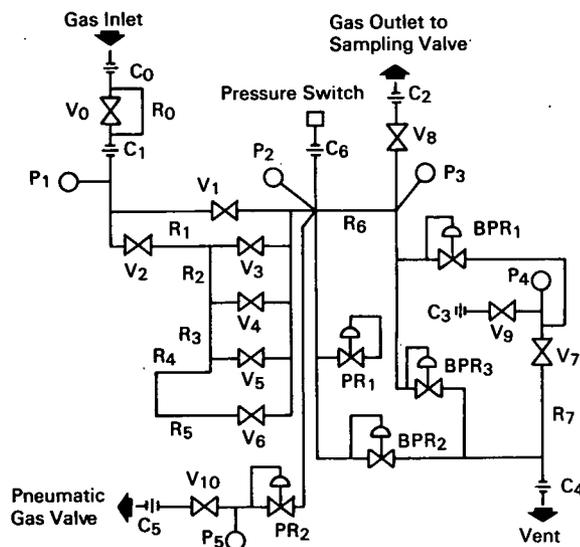


# NASA TECH BRIEF



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## System Automatically Supplies Precise Analytical Samples of High-Pressure Gases



Capillary Restrictors: R<sub>0</sub> to R<sub>7</sub> Incl.  
 Connectors: C<sub>0</sub> to C<sub>6</sub> Incl.  
 Pressure Regulators: PR<sub>1</sub> (set at 28 psig), PR<sub>2</sub> (set as needed for external flow)  
 Back-Pressure Regulators: BPR<sub>1</sub> (set at 32 psig), BPR<sub>2</sub> (set at 120 psig), BPR<sub>3</sub> (set at 33 psig).  
 Valves: V<sub>0</sub> to V<sub>10</sub> Incl.

### The problem:

To devise a high-pressure-reducing and flow-stabilization system for use in conjunction with a conventional automatic gas sampling valve. This apparatus is required to deliver analytical gas samples at a pressure of 30 psig and a flow rate of 100 milliliters per minute from a gas supply (air, nitrogen, argon, and helium) at pressures of up to 5000 psi. The gas samples, which are to be used for detection of trace constituents by gas chromatography or other standard analytical procedures, must not be changed in composition during the sampling process.

Although conventional two-stage pressure and flow regulators serve quite well in most applications, they

present a problem in that the gas samples may be contaminated as they pass through the regulator, or that condensable components from the gas samples may coalesce at the throttling section of the regulator.

### The solution:

A system employing parallel capillary restrictors for pressure reduction and downstream throttling valves for flow control. This system, used in conjunction with a standard seven-port sampling valve, greatly minimizes alterations of the sampled gas.

### How it's done:

For normal operation, the gas supply line to be sampled is connected to a standard 0.25-inch AN flare fitting (C<sub>0</sub>). The gas flow is initially set to pass

(continued overleaf)

through capillary restrictor  $R_0$  and the sum of the flow resistances  $R_1$  through  $R_5$  (representing the respective capillary restrictors). These resistances, selected to compensate for inlet pressures down to 500 psi, are consecutively bypassed, starting with  $R_5$ , until pressure  $P_2$  reads 110 psi. For pressures down to 250 psi, the flow is through  $V_0$  and  $R_1$ ; for pressures below 250 psi, either valve  $V_0$  or  $V_1$  is throttled and the other valve is left wide open. Flow resistance  $R_6$  is selected to give a flow rate of 100 ml/min for a pressure drop from 110 to 40 psi. If the sampling rate decreases because the source pressure is lowered,  $P_2$  will fall below 110 psi. The pressure switch, set at 108 psi, activates a light which remains on until it is reset by a pushbutton switch. Rated sampling flow can be retained with  $P_2$  close to 30 psi. However, the latter may cause some coalescence.  $P_2$  is regulated at 112 psi by back-pressure regulator  $BPR_2$ , which vents gas to connector  $C_4$ . The flow of the sampling gas is directed to the gas sampling valve by  $C_2$ . The pressure in this line is held close to 30 psig by back-pressure regulator  $BPR_3$ , whose action can be augmented by  $BPR_1$ , if desired.

When the pressure reducer is operating, the  $C_5$  outlet is connected to the pneumatic activator plunger of the gas sampling valve to provide compressed gas (20 to 25 psig) for its automatic operation. The gas valve is triggered by a thermal timing signal from a relay on a phosphorescent cathode ray tube, which

serves as the readout device for the hydrogen-flame ionization detector in a standard gas chromatograph.

**Notes:**

1. When this unit was incorporated into a standard gas chromatograph, analyses of trace amounts of condensable hydrocarbon gases in high-pressure gas supplies were carried out automatically at 30-second intervals.
2. This system is very efficient, reliable, and versatile. It can be used for either general gas sampling application or for high-pressure gas supplies in which extremely low levels of hydrocarbon contaminants must be detected.
3. Inquiries concerning this invention may be directed to:

Technology Utilization Officer  
Marshall Space Flight Center  
Huntsville, Alabama 35812  
Reference: B67-10090

**Patent status:**

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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