



## Process Analyzer Sampling System Training (PASS)

**Optimize your Sampling Systems.  
Avoid costly mistakes.**

Designed for Analytical Instrumentation  
System Engineers, Technicians and  
Industry Professionals

Swagelok®

# Optimize your Process Analyzer Sampling System in just five days

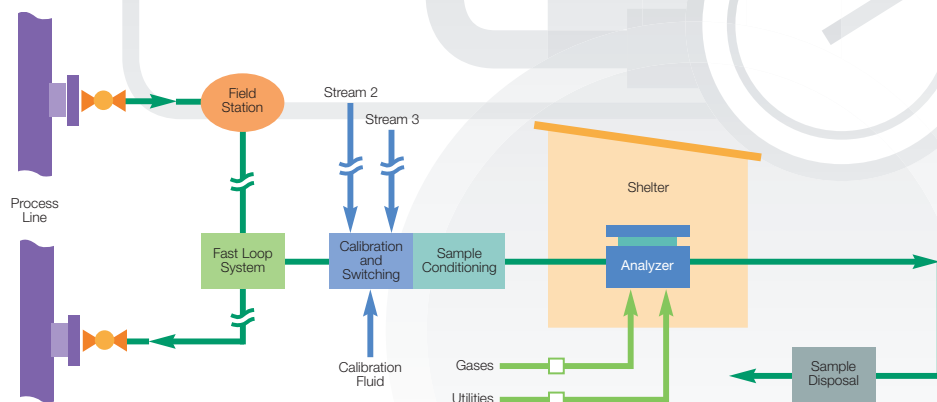
## Course Objectives

Here are a few examples of what you will learn:

- Read and create sampling system schematics
- Design and build a sampling system
- Diagnose sample transport problems
- Evaluate and determine sample tap location
- Calculate and evaluate sample transport lag (time delay) of liquids and gasses
- Calculate pressure drop in a fast loop or return line
- Calculate gas and liquid flow rates
- Avoid or account for adsorption and permeation
- Predict vapor condensation
- Prevent or control phase preservation
- Vaporize a sample
- Avoid deadlegs in a sampling system
- Techniques of stream switching

**[Learn more about PASS training at swagelok.com.](https://www.swagelok.com/training)**

This five-day training course covers aspects of a sample system, from process line and tap through transport lines, stream switching, sample conditioning, analyzer and disposal.



If you design, construct, operate or maintain sampling systems, you know how important quality data is. Inaccuracy usually results from problems within the sampling system, not the analyzer. With our hands-on training, we teach you to tell the difference.

You can learn to diagnose and eliminate common sampling system design

flaws that result in erroneous data by using engineering principles, formulas, and calculations rather than relying on guesswork. And you don't have to do it alone. You'll design a system in class, and apply what you've learned to your own process analyzer sampling system. Swagelok training teaches you in days what it could take years to learn on your own.

## About the Instructors

**Tony Waters** Industry Expert and Consultant



Tony Waters brings over 45 years of experience with process analyzers and sampling systems to his numerous training programs, which have been presented in many countries. Mr. Waters has also founded three companies, and has worked in engineering and marketing roles for an analyzer manufacturer, end-user, and a systems integrator. Mr. Waters holds a Bachelor's degree in Systems Engineering from The Open University, Milton Keynes, United Kingdom.

Mr. Waters has authored a technical reference book, *Industrial Sampling Systems*, which attendees receive with the course. The book is an indispensable resource for designing and maintaining sampling systems.

**Phil Harris** Industry Expert and Consultant



In over 30 years of experience in industry and academia, Phil Harris has provided expert insight and analysis for a variety of applications. Mr. Harris is the author of many papers on analyzer systems and routinely presents at industry conferences and technical seminars.

With extensive experience in research, development and project management, Mr. Harris has supported many industries, including nuclear energy, oil refining, and alternative fuels. Mr. Harris earned both his Bachelor's and Master's degrees from the University of Manitoba.

# Course schedule

## **DAY 1** Fundamentals: Classwork and Basic Exercises

- I. Basic Performance Criteria and Challenges
  - Sample compatibility with analyzer
  - Time delay in sampling
  - Mixing and contamination, including deadlegs
- II. Diagnosing and Fixing Time Delay Problems
  - Sample transport time calculations for liquids and gases
  - Gas compressibility and time delay

## **DAY 2** Classwork and Basic Exercises Group Project: Design a Complete Sampling System

- III. Sample Conditioning Techniques
  - Proper use of filters and coalescers
  - Liquid, vapor, and gas separation devices
  - The difference between vapor and liquid concentration
- IV. Sample Tap Design
  - Understanding process conditions, analyzer characteristics, and sample requirements
  - Location and design of process nozzle
  - Probe selection and design

## **DAY 3** Advanced Design Concepts Group Project: Design a Complete Sampling System

- V. Phase Preservation
  - How to condense or vaporize a sample (or avoid it)
  - How to use phase diagrams
  - Design of field stations and fast loops

## **DAY 4** Advanced Design Work Group Project: Prepare Group Design Presentations

- VI. Advanced Calculations
  - How to determine fluid velocity in line segments
  - Laminar and turbulent flow (Reynolds Number)
  - Effect of temperature and pressure
  - Calculating the pressure drop in each line segment

## **DAY 5** Stream and Calibration Selection

- VII. Techniques of Stream Switching
  - Avoiding deadlegs and mixing volumes
  - Modular sample conditioning systems
  - Design and build a modular sampling system
- VIII. Group Presentations
  - Group presentations and instructor comments

## Participant feedback:

### **Which are the benefits you received from the PASS course?**

- I am now able to better structure my know-how and to get a more in-depth understanding of the subject matter.
- I learned about a variety of different design assessment methods with a strong emphasis on very practical calculations supported by very extensive charts.
- Most of the course content I was able to put to use already in my day-to-day work life – especially the calculation templates were very helpful.

### **What advantages did the PASS course have for your daily business?**

- After the 5-day class it was easy for me to calculate pressure drop and dead time by using the methods taught by Tony Waters.
- I am using the dew-point calculation based on the partial pressure concept in several of my daily gas applications.
- Calculating the resonance length of probes at high velocity continues to be important and is now much easier understood.
- Another helpful tool was to learn about the usage of the permapur dryer in return flow techniques.

### **Would you recommend the PASS course as well as the instructor? (If yes, why?)**

- Yes, absolutely! I believe that Tony Waters is especially helpful and important for experienced system engineers.
- The main focus of the class was not so much the knowledge transfer as it was the structured problem analysis and generally the clear structure of the instructor's long-term experience and know-how.
- Examples are used of almost all parts of process analyzing – for every theoretical subsystem.
- It was wonderful to network and exchange ideas amongst other industry experts. Very knowledgeable group!

### **Uwe Zscherp**

Project Engineer SICK AG,  
one of the world's leading producers of sensors and sensor solutions for industrial applications

Attendant PASS Training