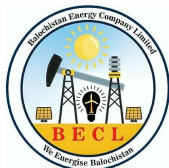




ATTACHMENT-II

TECHNICAL SPECIFICATION FOR LPG TESTING EQUIPMENTS

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1.0 **Gas Chromatograph for the Determination of Hydrocarbons in Liquefied Petroleum Gases (ASTM D-2163)**

ASTM D-2163 Method covers the quantitative determination of individual hydrocarbons in liquefied petroleum (LP) gases and mixtures of propane and propene.

The required typical gas chromatograph shall consist of minimum required items, accessories etc. as per **ASTM D-2163**.

Gas Chromatograph Analyzer for LPG streams based on ASTM D2163, capable of testing C1 to C6+ hydrocarbons.

1. **Gas chromatograph (GC):** Equipment shall be equipped with linear temperature programmable column oven. The temperature control must be capable of obtaining a retention time repeatability of 0.05 min (3 sec) throughout the scope of analysis.
2. **Detector:** Flame Ionization detector having a sensitivity of 0.5 ppm or less for the compounds mentioned in the standard D-2163 method.
3. **Sample Introduction:** Whether liquid or vapor sampling, the combination of valve injection size and split ratio must be selected such that the required sensitivity is achieved and also that no component concentration in a sample is greater than the detector upper linearity limit.
 - i. If capillary columns will be used, then the GC must include a heated splitting type injector that is operated isothermally. If packed columns will be used, then a splitting type injector is not required and a suitable packed inlet port may be used.
 - ii. **Liquid Sampling:** GC should be equipped with LPG sampling valve/injector with an internal fixed sample volume between 0.2 to 0.5 μL . The valve shall be rated for at least 200 psi above the vapor pressure of the sample at the valve operating temperature. A 2 to 7 μm packed screen type filter should be provided at the sample inlet port of the sampling valve to remove possible particulate material from the sample.
 - iii. **Vapor Sampling:** A six-port gas sampling valve or a ten-port sampling/column switching valve with 1.6 mm (1/16 in.) fittings and a 200 μL fixed sampling loop may be provided. The use of a 2 to 7 μm frit or packed-screen type filter ahead of the sample introduction port is recommended.
4. **Column Series/Reversal Switching Valve:** If desired, a multi-port valve mentioned may be used to provide the C5 olefin/C6+ determination for this analysis.



5. Columns:

- i. **Analytical Column:** The recommended column is 50 m by 0.53 mm (I.D) Na_2SO_4 deactivated Al_2O_3 porous layer open tubular (PLOT) column. Alternatively any column(s) that provides appropriate component separation may be used.
 - ii. **Pre-Column:** A column such as a 10 to 30 m section of 0.53 mm (I.D) 1 μm film thickness dimethylpolysiloxane or polyethylene glycol capillary column or a 9 to 15 cm section of the same column material as the analytical column or any pre column that provides the desired retention of C5 olefins, hexanes and heavier components.
6. **Reference Gas Mixture:** Individual and mixed component reference material. Due to high pressure of methane and ethylene, be limited to 0.2 vol% of the mixture composition. Calibration standards are contained in floating piston cylinders pressurized to at least 200 psi above the vapour pressure of the mixture.
7. **Hydrocarbon Trap**
8. **Moisture Trap**
9. **Calories calculation software**
10. **Computer:** Min. requirement Intel i7 6th Gen. with 8 Gb RAM & 500 Gb HDD or better
11. **Printer:** any latest laser jet.

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories and equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.



2.0 **Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (ASTM D-1267)**

ASTM D-1267 Method covers the determination of the gage vapor pressures of liquefied petroleum gas products at temperatures of 37.8°C (100°F).

