

## Liquid hydrocarbon mixtures with Depletion Calculation Certificate for Online Process Analysis Applications



“Easy to use cylinder  
with Dual-Port  
valve and Dip tube”

### We Create Value

Air Liquide offers technical know-how and experience, together with our comprehensive offer of gas products and equipment such as the most extensive list of hydrocarbon components available, piston cylinders, cylinder heating jackets and more.

Our expertise in hydrocarbon mixtures allows us to provide mixtures in liquid phase with precise gas concentration prediction for every single component throughout the cylinder consumption.

Your solution for accurate validation of online process applications using liquid mixtures with liquefied or vapor components

#### Online process analyser validation

Ten step depletion table that approaches the consumption pattern for on-line process analyser validation.

#### Minimize potential errors and reflecting true value

Calculated values that minimize potential errors and reflect the true value during consumption of the two phase mixture.

#### Increased efficiency

Reports dissolved helium concentration in liquid mixture that is caused by the helium pressure pad.

#### Suited to process environment

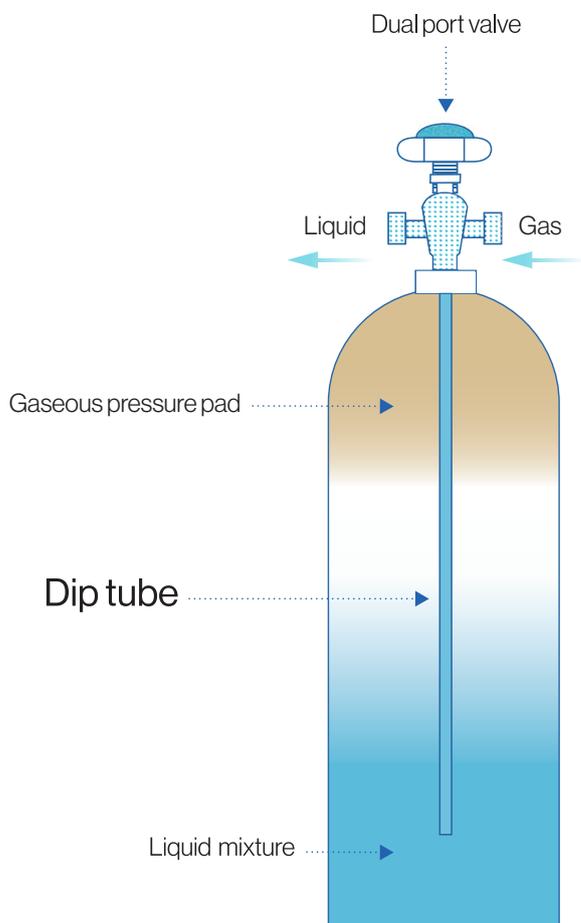
Recommended for the validation of online process Gas Chromatograph in a production process environment.

## Validation of analytical online process applications

The composition of a liquid mixture, containing liquefied components, is not homogeneous and exists in the gas phase as well as in the liquid phase in a gas cylinder. Samples taken from the cylinder will then differ from its original analysis.

As a result of the liquid extraction, the hydrocarbon concentrations in both the liquid phase and overhead gas phase change due to the different volatility of the components. The typical solution to guarantee that the components remain in the liquid phase throughout the use of the mixture in offline laboratory applications is a piston cylinder. Production process environment would however often require a different kind of equipment.

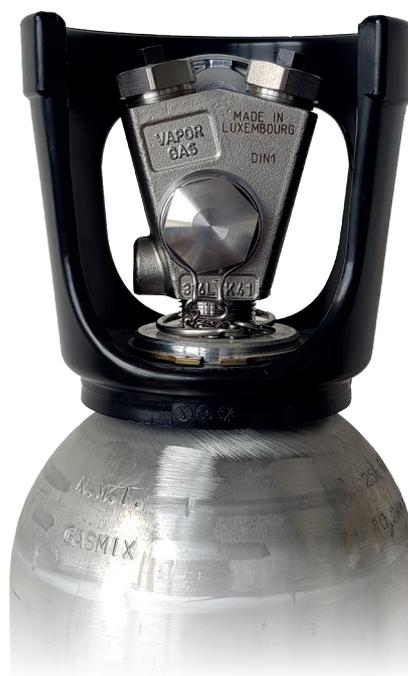
The demand for validation of online process analyzers is growing. Air Liquide has therefore initiated a new scientific approach for liquid mixtures, containing liquefied components, in conventional high pressure cylinders.



