Swagelok

Grab Sample
Evaluation and Advisory Services

ABC COMPANY

XXX

VIETNAM

Prepared by: Scott Cookson, Takashi Matsuura & Alice Chin

23RD May 2018

Prepared on behalf of Swagelok Vietnam

SWAGELOK® GRAB SAMPLE SYSTEM EVALUATION AND ADVISORY SERVICES

Swagelok Grab Sample System Evaluation and Advisory Services is a service program offered by Swagelok and its global distributor network in which we use our industry expertise in analytical instrumentation system design to help improve the quality of sampling at your facilities.

A Swagelok Grab Sample System Advisor serves as your high performance resource to troubleshoot problem areas in grab sampling systems that may exist at your facilities.

SWAGELOK® FIELD ENGINEERING

Swagelok employs a team of engineers throughout the world as an extension of our headquarters in Solon, Ohio. Their mission is to be the technical liaison and advocate between the customer, our distributor network, and the factory by providing an extension of Swagelok engineering resources.

Their primary focus is to provide technical expertise through a sound understanding of our customers' applications.

DISCLAIMER

Swagelok provides this report for general information only, and it is based in part on a variety of facts and assumptions (some of which are variable and subject to change), as well as information supplied by the recipient and third parties. While Swagelok believes the information and conclusions in this report are accurate, Swagelok does not provide any warranty or guarantee regarding the accuracy or completeness of the information and conclusions in the report. Swagelok does not have the same level of knowledge and information as the recipient about the recipient's applications, products, designs, and conditions of use, and the recipient bears responsibility for determining the suitability of Swagelok's products and recommendations for the recipient's own situation and application. This report is CONFIDENTIAL information of Swagelok and may not be copied, shared or given to any other third parties except as otherwise stated in the report or by Swagelok in writing.

The information within this report is deemed entirely CONFIDENTIAL by Swagelok Company and may not be copied, shared or given to any other outside parties except those directly involved with the project, as set forth in the report. A formal agreement, executed between Swagelok Company and the Customer, would set forth the rights, duties, and obligations of each respective party prior to commencement of any work.

If the original English version of this document is translated into any other language and there is any conflict or inconsistency between the translated and English versions, the English version shall be the governing and prevailing version.

Any calculations or statements of improvement are based on the industry-referenced *book, Industrial Sampling Systems—Reliable Design and Maintenance for Process Analyzers*, by Tony Waters.

Learn more at http://www.industrial-sampling-systems.com/

TABLE OF CONTENTS
Contents

Swagelok® Sample System Advisory Service Team	Swagelok Distributor Team	Customer Facility Team
Scott Cookson Regional Field Engineer +61 433 134 241	Vu Minh Ang Technical Manager Swagelok Vietnam +84 973 990 309	
Alice Chin Factory Field Engineer +60 12 412 2833		
Takashi Matsuura Factory Field Engineer +81 70 1376 8120		

Their cooperation and contributions are gratefully acknowledged.

EXECUTIVE SUMMARY

This section summarizes the background, goals, process, findings and recommendations of the Swagelok Sample System Evaluation and Advisory Services review of ABC Company, Vietnam. The Sample System Evaluation and Advisory Services team met with XXX

Existing Systems

The information contained in this section includes photos supplied by the owner company and drawings prepared by Swagelok Field Engineering, which have been reviewed by the owner company. It also contains references from the site escort and observations from the Field Engineer.

Findings

There were three types of processes tapped for lab validation or grab sampling observed at ABC Comapny: gas, volatile liquid and liquid process sample points. The information contained in this section includes an appendix featuring grading criteria with schematics and photographs (where appropriate) addressing specific issues and concerns prepared by Swagelok Field Engineering. It also contains information obtained from the site escort and observations from the Field Engineer Team.

Recommended Improvements

This information is provided as the basis for further detailed engineering to be carried out as part of any project to adopt the suggested changes. References are made to *Industrial Sampling Systems—Reliable Design and Maintenance for Process Analyzers* by Tony Waters, published by Swagelok.

