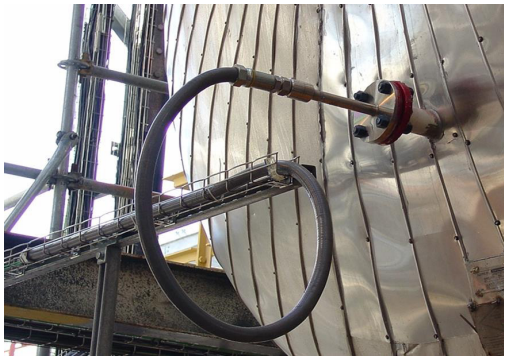
Process Sample Interfaces: Probes or Flow Cells
How to Choose for Optimal Analyzer System Performance

Online process measurements with NIR or UV-Vis spectroscopic analyzers will require a sample interface. The sample interface is a critical element of any process analyzer system and is the "virtual view" into the process. The sample interface consists of either a probe or flow cell and is designed for use with fiber optic cables which are coupled to the analyzer. The probe or flow cell is the point where the light meets the sample.

Optimal System Performance = Reliable Measurements

Sample interface performance strongly affects the overall system performance of a process analyzer. High optical efficiency and low sensitivity to environmental factors are essential to precise, reliable measurements. Optimal system performance requires sample interfaces that are not overly sensitive to vibration, temperature and pressure changes.



How to Choose the Correct Sample Interface

Perhaps the most critical decision in designing a successful online analyzer system is the selection of the sample interface.

Guided Wave pioneered in-line fiber optic sample probes more than two decades ago, with the introduction of the SST (Single Sided Transmission) Probe. This probe permits precise spectroscopic analysis of products directly in the process line without the need for sample systems and their associated investment and installation costs, lag times, failures, and constant maintenance requirements.

When sample systems fail, reliable measurements stop, resulting in system downtime that is not the fault of the analyzer. Sample systems have their place and should be used when samples are particulate-laden, wet (2-phase), or overly temperature sensitive. Otherwise in-line probes are the most cost effective and trouble free solution to real-time process spectral analysis.

While an insertion probe approach can often reduce installation costs, sometimes safety, servicing, and/or sample conditioning requirements make it necessary to integrate a sampling loop or slip stream. Flow cells are preferred whenever:

(a) direct insertion probes are inappropriate and

(b) the required optical path length is 30 mm or greater.

Another consideration is usability. All probes and flow cells must be referenced periodically. The period will depend upon the instrument and the process, and may range from one hour to several months. Depending on the process, windows may become fouled in time and require cleaning. Therefore it is convenient if some accommodation has been made to either remove the probe from the process for these required services or to be able to perform them in place. Guided Wave offers a probe extraction device and/or cleaning ports on flow cell to facilitate this maintenance.

Following is a basic guide to help choose the best sample interface solution depending on your specific requirements.

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INSERTION PROBES	FLOW CELLS
In Situ Sampling: • No Sample Prep • No Lag Time • Representative Sample Assured Service 	Sample Loop Required: • Sample Prep Possible - Thermostating - Filtering - Drying • Lag Time (depends on fast loop design)
Service: • Probe must be removed from process for cleaning and zeroing • Extractor Mechanisms available	Service: • Can be cleaned and zeroed in place
Reliability: • Excellent	Reliability: • Excellent • Sample Systems require maintenance

Selecting Insertion Probes

Selecting the proper probe is crucial to the success of the application. NIR and UV-Vis spectroscopy both cover many varied applications, which require a varied array of probes. While probes are predominantly passive devices in an otherwise active measurement system, their physical and optical properties can significantly add to or detract from the desired measurement. Effective pathlength, optical properties such as throughput, collimation, aberrations, sensitivity to vibration, sensitivity to thermal changes, and the quality of fiber connectors are important parameters in a probe design.

The probe is contained in a housing that must be sealed to the process to prevent escape of the sample. The housing is usually metallic but may be glass, ceramic, polytetrafluoroethylene (PTFE), polymer or any material compatible with the process. The probe-to-process seal may be o-rings, energized seals, compression fittings, chevron seals, welded flanges, etc. The process conditions and parameters will mandate the seal and safety requirements.

Selecting Flow Cells

Insertion probes can be directly dipped into a laboratory beaker or inserted into a process pipe, so that the light is truly brought to the sample. However, in some applications, it may be more convenient to compromise and meet the sample halfway by using a flow cell. When it is not possible to insert a probe directly into a process line due to safety reasons, service requirements or the need to precondition the sample, a flow cell is the best choice.

Optically establishing and maintaining alignment of the two halves and ensuring that the pathlength is constant and reproducible are key for continuous performance.

Flow cells are convenient for their serviceability. They are usually mounted in a process side loop for maintenance reasons. Often, the seal technology is simple o-rings which require periodic service. Hence, unlike most insertion probes, flow cells are designed to be disassembled in the field. On re-assembly, it is critical that the flow cell design is such that the pathlength returns to its original value.

