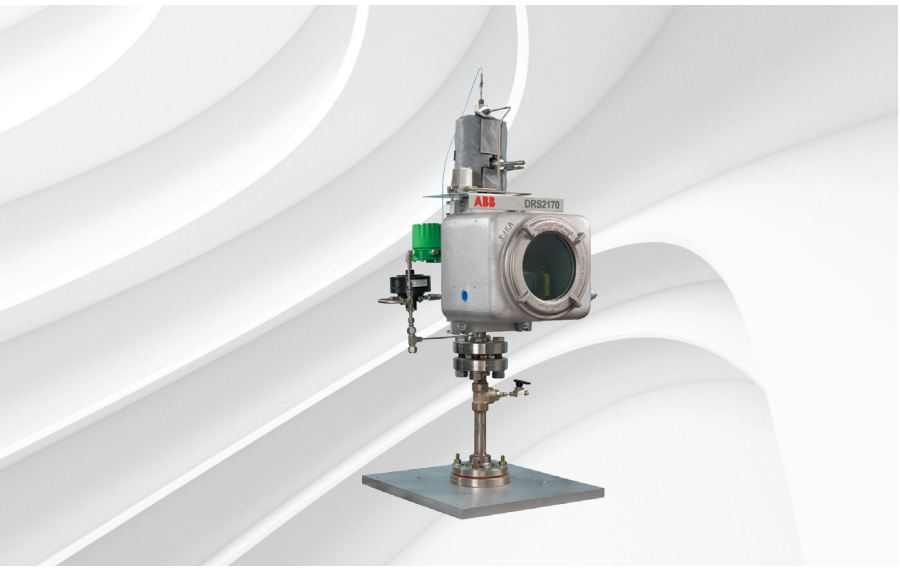
ABB MEASUREMENT & ANALYTICS | DATA SHEET

DRS2170
Dynamic reflux sampler



Clean samples for your process analyzer

Measurement made easy

DRS2170 Dynamic reflux sampler

Overview

Obtaining representative, reproducible samples has long been identified as one of the most difficult problems in the field of process analytical chemistry. Hot, particulate laden, corrosive and otherwise nasty sample locations in a process are often the most important from a process control perspective. Process examples include ethylene cracking, ammonia reaction, catalytic cracking and alkylation. Various approaches have been taken to solve the sampling problems including in situ optical measurement, direct extractive techniques and others. Nevertheless, specific problems such as window clouding and equipment plugging eventually render these approaches ineffective.

Principle of operation

The Dynamic Reflux Sampler (DRS) supports a reliable analyzer system installation with the “keep it simple” approach in mind. The unit is a self-contained sampling device suitable for mounting at or near the process pipeline tap, thereby eliminating the need for sample conditioning before sample transport occurs. Primary sample conditioning occurs in a virtually in-situ fashion with the DRS approach. Condensable components are removed and are used to support particulate removal before they can present problems in the sample transport system’s downstream components and the analyzer.

The DRS is essentially a fixed temperature distillation derived from the need to remove water as a condensable component from low boiling point gases. Cooling is provided by way of a vortex cooler controlled by an electronic temperature controller. The sample temperature input for control of the cooling operation is a sensor placed directly in the sample path. Since the cooling capacity of the vortex cooler is essentially fixed, the flow rate of the conditioned sample exiting the DRS is also limited and dependent on the water/ condensable content of the inlet gas.

Water as a condensable component is advantageous due to the large difference between the boiling point of water and the boiling points of most components of interest. The polar nature of water and the lack solubility for most hydrocarbon specified of interest for process analysis optimize the simplicity of separation with a fixed point cooling system.

Clean samples from difficult process condition

High sample throughput, precise temperature control, certified for hazardous areas

Sample and Instrumentation considerations
In process gas chromatography, condensation of free water causes representative sample problems in the inject valves typically supported by 1/16 in. ports and tubing. Control of sample volume is critical in GC sample valves and the presence of free water or condensate changes sample volumes dramatically. Process photometry is also adversely impacted by free water entering the analysis cell due to window fogging or signal energy displacement into the liquid phase contaminants entrained in the vapor phase. Mass Spectrometry (MS) is also adversely impacted by free water on the inlet, or molecular leak, prior to the ionization chamber. Free water in contact with an inlet such as a silica frit causes partial or complete plugging of the frit that is detrimental to maintaining the steady state of pressure and flow into the MS analysis chamber essential for consistent and repre- sentative analyses from the analyzer.