Vapor Pressure Apparatus, consisting of two chambers, a vapor chamber (upper section) and a liquid chamber (lower section), shall conform to the following requirements:

1. **Vapor Chamber (Upper Section):** A cylindrical vessel having the inside dimensions of 51 ± 3 mm ($2 \pm 1/8$ in.) in diameter and 254 ± 3 mm ($10 \pm 1/8$ in.) in length.
2. **Liquid Chambers:** With one opening and two openings.
3. **Pressure Gauge:** The pressure gauge shall be a Bourdon type spring gauge of test gauge quality 100 to 150 mm (4.5 to 6.5 in.) in diameter provided with a nominal 6.35-mm (0.25-in.) male thread connection with a passageway not less than 4.7 mm (3/16 in.) in diameter from the Bourdon tube to the atmosphere.
4. **Cooling Bath:** A cooling bath having temperature range between 0 and 1 (32 and 34°F).
5. **Water Bath:** For maintaining the bath at a constant temp. of $37.8 \pm 0.1^\circ\text{C}$ ($100 \pm .2^\circ\text{F}$).
6. **Temperature Measuring Device:** Capable of monitoring the desired test temperature in the water bath in the range of 35 to 70°C to within 60.1°C.
7. **Pressure Measuring Device:** The pressure measuring device with a minimum accuracy of 0.5 kPa (0.07 psi) with increments no larger than 0.5 kPa (0.07 psi).
8. **Dead-Weight Tester:** A dead weight tester of satisfactory range may be used checking the accuracy of vapor pressure gages
9. **Sample Transfer Connection:** A device for removing liquid from the sample container without interfering with the vapor space.
10. **Flexible Coupler:** A suitable flexible coupling shall be provided for connection of the rotating vapor pressure apparatus to the pressure measuring device.
11. **Vapor Chamber Tube:** The vapor chamber tube of inner diameter 3 mm (1/8 in.) and length of 114 mm (4.5 in.).

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories & equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.



3.0 Volatility of Liquefied Petroleum Gases ASTM D-1837

ASTM D-1837 Method is a measure of the relative purity of the various types of liquefied petroleum (LP) gases and helps to ensure suitable volatility performance

Following apparatus are required as per ASTM D-1837 Method:

- 1) **Weathering Tube:** A Centrifuge tube, cone shaped, 100 mL, 203 mm, graduated to 0.05 mL and made of thoroughly annealed heat-resistant glass.
- 2) **Tube Support:** Support to be provided for the weathering tube by its neck in a vertical position
- 3) **Water Bath:** Shallow container filled with clean water having a temperature maintained at 15-21°C and a depth of 38 mm
- 4) **Armoured weathering Test Thermometer:** 99C-92, -50°C to 5°C.
- 5) **Pre-cooling Equipment:** Cooling Coil and Cooling Vessel according to ASTM-D1837
- 6) **Motorized Stirring,** Cooling Bath Temp (-55 to 30°C), PT100 Sensing, Digital Display Temperature Control.

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories and equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.



4.0 **Residual Matter in LPG ASTM D-2158**

ASTM D-2158 Method covers the determination of extraneous materials weathering above 38°C that are present in liquefied petroleum gases.

Following apparatus are required as per ASTM D-2158 Method:

- 1) **Centrifuge Tube:** Cone shaped, 100 mL, 203 mm, compatible with method specifications.
- 2) **Pre-cooling equipment:** Cooling Coil and Cooling Vessel according to ASTM-D1837
- 3) **Syringe:** 2 mL, graduated in 0.1 ml, equipped with a needle 200 ± 5 mm long
- 4) **Thermometer:** Low range ASTM, 5C & 6C. High range ASTM 57C.
- 5) **Water Bath:** Controlled at 38 ± 2°C
- 6) **Copper Wire:** 1-2 mm Dia, 10 mm longer than centrifuge tube height.
- 7) **Absorbent paper:** Medium-grade, rapid, white, 125-mm diameter.
- 8) **Clamp:** For holding the centrifuge tube during weathering

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories and equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.



5.0 Copper Strip Corrosion for LPG ASTM D-1838

ASTM D-1838 Method covers the detection of the presence of components in liquefied petroleum gases which can be corrosive to copper

Following apparatus & materials are required as per ASTM D-1838 Method.

