the calculations use the correct measurement so that emission calculations are correct. **Equation 1** should read as follows:

$$Volume\_{Gas} =FGOR×Volume\_{Post-flash liquid, Bbl/day}×365$$

 **11.2** And **11.3**

 The equations should be formatted properly.

**Section 12**

 Table 1 appears to be incomplete.

**Section 13**

The prescribed analysis method you list, “Flash Liberation” is not an ASTM or GPA method. It may contain steps that are modifications of ASTM or GPA methods, but there is no reference method for flash liberation. We are working on a related project, and the results of GPA 2186 (modified to eliminate normalization) and GPA 2103 are at least the equivalent of, if not superior to flash liberation. We have data from multiple laboratories running all three methods on multiple Certified Reference Materials that is soon to be published.

All references to industry standards should reflect the most recent revision.