Gas Measurement Systems

Parr offers a variety of accessories for its line of pressure reaction vessels to enable the investigator to accurately determine the amount of gas consumed in a reaction conducted at elevated pressures and temperatures. There are essentially two methods used to measure the amount of gas delivered to a reaction vessel. These are:

1. The measurement of the pressure drop in an auxiliary supply vessel of known volume.
2. The measurement and integration of the flow rates using an electronic mass flow meter.

Each of these methods has its advantages and limitations as discussed below.

Intermediate Supply Tanks

Certainly the simplest method to measure the amount of gas consumed in a reaction is to feed the gas from a vessel of known volume and to measure the pressure drop in this vessel during the course of the reaction. The consideration in this method is to select a supply vessel with a volume matched to the amount of gas that will be consumed in the reaction. It needs to be large enough to contain enough gas to complete the reaction and small enough that the pressure drop will be significant and measurable. This basic technique can be applied in a number of ways:

1. The supply tank can be connected directly to the reaction vessel. This is the simplest and least expensive. The principal limitation of this approach is that the reaction pressure will fall as gas is consumed and the reaction will not be conducted at a constant pressure.
2. The supply tank can be fitted with a constant pressure regulator. The regulator must be selected to match the planned operating pressure. This regulator will deliver gas to the reaction vessel at constant pressure overcoming the limitation described in (1) above.
3. Initial and final pressures in the supply tank can be measured with analog gages, or continuous pressure readings can be made and recorded using pressure transducers. While the transducers add cost, they also add increased resolution and the opportunity to follow the rate of the pressure drop and hence the rate of reaction.
4. Enhanced precision can be achieved by measuring the temperature in the supply tank and applying corrections as appropriate.

Parr offers a series of high pressure burettes in complete packages for direct connection to our reactors. The basic ones are listed on the following page.

These burettes can also be equipped with digital pressure transducers, internal thermocouples and data acquisition and reduction support. Please contact our customer support group for information on these possibilities.

Mass Flow

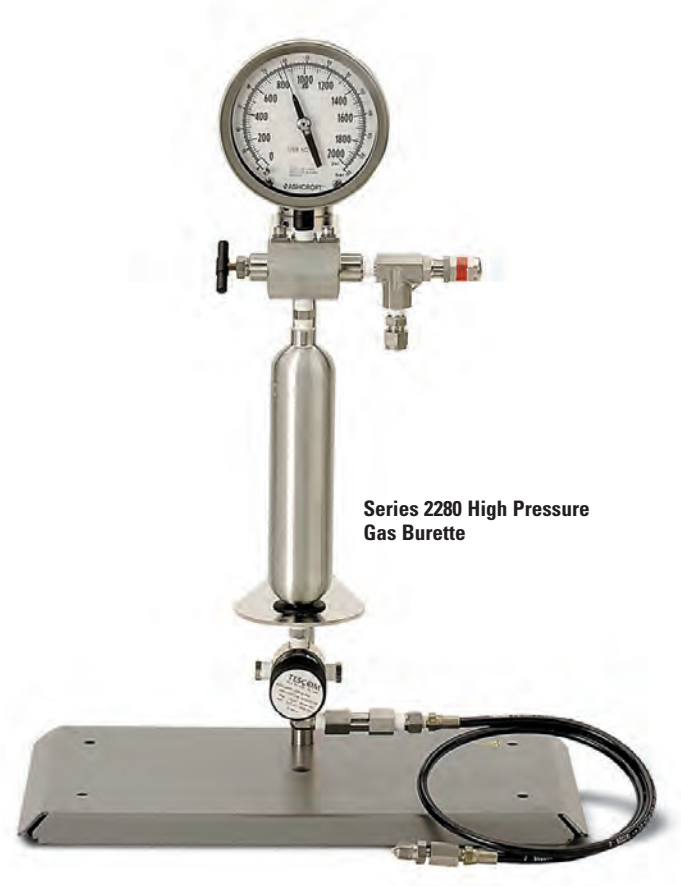
Parr Instrument Company can provide mass flow meters or controllers for quantitative mass flow based analysis. Mass flow controllers are mass flow meters that incorporate an integral control valve, external valve, or feed pump to control the fluid flow. Mass flow controllers are typically used in automated or semi-automated systems. Due to many application and calibration specific requirements, please contact Parr Instrument Company for technical assistance with mass flow meters or controllers.

Parr offers multiple, price driven, electronic interface devices for mass flow meters and controllers. The Parr A2200E Mass Flow Meter/Controller interface system offers a manually operated readout and/or set point module for up to four mass flow meters/controllers. When the A2200E is used with a mass flow controller, a manually operated back pressure regulator is required. The Parr 4871 Process Controller offers remote set point, readout, data logging, totalizing, gas mixing, and process related interfaces with these mass flow devices. Other intermediate interfaces can be provided.

High Pressure Gas Burettes

Parr offers a series of high pressure burettes intended to introduce gas (commonly hydrogen) to a reactor at a constant pressure. The burettes consist of a high pressure reservoir equipped with an inlet valve, a pressure gage and a relief valve. A constant pressure regulator with a check valve, a connecting hose and a support stand are included with each pipette.