Apparatus:

- 1) **LPG Corrosion Test Cylinder:** Constructed of Stainless steel with an O-ring removable top closure. The whole assembly shall be constructed to withstand a minimum hydrostatic pressure of 6895 kPa (1000 psig).
- 2) **Water Bath:** Capable of being maintained at $37.8^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$ ($100^{\circ}\text{F} \pm 1^{\circ}\text{F}$). Incorporate suitable support to hold the test cylinder in an upright position. The bath shall be deep enough so that the entire cylinder and valves will be covered during the test.
- 3) **Thermometer:** Capable of monitoring the desired test temperature in the bath to within accuracy of $\pm 0.5^{\circ}\text{C}$ (1°F) or better.
- 4) **Strip Polishing Vise:** To hold the copper strip firmly without marring the edges.

Materials:

- 5) **Wash Solvent:** Acetone or as per specifications mentioned in the ASTM D-1838 method.
- 6) **Copper Strip:** As per specifications mentioned in article 7.2 in the ASTM D-1838 method.
- 7) **Surface Preparation/Polishing materials:** Silicon Carbide grit paper or cloth of varying degrees of fineness including 65- μm grade (220-grit) and (120-150 grit).
- 8) **ASTM Copper Strip Corrosion Standard** Plastic strip (ADJD0130)

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories and equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.



6.0 **Determination of Total Sulphur in gaseous hydrocarbons and LPG by UV Fluorescence (ASTM D-6667)**

ASTM D-6667 method covers the determination of total volatile sulfur in gaseous hydrocarbons and liquefied petroleum (LP) gases.

Following are the apparatus required for Determination of Total Sulphur as per ASTM D-6667 Method:

- 1) **Furnace:** An electric furnace held at a temperature ($1075 \pm 25^{\circ}\text{C}$) sufficient to pyrolyze the entire sample and oxidize sulfur to SO_2
- 2) **Combustion Tube:** A quartz combustion tube constructed to allow the direct injection of the sample into the heated oxidation zone of the furnace
- 3) **Flow Control:** Apparatus shall be equipped with flow controllers capable of maintaining a constant supply of oxygen and carrier gas at the specified rates.
- 4) **Drier Tube:** Apparatus shall be equipped with a mechanism for the removal of water vapor formed during sample combustion like, Permeation dryer
- 5) **UV Fluorescence Detector:** A quantitative detector capable of measuring light emitted from the fluorescence of sulfur dioxide by UV light.
- 6) **Sample Inlet System**
- 7) **Strip Chart Recorder:** Electronic data logger, integrator or recorder.
- 8) **Inert Gas:** Argon or Helium, high purity grade 99.998 % min purity.

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories and equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.



7.0 Moisture Content (for LPG) or Dryness of Propane (Valve Freeze Method) ASTM D-2713

ASTM D-2713 method covers the measurement of the dryness of propane products that do not contain antifreeze agents.

Following are the apparatus required for Dryness of Propane (Valve Freeze Method) as per ASTM D-2713:

- 1) **Propane Water Test Valve:** specially constructed and calibrated valve. The valve has two open positions, a wide-open position for flushing, and a small preset flow position for testing
- 2) **Stop Watch or Timer**, measuring in seconds.
- 3) **LP Gas Sample Cylinder** having minimum capacity of 11 L (3 gal)
- 4) **Cloth, dry, clean.**
- 5) **Connection Tubing:** clean pipe or metallic tubing for connecting the propane water test valve to the sample point or sample cylinder

Notes:

- Supplier to also provide OEM recommended **Spares and Consumables** for 2 years moderate operation (Separate Price from the essential Accessories and equipment needed for unit operation)
- Supplier to give **Warranty** of Two (2) year for parts and service.

8.0 Other Requirements:

Supplier to also provide following:

- **Standard Accessories:** As per ASTM method.
- **Standards and Certified Reference Material with certificates as per ASTM Method.**
- **Validation Program:** Complies with ASTM, Calibration certificates, Real Time IQ, OQ, PQ required at time of I&C
- **Periodic Maintenance/service/user Manuals with schematics (electronic/pneumatic) soft and hard copy.**
- **One Month Training for staff.**