## An innovative Air Liquide solution for gas concentration prediction throughout use of the cylinder

Air Liquide developed a proprietary software tool based on the Peng–Robinson equation which is able to estimate the hydrocarbon concentrations during the whole cylinder depletion process. This information is provided with each mixture and is an estimation of the concentrations after a certain amount of material has been withdrawn from the cylinder.

- The certificate confirms a certified value that is calculated in order to express the thermodynamic phase equilibrium of the mixture.
- Depletion calculations in 10 steps.
- The cylinder is pressurized with helium gas and the solubility of helium in liquid phase is reported as well.
- Pressure pad does not need to be maintained at a constant level during use.
- All concentrations are normalized from total of added pure components, including helium.



## Standard Cylinder with Dual-Port Valve and Constant Pressure Pad

Liquid mixtures using a standard size cylinder with dual-port valve and constant pressure pad are blended gravimetrically.

The headspace above the liquid is initially pressurized (pre-charged) with an inert gas such as helium. Liquid is drawn off the bottom of the cylinder using the pressure in the headspace.

A photograph of a male worker in a blue uniform and white hard hat, wearing yellow gloves and ear protection, working on a complex industrial machine with yellow and white components. The machine has various pipes, valves, and a large cylindrical tank. The worker is focused on his task, looking down at the equipment. The background shows more of the industrial facility with metal structures and pipes.

## Keep it simple

- Accurate validation solution for liquid mixtures that contain liquefied or vapor components
- Certificate of Analysis and detailed depletion calculations delivered with your cylinder
- Direct access to gas experts from our Expertise Center

Air Liquide also provides Instrument calibration solutions for use of liquid mixtures with liquefied components in off-line laboratory analyser applications. Please contact your Air Liquide representative regarding your specific liquid mixture need for off-line applications.

### Validation or calibration ?

Calibration is process of comparison with a reference in order to set corrections and/or uncertainties characteristic of the instrument being calibrated. The results of the calibration process may then be used in the adjustment of the instrument.

Validation provides information regarding the accuracy or inaccuracy of the gas chromatograph. It is a check to confirm that the instrument fits the specifications required for some particular use and minimizes potential risk in offset of your production process.