The amount of gas consumed in a reaction can be determined by knowing the volume of the high pressure reservoir and observing the pressure drop in the reservoir during a reaction.



Series 2280 High Pressure Gas Burette

Parr high pressure burettes can be furnished in various sizes as shown in the adjoining table, each with a regulator to deliver gas to the reactor over the designated pressure range. The moles of gas shown in the table represent the amount of hydrogen that will be held in the burette at the maximum pressure. The deliverable volume will be a function of the difference in pressure between the pipette and the reactor. The size of the burette selected should be large enough to provide sufficient gas to complete the reaction while still maintaining sufficient pressure in the burette to force gas into the reactor.

Reservoirs with larger volumes are available as are regulators with different delivery ranges. Modifications can be made to these basic systems to add an internal thermocouple to the reservoir and/or a pressure transducer for digital readout and/or recording.

Gas Burettes Sizing

Sample Cylinder Volume, mL	Maximum Pressure, psi	Moles of H_2	Maximum Pressure (bar) For CE (TPED) Applications	Moles of H_2 For CE (TPED) Applications
150	1800	0.6	100	0.5
300		1.3		1.1
500		2.3		1.8
1000		4.6		3.7
2250		10.4		8.5
150	5000	1.7	300	1.5
300		3.4		3.0
500		5.7		5.0

Liquid Charging Systems

Liquid Metering Pumps

Liquid metering pumps are commonly used to introduce liquids into a reactor or vessel at elevated pressures on a continuous basis. A wide variety of pumps are available to meet various pressure, flow, and control requirements. The pumps listed here cover some of the more common pressure and flow requirements associated with Parr reactors and pressure vessels. The pumps described under these catalog numbers include an inlet filter, a reverse-flow check valve and the outlet tubing to the reactor. Special pumps can be furnished to meet requirements outside the range of these pumps. All pumps can be operated from their faceplates and all except the 2312E can also be remotely controlled with a 0-10VDC analog signal, such as from the Model 4871 Process Controller.

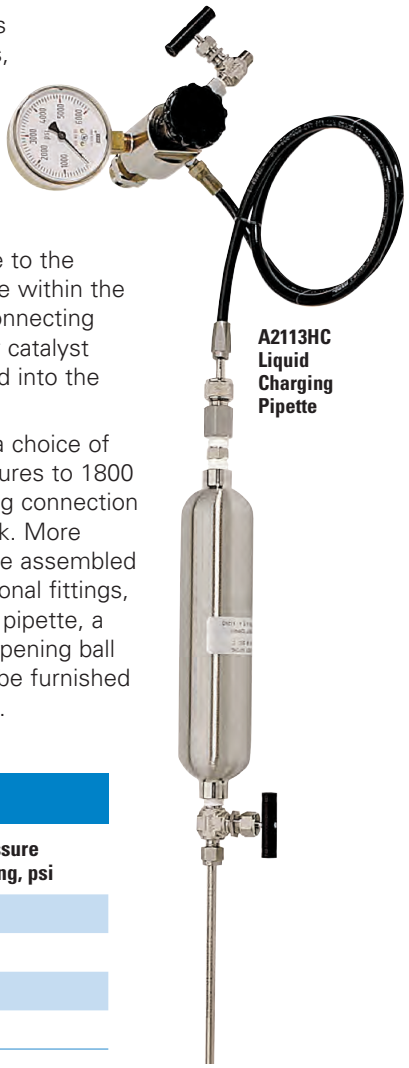
Liquid Metering Pumps

Part No.	Flow Rate, mL/min	Pressure, Max. psi	Wetted Material	Digital Pressure Alarm / Shut-off
2312E	0.01-10	2000	PEEK	No
2313E	0.01-10	5000	Stainless	No
2314E	0.04-40	1500	Stainless	No
2315E	0.01-10	5000	Stainless	Yes
2316E	0.04-40	1500	Stainless	Yes

Liquid Charging Pipettes

To introduce liquids into reactors or vessels at elevated pressures, the most economical way is to use a pressure pipette as a secondary vessel. These are often used for liquid addition to a batch process. Liquid is forced into the reactor from the pipette by applying gas pressure to the pipette greater than the pressure within the vessel. If the passages in the connecting line are large enough, slurries or catalyst suspensions can also be charged into the reactor in this manner.

The pipettes listed below offer a choice of volumes and are rated for pressures to 1800 psi. They include a nitrogen filling connection for attachment to a nitrogen tank. More elaborate pipette systems can be assembled to special order to include additional fittings, such as a pressure gage for the pipette, a pressure relief valve or a large opening ball valve. Special pipettes can also be furnished for higher pressures to 5000 psi.



A2113HC Liquid Charging Pipette

Liquid Charging Pipettes

Part No.	Pipette Volume, mL	Pressure Rating, psi
A2113HC3	50	1800
A2113HC4	150	1800
A2113HC	300	1800
A2113HC2	1000	1800