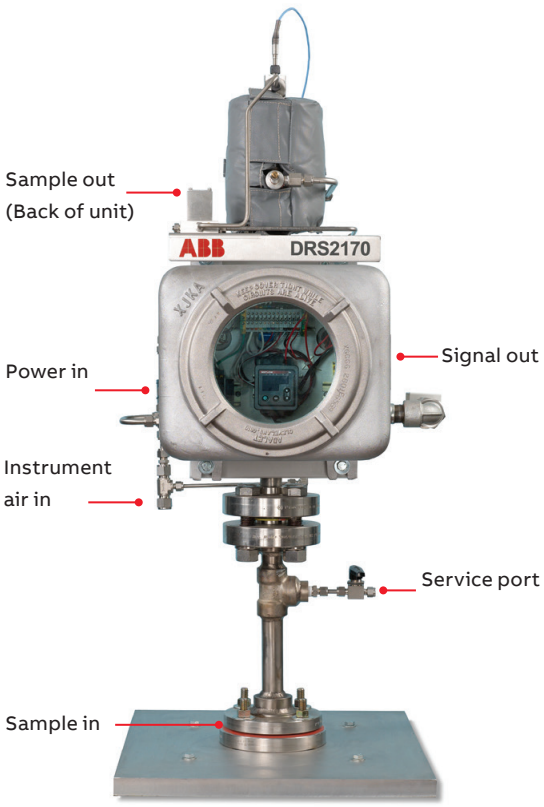


Figure 1 DRS2170

Applications

- Ethylene furnace measurements
- Ammonia processes
- Acetylene
- Naphtha cracker furnace gas
- Fluidized cat cracker

Ethylene furnace
Components in ethylene furnace effluent are typically measured by both mass spectrometry and gas chromatography techniques while components in ethylene decoke are typically measured by process infrared photometry in a continuous mode.

Ethylene furnace effluent samples generally contain hydrocarbon components of analysis interest mixed with water vapor content between 10 and 50 volume percentage. Additional contaminants often present in furnace effluent are residual heavy hydrocarbons, carbon fines and in some cases tars.

The decoke cycle of the ethylene furnace presents continuous sample conditioning issues in terms of high carbon particulate and water vapor content. High initial particulate and water vapor content requires isolation for some time during initial decoke, with water levels in the 35 to 90 volume percentage range during endpoint monitoring for the decoke process. An additional degree of complexity is experienced in sampling furnace effluents and furnace–decoke effluents in that the samples are at low pressures.

Ammonia processes
Ammonia process streams require water removal without the burden of particulate contamination and are conditioned at high sample pressures that enhance the DRS water removal capacity. Ammonia process monitoring is an excellent gas chromatography and photometry applications specifically for measurements such as hydrocarbon / steam ratio; methane analysis; BTU analysis; sulfur analysis; CO + CO2 analysis; and synthesis gas analysis. Eliminating water dew point issues and removing particulate is critical to the success of these ammonia process instrumentation applications.

Specification

Physical
Ambient temperature range
32 °F to 140 °F (0 °C to 60 °C)
Sample inlet
2 inches ANSI class 150# standard.
Also available in ANSI class 300, 600, 900, 1500 inlet connection with certification
Materials
All 316SS class 3000 fittings standard
All welded column 316SS construction certified to ASTM pressure vessel requirements to meet CE / CSA / CRN requirements, PTFE, Viton, Glass

Safety area classification
NEC and CSA
Class I; gas groups B,C,D; division 1; T3C (160 °C)
ATEX Category 2
Zone 1: CE II 2G, Ex dm [ia] ia IIB+H2 T4 (135 °C)

Service suitability
- Ethylene furnace (GC, MS, photometer)
- Naptha cracker furnace gas (GC, MS photometer)
- Ammonia production (MS)
- Fluidized cat crackers (O2, GC, MS, photometer)
- Acetylene (O2, GC)

Electrical & control (hot, neutral, ground)
Power Requirement
120 VAC or 240 VAC, 50 to 60 Hz**)**
Controller
Electronic PID, self-tuning
Temperature set point
Local manual adjust, 4 to 20 mA input, remote PC monitoring and setup with RS485 communications and software available

Cooling
Air supply connection fittings
½ in. tube, Swagelok
Pressure
10 to 100 psig (412 – 689 kPa)
Volume
10 to 15 SCFM
Quality
Plant grade: clean, oil free
Liquid cooled version available

Sample section
Sample outlet fittings
¼ in. tube
Flow rate
2 to 5 LPM @ 50%

Temperature
Sample gas temperature control ± 0.5 °F (± 0.3 °C)
Minimum outlet sample temperatures of 3 °F (–16 °C)
50 to 1000 °F (10 to 537 °C)class 150# flange; 1000 to 1500 °F (537 to 816 °C) class 300# up
Pressure
Standard 150# flange; ASME certified 80 psig at 800 °F (550 kPA at 426 °C) –20 to 1000 °F (–28 to 537 °C)
Up to 3600 psig at 50 °F (10 °C) and 205 psig at 1500 °F (816 °C)

Dimensions (W x D x H)
15 in. x 25 in. x 45 in. x 25 in.
391 mm x 636 mm x 1143 cm

Conclusion
The concept of reflux sampling offers advantages in classically difficult applications by supporting the basic principles of sample conditioning. Conditioning is performed as close to the source as possible. The sample is conditioned away from the saturated condition. The device is standalone and utilizes utilities commonly available in the process environment.

Furthermore, the device is simple with few moving parts – the physics of phase equilibrium does all the work. Reliability of the overall system is enhanced which reduces the costs of analyzer system maintenance across the overall installation. The Dynamic Reflux Sampler provides this in a standardized package.

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