# EXISTING PROCESS SAMPLING METHODS & NEW SAMPLING DEVICES FOR THE PROCESS INDUSTRY

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**WHY SAMPLE?**

Throughout the years, people have been trying to find better methods to sample process liquids. While sampling has been done for years, only recently have valve manufacturers begun to truly evaluate the needs of customers and develop better sampling systems to meet today's more sophisticated sampling requirements. There are many reasons sampling is done in a process piping system. Sampling of processes is routinely done to check product quality, purity, or to refine process procedures. Sampling is typically a major concern for most plants since product samples must be representative and accurate. Environmental and safety concerns related to sample taking of toxic or hazardous materials are also having a larger impact on the development of sampling devices.

**CONSIDERATIONS FOR SAMPLING SYSTEMS**

When considering process sampling, several critical questions must be answered to determine what type of sampling device will be required and the best method for taking the sample. This will then lead the customer to a specific type of sampling equipment that best suits their needs.

Some of the basic questions for a customer to answer are:

- Why is the media being sampled? (process verification, bacteria counts, quality assurance)
- How often is the media being sampled?
- What type of media is being sampled? (powder, slurry, liquid)
- What are the properties of the media? (corrosive, hazardous, flammable, carcinogenic)
- Where in the process is the sample being taken?
- What is the viscosity of the media and are solids present?
- Does the media crystallize?
- Will the sample be taken from a pipeline or vessel?

The answers to these questions will lead the customer to the product that best fits their expectations.

## EXISTING METHODS OF SAMPLING

Existing sampling methods range from opening a valve and allowing the liquid sample to flow into a bucket or jar, to more sophisticated sampling systems providing representative and safe samples from both pipelines and vessels or reactors. Over the last ten years, the sophistication of these sampling methods has increased dramatically due to the requirements of the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) as well as plant environmental and safety concerns.

In the past, sampling methods have traditionally been engineered internally by customers using existing process valves on the market (ball, globe, or plug) and adapting them to their process systems and sampling needs. The most basic of these systems is to provide a "tee" in a process pipe or vessel with a small valve on the "tee" that would be used to drop the sample from the line or tank. A bucket or jar would be held under the valve opening to catch and hold the sample being taken. Sometimes a glove box is built around the valve to protect the sample taker while they are taking the sample. In some applications, separate bypass loops are built for taking samples. In these cases, there are typically several isolation valves piped into the system to isolate the sample in the bypass loop and allow the sample to be dropped into a sample container.

Some batch processes utilizing reactions would require samples to be taken from the reactor vessel during the process. Samples from these systems were typically taken by opening the hatch at the top of the reactor and dipping a cup attached to a long stick into the vessel to withdraw a sample.

In other cases, samples are taken by creating a re-circulation loop with product being pumped out of the reactor, through a piping system including a standard valve for taking the sample and then back into the reactor. This is very expensive and usually requires that you use two nozzles on top of the reactor.

One additional method for sampling from a reactor or tank is to take a sample through a traditional ram type, y-pattern sample valve, or tank bottom ball valve at the bottom of the reactor. This type of valve is mounted flush with the bottom of the reactor and the valve is opened to allow the sample to flow from the bottom of the reactor to a sample container. This method of sampling is efficient but cannot provide a representative sample since the sample is always taken from the bottom of the vessel or reactor.

## NEW METHODS AND EQUIPMENT

The latest sample valve designs try to incorporate safety, environmental protection, and reliability while allowing the user to take representative process samples. These designs are continuing to evolve as customers realize the capabilities of sampling valve manufacturers and push them to improve their existing systems.

Current sample valve designs can be easily categorized from the area in the process where the samples are being taken. The general categories are in-line sampling, and reactor or tank sampling.

The latest In-line sampling systems allow process samples to be taken directly from a pipe into a sample container. This ensures that a representative sample is taken from the process stream and eliminates the need for a separate bypass to be installed into the piping system to allow sample taking. The newest In-Line sampling devices also ensure that samples are not exposed to the atmosphere. This feature ensures the safety of the sample taker from hazardous samples, while also maintaining the integrity of the sample since the atmosphere cannot contaminate the sample.

These In-Line systems have several different methods of retrieving the sample from the pipeline. The basic In-line sampling valve either mounts between two standard flanges or can be mounted directly by welding into the side of the pipe.

Side mounted sampling devices are typically more compact and use a small ball or globe valve to isolate the sample container from the process pipeline. They will either have an orifice directly on the side of the pipeline connected to the valve or will utilize a probe sticking out into the pipeline connected to the isolation valve. These devices typically have small orifices and are best used for clean liquid samples.

The sample container is usually a glass jar with a septum top. The sample is transferred into the jar through a pair of needles puncturing the septum. One needle is to vent the air in the jar while the other needle allows the sample to fill the jar. The vent is typically piped to a scrubber system for hazardous processes.

The septum bottles typically provide the best containment of the sample since there is no chance that the sample can be exposed to the atmosphere. One drawback of using septum bottles is that the needles are typically a small diameter and can plug when sampling liquids with solids or liquids that tend to crystallize.