Each system evaluated was assigned a recommended action of:

- Repair – Some systems are recommended for repair
- Replace – Some systems are recommended for replacement

Rating Scale

To facilitate system improvements, each system addressed in the report includes a rating for Safety, Environmental, Quality, and Function (S, E, Q, F). The scale for each category is detailed below:

Rating	Disposition
1	No action required.
2	Action suggested at next maintenance interval.
3	Action required at next maintenance interval.
4	Urgent action required to rectify the issue (<1 month).
5	Immediate action required to rectify the Issue.

INTRODUCTION

Grab Sample Systems are the primary way process media is captured for laboratory analysis. Without proper grab sample system design and maintenance, capturing, handling, and analysing the samples becomes more difficult and the analysis suspect. The intent of this report is to assess the design and performance of those systems. By surveying 4 systems, the Swagelok Field Engineering and Application Engineering Teams will help ABC Company to recognize potential improvements.

This report reviews 4 system(s):

1. ABC-001
2. ABC-002
3. XYZ-003
4. XYZ-004

FINDINGS

GRAB SAMPLE SYSTEM EVALUATION DATA SHEETS

3 gas cylinder sampling systems across different processing units, with one proposed upgrade to a bag sampling point were evaluated while the team was onsite. The gas cylinder sampling systems evaluated were in varying stages of functionality, ranging from fully functional to completely non-functional. We noted instances of not following best practices.

Attached are the individual data sheets for each grab sample system evaluated, along with the Safety, Environmental, Quality, and Function ratings for each system.

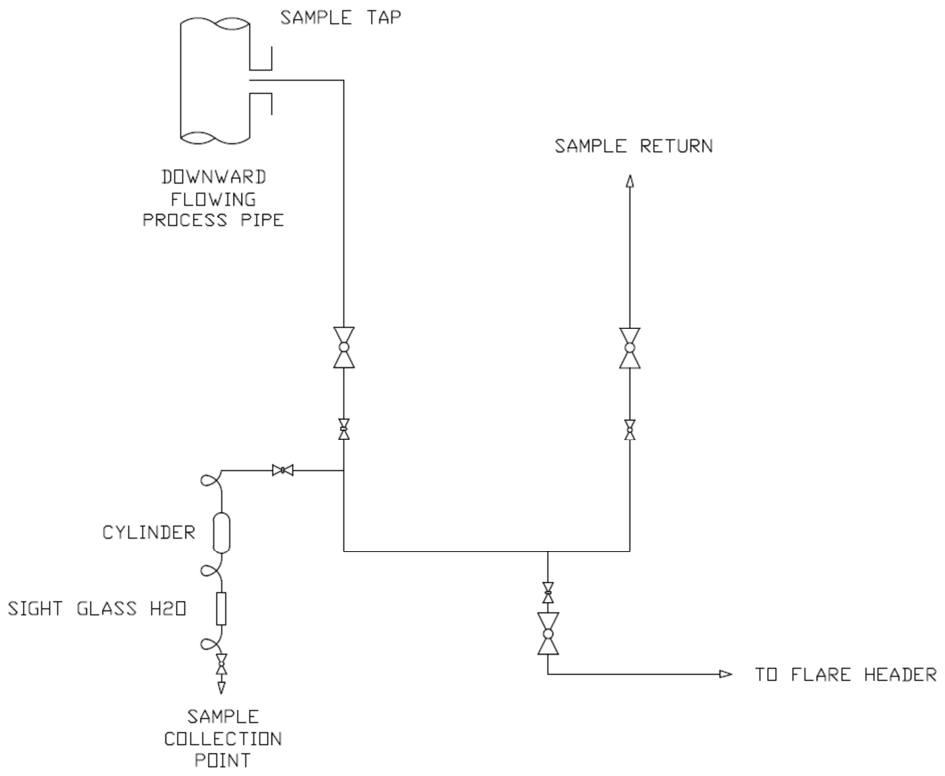
RATING SCALE

To facilitate system improvements, each system addressed in the report includes a rating for Safety, Environmental, Quality, and Function. The scale for each category is detailed below:

Rating	Disposition
1	No action required.
2	Action suggested at next maintenance interval.
3	Action required at next maintenance interval.
4	Urgent action required to rectify the issue (<1 month).
5	Immediate action required to rectify the Issue.