Some common convenient auxiliary features of flow cells may be thermal control, clean-out ports, and adjustable pathlengths.

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PROBE TYPE	ADVANTAGES	DISADVANTAGES
• Insertion Probe 	• No additional plumbing • Direct process sample measurement • Maintains sample integrity • Some designs eliminate o-ring maintenance • Wider pressure and temperature range • Improved safety to plant and personnel • No lag time	• Requires extraction for cleaning and reference • More susceptible to physical vibrations • In pressurized vessels an insertion style probe may have net ejection force
• Flow Cell 	• Easier access for cleaning and reference • Flow induced noise can be controlled by flow rate • Can be protected in a cabinet along with sample conditioning gear • Available in Teflon and other similar materials	• Additional plumbing hardware required • Extraction sampling - may change sample characteristics • May require additional enclosure • May require a pump if differential pressure inadequate • Lag time may be introduced • O-ring maintenance required on some designs

Connecting Probes or Flow Cells to the Analyzer

The probe or flow cell is coupled to the analyzer with fiber optic cables to complete the sample interface. To optimize overall system performance it is important to choose fiber that is designed specifically for spectroscopic analysis to ensure the highest possible performance in transmission efficiency and durability.

Safety Advantage of Using NIR and UV-Vis Spectroscopy Technology

One of the primary advantages of NIR and UV-Vis process spectroscopy is the utilization of intrinsically safe fiber optic cables to remotely locate the analyzer relative to your process.

Signal stability and low noise in remote spectroscopy depend upon fiber optic cables with high transmission, while minimally being affected by environmental influences, such as temperature, vibration and ambient light levels.

Additionally see Guided Wave's Safety Standards Applicable to the Installation of Fiber Optic Probes and Flow Cells (white paper #2029).

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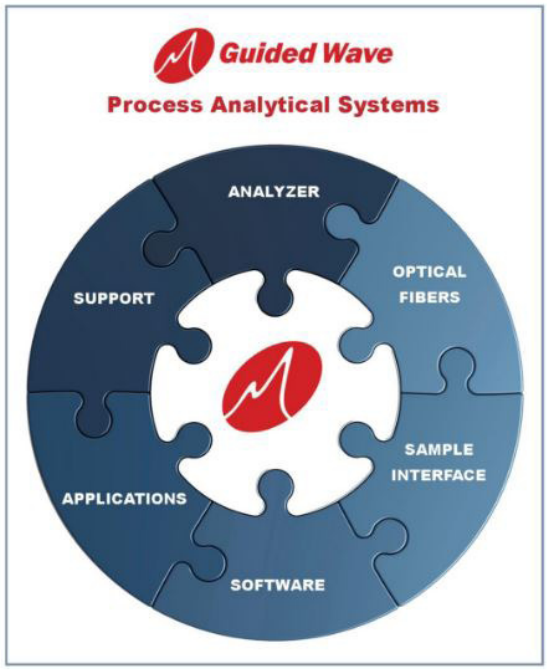

Servicing Probes and Flow Cells

No matter the manufacturer all probes and flow cells used for absorption spectroscopy must be referenced (or zeroed) periodically. Furthermore, the windows may need periodic cleaning plus o-rings and other elements may need service.

Therefore practical methods for maintenance of the probe and flow cell, access to the windows, or complete disassembly and reassembly abilities must be considered when choosing new sample interfaces.

See Guided Wave's In-line Probe Extractor Mechanism (data sheet #1046) which allows for quick and easy probe cleaning without interruption of the process.

The Smart Choice

Guided Wave's sample interfaces deliver accurate, real-time process measurement results. Durability, as well as the low maintenance requirements make Guided Wave sample interfaces a cost effective, smart choice to help optimize production, improve yields, ensure consistent product quality and enhance profitability.

Guided Wave has been a leader in online, fiber-coupled, process probe and flow cell design for over 35 years. While Guided Wave's probes and flow cells are optically matched for use with our NIR or UV-Vis analyzers to provide top system performance, we also supply sample interfaces for use with many other analyzer brands.

Our reputation, experience and design compatibility have made Guided Wave the "go-to" provider worldwide for direct insertion probes and sample loop flow cells:

- For liquid or gas streams
- Optical measurement pathlengths from 1mm to 1 meter
- Customized, innovative designs to meet users' specific process and safety needs
- Optically efficient designs which deliver more light, ultimately providing more chemical specificity and lower detection limits
- Rugged designs built to withstand harsh process conditions, while maintaining safety, ease of maintenance and longer service life
- Intrinsically safe designs (white paper #2029) - meets ANSI/ISA dual seal requirement and IEC 60079-28 standard
- CRN Certification available
- Common integration with most analyzers; manufactured to facilitate full integration with any fiber optic system configured with SMA905 connectors and fibers having a core diameter from 400 to 600 micron

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