Wafer or flanged In-Line systems that mount between two flanges in a piping system typically use a rising stem design with a spindle that seats at the bottom of the valve. The spindle is lifted either by a multi-turn hand wheel or a quarter turn lever. Once the spindle is lifted the sample can be dropped into a sample container. These devices provide the most representative samples since there are no dead legs in the valve and the sample comes directly from the process pipeline.

These devices typically have larger orifices and can handle liquids with solids or crystallizing liquids. These devices have two ports for sample taking. A smaller port vents the air from the bottle and the larger port allows the sample to enter the bottle. The vent port is usually piped to a scrubber system when the samplers are being used in hazardous processes.

Multi-turn designs allow accurate metering of the sample into the container but are not fail-safe since the operator could potentially leave the sample valve open and overflow the sample container. Lever operated designs are usually safer since they incorporate a spring loaded handle which automatically closes the valve when the operator releases the handle.

There are two types of sample containers used with these wafer and flanged style sampling devices. The most common container is a glass bottle threaded into the bottom of the sample valve. This bottle holds the sample when it is dropped from the pipeline. The bottle is not the best method of containing the sample since they must be unscrewed from the sample device and capped. This exposes the sample to atmosphere and exposes the sample taker to the sample. Using a glove box around the sample device can minimize the exposure of the sample taker to the sample. This allows the bottle to be capped in the glove box without exposing the sample taker to any fumes from the sample. ***(Figure 1.)***

The last method for transferring the sample from a flanged or wafer type In-Line sample valve is to use a syringe to remove the sample from the pipeline. The syringe allows the sample to be totally contained and transported safely back to the lab. This method ensures the safety of the sample taker and the integrity of the sample. The syringe does have a drawback in that the orifices are smaller in the syringe so that it can only handle clean liquids. The syringe type sampling systems also require cleaning after each sample to prevent contamination of the next sample to be taken. ***(See Figure 2.)***

There are many other sampling applications that for which new In-Line equipment is being developed. There are aseptic sampling systems, which are used in the food processing industry. These In-Line systems incorporate steam and CIP systems that sterilize the sample valve before each sample is taken. These systems are typically used in applications where samples are taken for bacteria counts to document the purity of the processed liquids.

Reactor sampling systems are becoming more popular especially in the bulk pharmaceutical plants and specialty chemical plants. These systems usually incorporate a PTFE lined or alloy dip tube mounted to the top of the reactor. The dip tube allows access into the reactor for the suction hose as well as the introduction of additional chemicals to the reactor. The dip tube is placed at a level in the reactor where the client wants to sample from.

On top of the dip tube goes the reactor sampling system.

***Figure 1***

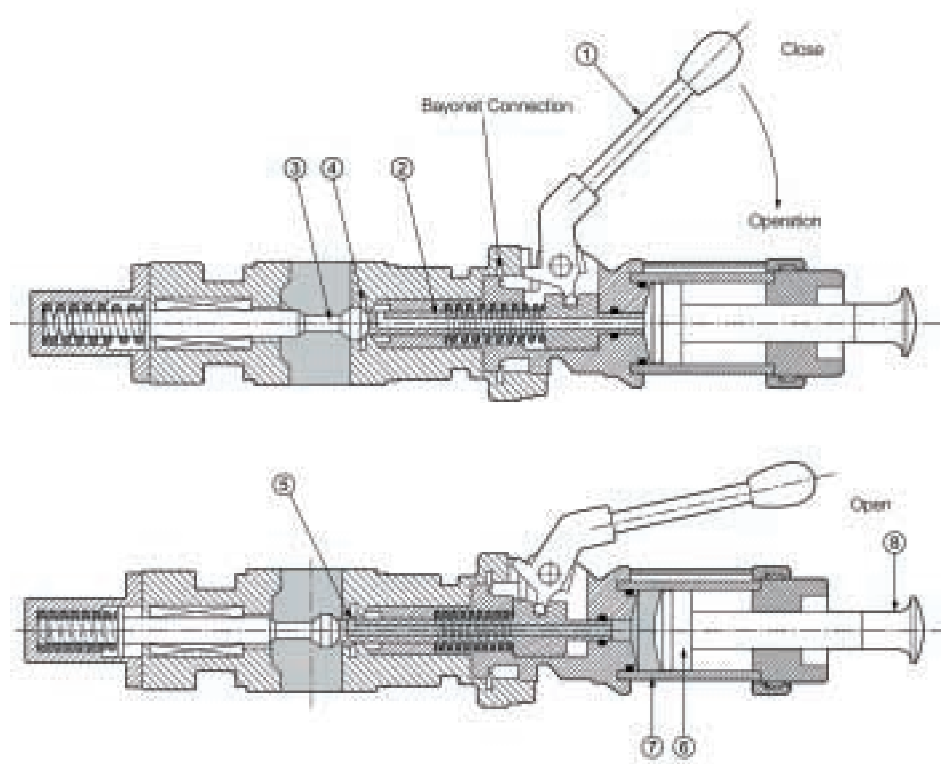


***Figure 2: Sapro Syringe.***

This system usually consists of an isolation valve on the dip tube, a combination ball check/sight glass, and a transfer device to take the sample from the sight glass into a bottle or other container. The simplest systems use a vacuum to draw the sample up the suction hose and into the sampling system. More sophisticated systems will use a re-circulation pump attached to the sampling system that re-circulates the sample before it is taken so that more accurate and representative samples can be taken. These systems with re-circulation pumps can typically also be used to monitor pH in the process while the sample is being re-circulated. ***(See Figure 3)***