1. ABC-001

ABC-001				Cat
Sample Pressure	2 bara	Sample Temperature	90 deg C	
Safety	Enviro	Quality	Functional	
3	3	3	3	



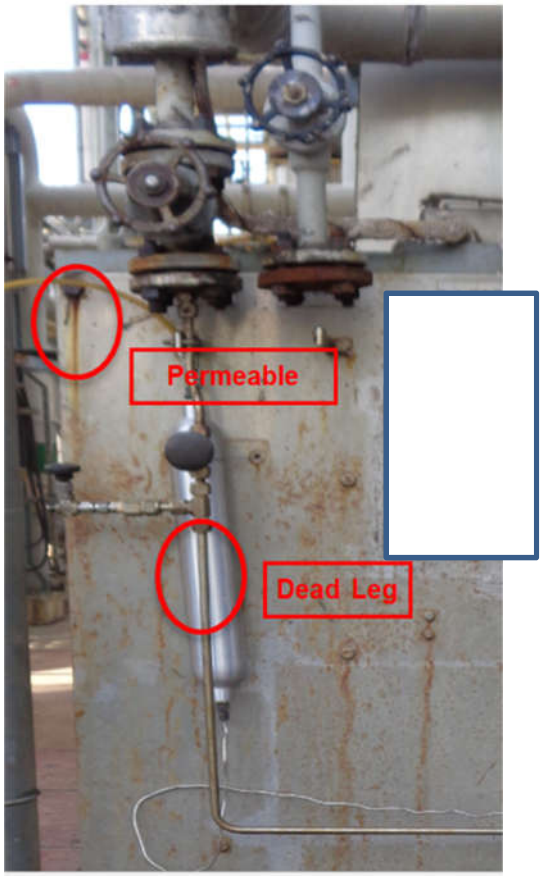
Sketch Drawing of Existing System

FINDINGS

1. Sample extraction point located on a vertical process pipe flowing downward.
2. No instrumentation for indication of pressure, temperature or flow.
3. No probe to avoid pipe wall or solids accumulation.
4. No clamps to hold cylinder.
5. Dead leg at sample collection point while filling.
6. Standard operating procedures (SOP) available but not accurate.
7. Nylon tubing used on inlet to sample collection container.

RECOMMENDATIONS

1. Best practice sampling for gas is from the top of a horizontal process pipe.
2. Install instrumentation, preferably downstream of the sample collection point to aid tuning of the sample system.
3. Consider adding a sample extraction probe to avoid pipe wall or solids accumulation.
4. Install a fixture to retain the sample collection container for hands free sampling.
5. Remove dead legs.
6. Replace standard operating procedure (SOP) with a clearly defined and exact placard to improve repeatability.
7. Replace nylon tubes with stainless steel flexible tubing.

