

# Gastropod Gas Liquid Module

# Gastropod Gas-Liquid Module

For your continuous chemistry applications

*The mixing of gas and liquid phases in continuous chemistry applications can now be achieved in an efficient, controllable and reliable manner thanks to the **Gastropod** Gas-Liquid Module.*

Typically, gas-liquid contact in flow chemistry has relied on mechanical mixing of the two phases. This can be problematic in a tubular configuration. To improve the contact between the phases, *the Gastropod* uses semi-permeable membrane technology, which permits interaction of the gas and the liquid at every point along its length, thus making it efficient, controllable and reliable.

The Gastropod is suitable for use with many gases and with a wide range of solvents. It is designed to be linked with commonly available flow chemistry devices, allowing it to be used as a reactor in its own right, or as a gas introduction module, depending on your needs



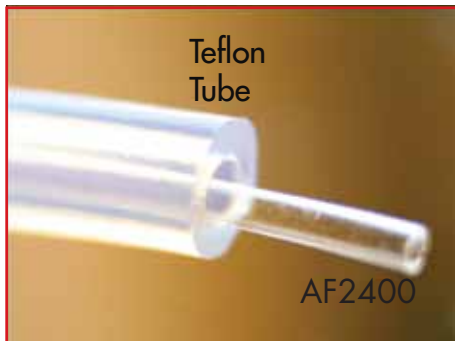
Gastropod - Gas Addition Module  
Part Number 25620

Portable Gas Reservoir (FFKM Seals)  
Part Number 30790

- *Rapidly generate a continuous gas-saturated solvent stream*
- *Effortlessly perform gas-liquid reactions in flow*
- *Optional Portable Gas Reservoir*
- *Built-in features for safe gas management*



# Flow Chemistry Solutions



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## Typical Specifications

- Reactor Vol. 0.28 - 1.12 mL (1-4 m of tubing)
- Gas Pressures 5 - 25 bar
- Flow rates 0.1 - 10.0 mL
- Safety - Very small volume of gas
- Adaptable to CRD's *Polar Bear Plus*

## Gastropod - Publications

- Carboxylation of Grignard reagents.  
A. Polyzos, M. O'Brien, T.P. Petersen, I.R. Baxendale, S.V. Ley
- Efficient Gas-Liquid Contact in Continuous Flow Synthesis: Palladium-Catalyzed Carbonylations using Teflon AF-2400.  
Peter Koos, Anastasios Polyzos, Matthew O'Brien, Ian R. Baxendale and Steven V. Ley
- Hydrogenation in flow: Homogeneous and heterogeneous catalysis using Teflon AF-2400 to effect gas-liquid contact at elevated pressures  
Matthew O'Brien, Nicholas Taylor, Anastasios Polyzos, Ian R. Baxendale and Steven V. Ley
- The Continuous-Flow Synthesis of Carboxylic Acids using CO<sub>2</sub> in a Tube-In-Tube Gas Permeable Membrane Reactor  
Anastasios Polyzos, Matthew O'Brien, Trine P. Petersen, Ian R. Baxendale, and Steven V. Ley

Based on an original concept from chemists at Cambridge University and Engineers at Cambridge Reactor Design, the Gastropod allows gas to be delivered to a substrate or solvent stream in a continuous fashion. A **Tube-in-a-Tube** incorporates a gas permeable membrane tube within a larger diameter teflon tube. There are two configurations.

In the *Gas Introduction Module*, the liquid feed flows through the inner tube whilst reactive gas fills the annular area. This pre-dissolves the gas into one of the reagent streams. It is then taken into the main reactor downstream

In the *Gas Reaction Module*, the gas fills the inner tube and the liquid flows along the annular path so it is easy to conduct heat in and out of the flowing liquid. The advantage of this approach is that gas can be supplied during the course of a reaction - the gas is consumed, and the solubility of the gas need not be a limitation.

In both cases gas-liquid transfer occurs by diffusion across the gas permeable membrane. The Gastropod comes with all the valving you need to control the introduction of the gas and liquid streams.

## Typical Reactions

- Carboxylation Grignard Reagents (CO<sub>2</sub>)
- Carbonylation (CO)
- Glaser Coupling (O<sub>2</sub>)
- Hydrogenation (H<sub>2</sub>)

Provided that the pressure is controlled, bubbles of gas can be avoided and a good residence time distribution can be achieved.

The equipment has been used successfully with a number of reactive gases including hydrogen, carbon monoxide, carbon dioxide, oxygen and ozone., as well as with a wide range of solvents such as methanol, THF, dichloromethane and acetonitrile.



Gastropod - Gas Reaction Module  
Part Number 46820

Gastropod - Teflon AF2400 (1m)  
Part Number 29160