The reactor sampling systems are typically very modular and can be customized to the specific requirements of each customer. Most systems will also allow for additional access ports to the sampling system. These additional access ports can be used to clean the sampling system with CIP or purge the system with nitrogen after each sample is taken.

Some reactor sampling systems allow access back into the reactor through the sampling system so that the customer can still use only one nozzle at the top of the reactor for sampling and adding additional chemicals back into the reactor. These newer systems eliminate the need to open the reactor to sample or to stop the reaction process to sample. ***(See Figure 4)***

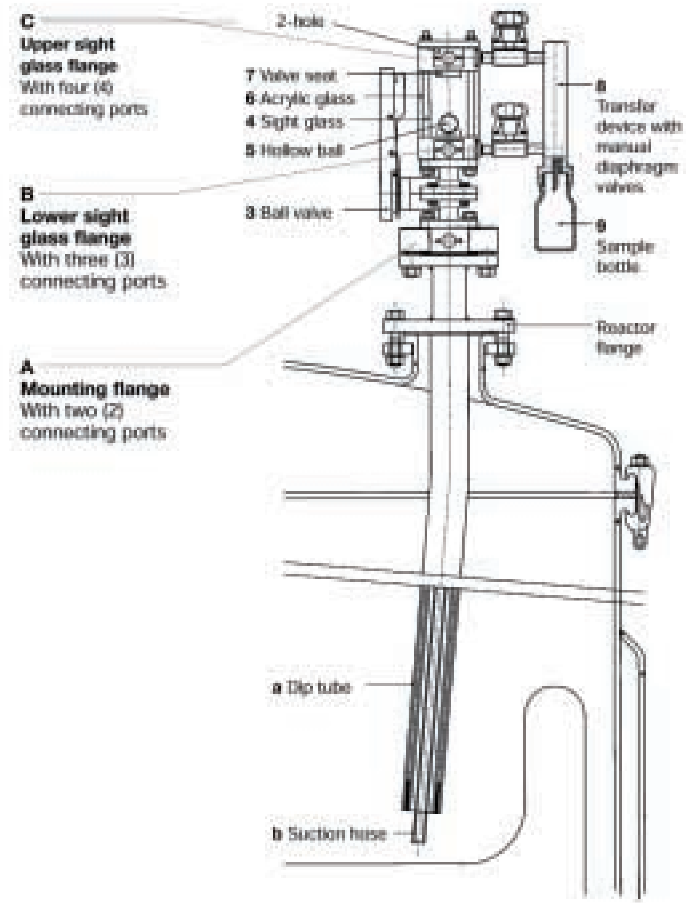


*Figure 3: PEV Reactor Sampling.*

## CONCLUSIONS

Existing environmental regulations, increased government regulation, and stricter quality requirements are causing many process industries to re-evaluate their current sample taking methods and to improve the way they sample. These customers are driving equipment manufacturers to continue to develop newer and better sampling systems.

There are many new sampling systems that are being introduced to the market everyday. The new focus by customers on the importance of accurate and safe sampling is putting new demands on equipment manufactures. Manufacturers are up to the challenge to continue to produce more accurate and safer sampling systems. Over the next decade, we will continue to see more sophisticated and reliable sampling systems introduced to market, in order to keep up with customer requirements. VM

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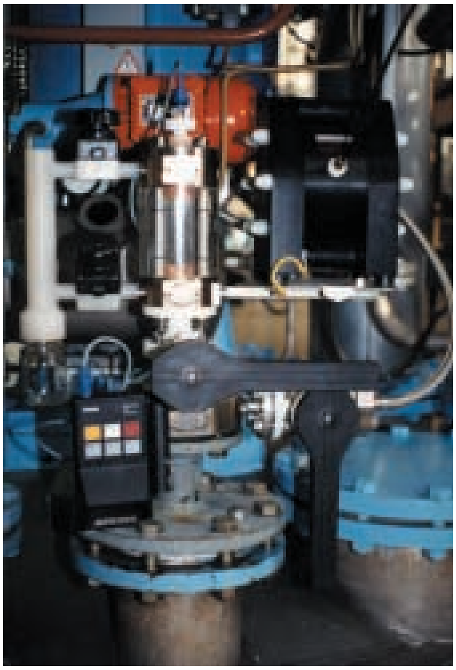

*Figure 4: PEV Reactor Sampler.*