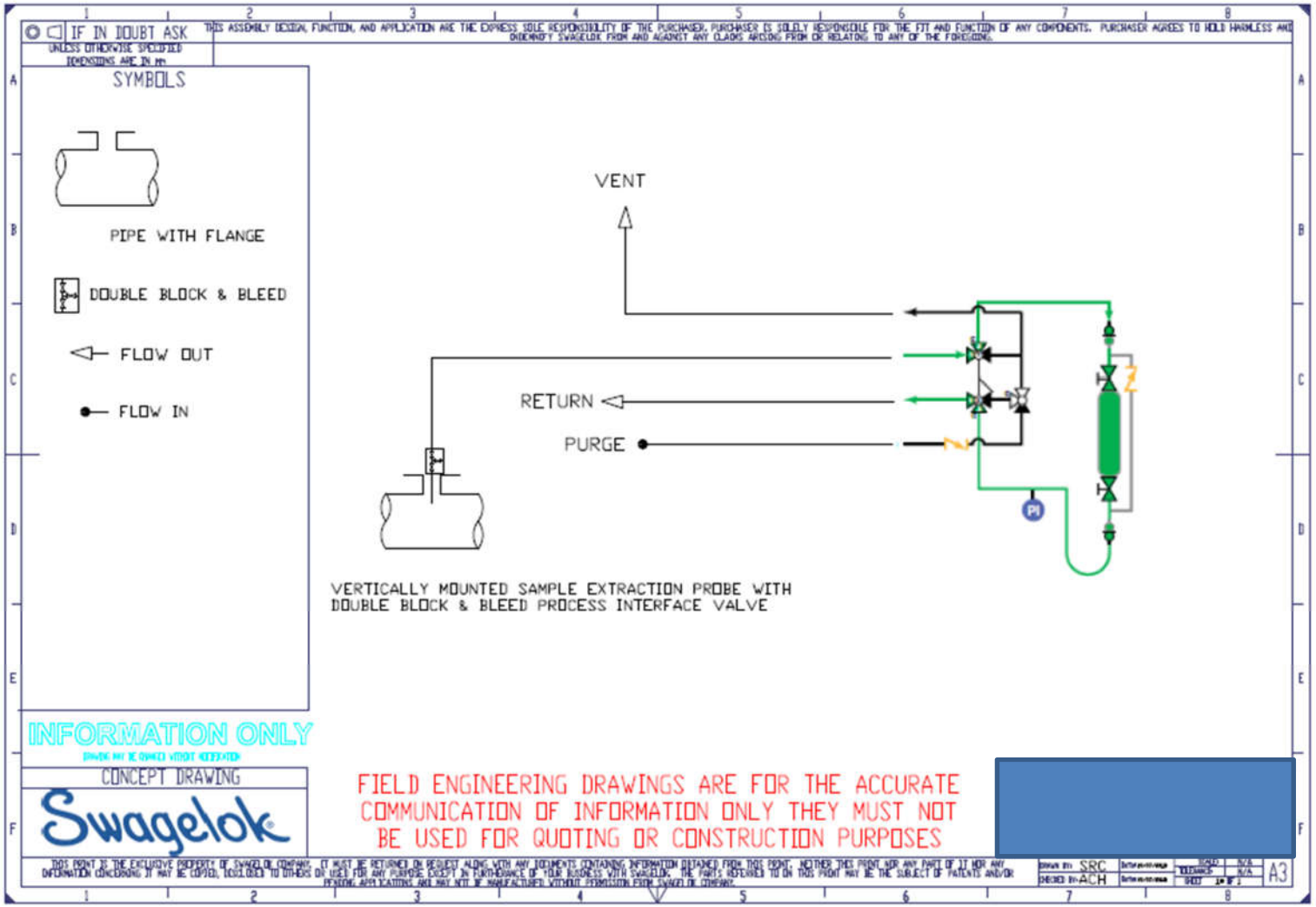
Sample Extraction Point 	The tapping point for this system is on a vertical process pipe flowing downwards, this is not an ideal position to be drawing a sample from. Best practice indicates tapping a gas process for sampling from the top of a horizontal process pipe and we would recommend the use of a correctly engineered sample extraction probe to help exclude particulate and liquid droplets from the sample system.
Sample Panel Station 	There is no instrumentation to indicate pressure, temperature or flow for the sample system. This makes it nearly impossible to tune the system for optimal performance. It also makes it very difficult to follow a known sampling procedure which allows for the collection of a clean and representative sample for analysis. There are standard operating procedure (SOP) instructions mounted on the sample panel but they are not well defined or exact, this will lead to samples being taken in different ways and affect the repeatability of the sampling process. For example, one of the steps in the procedure is to “purge the system for some time” which is ambiguous and open to interpretation. The sample panel uses hoses on the delivery side of the sample collection container; best practise would see hoses only mounted on the outlet side of the collection point. Hoses are hard to purge, especially if convoluted, and are likely to contaminate a current sample with old sample. The hoses being used are Nylon which is a permeable material and could be allowing atmospheric moisture and other contaminants to permeate into the sample. Again following the procedural instructions mounted on the panel the flare line and sample return line are closed when sampling, this creates a dead leg. If any