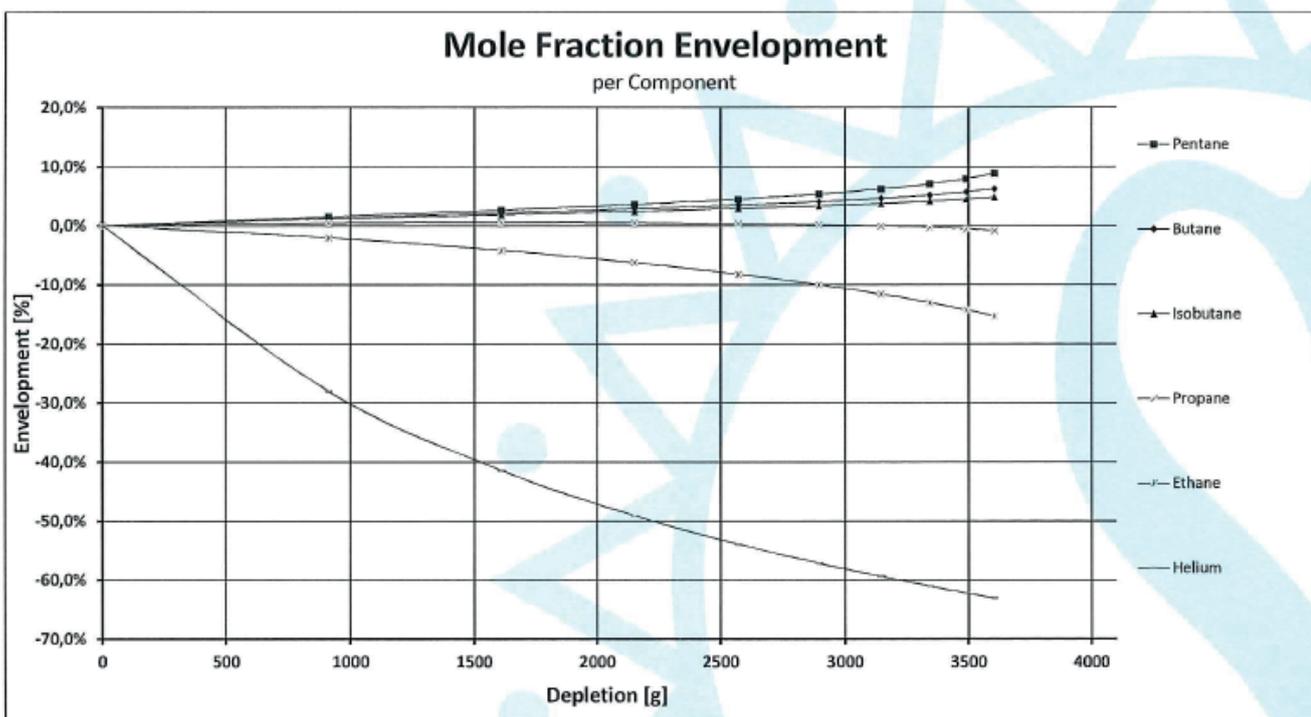
## Example of depletion calculations for liquified mixtures

Certificate Reference: 20-99883-001	Cylinder ID: 9703325	Cyl. Volume: 10 litre	Headspace: Helium
Customer Name:		Temperature: 20 °C	Pressure: 25 bara hyperbaric

Depletion	0 g	910 g	700 g	540 g	420 g	325 g	250 g	195 g	150 g	115 g
Total depleted	0 g	910 g	1610 g	2150 g	2570 g	2895 g	3145 g	3340 g	3490 g	3605 g
Helium Headspace Pressure	25,0 bara	19,6 bara	17,1 bara	15,6 bara	14,7 bara	14,1 bara	13,6 bara	13,3 bara	13,1 bara	12,9 bara

Component Name	Initial Liquid mol %	Applied Accuracy	Calculated composition of liquid phase								
			Mole fractions [%]								
Pentane	10,3 %	2	10,5 %	10,6 %	10,7 %	10,8 %	10,9 %	11,0 %	11,0 %	11,1 %	11,2 %
Butane	15,8 %	2	16,0 %	16,1 %	16,2 %	16,3 %	16,4 %	16,5 %	16,6 %	16,7 %	16,7 %
Isobutane	8,8 %	2	8,9 %	8,9 %	9,0 %	9,0 %	9,1 %	9,1 %	9,1 %	9,2 %	9,2 %
Propane	61,2 %	1	61,5 %	61,5 %	61,5 %	61,4 %	61,3 %	61,2 %	61,0 %	60,8 %	60,7 %
Ethane	1,43 %	2	1,40 %	1,37 %	1,34 %	1,31 %	1,28 %	1,26 %	1,24 %	1,22 %	1,21 %
Helium	2,5 %	5	1,83 %	1,49 %	1,29 %	1,17 %	1,09 %	1,03 %	0,99 %	0,96 %	0,94 %

Note : All concentrations mentioned are normalized from the total of added pure components, helium included.



- ✓ Simpler choices
- ✓ Consistent, reliable service
- ✓ Quality you can depend on

[www.airliquide.com](http://www.airliquide.com)



The world leader in gases, technologies and services for Industry and Health, Air Liquide is present in 80 countries with approximately 67,000 employees and serves more than 3 million customers and patients.