	old sample or other contaminants remain in those lines which are not flowing, they could affect the representativeness of the sample being taken.
	The gas cylinder sampling system shown at right exhibited nowhere for cylinder cradles or clamps, it is assumed the sample is taken without support for the cylinder or the operator holds on to the cylinder. Adding cylinder cradles and clamps will make the operation of the sample station easier and safer for the operator. Clamping the cylinder in place will reduce the stress on the upper quick connect, increasing the service life of the quick connect, and reducing maintenance while improving operator safety.

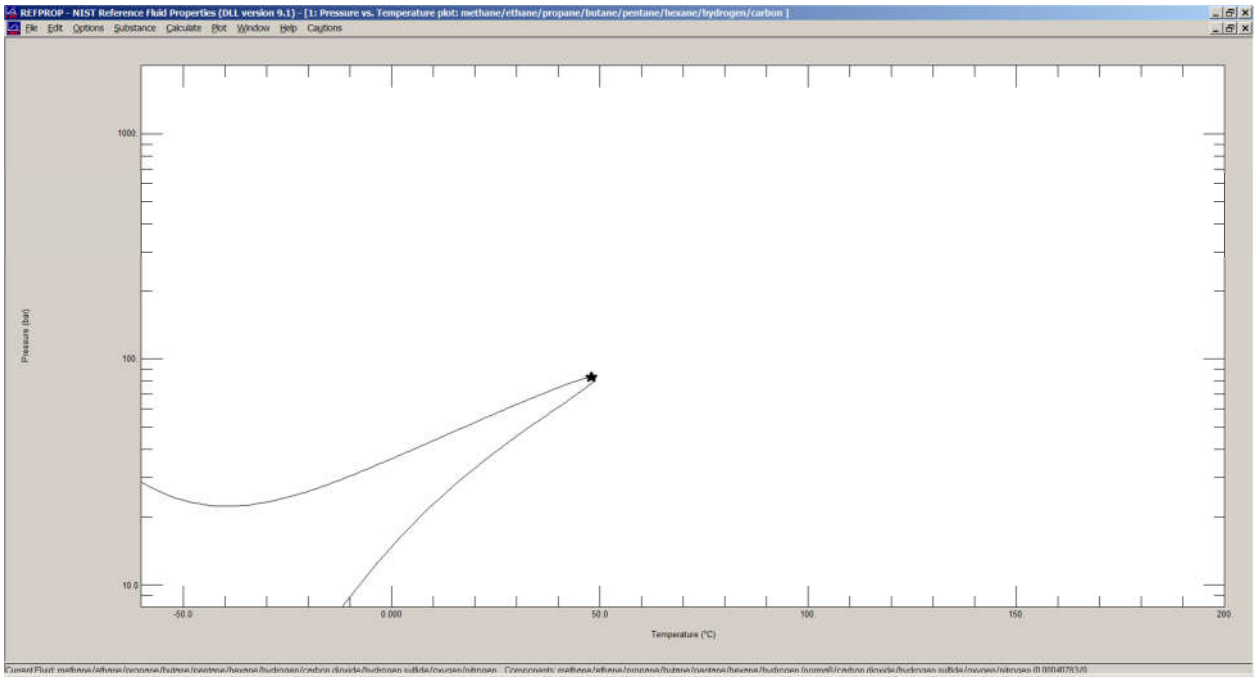
Grab Sample Evaluation and Advisory Services Report

Conceptual Design for ABC-001

Installing a sample probe on the top of a horizontal process pipe will help to eliminate particulate and liquid droplets from entering the system. Installing a closed loop sample station with instrumentation and purging function will help in gathering a more representative sample using a repeatable process, the purging function will ensure operator safety.


IF IN DOUBT ASK
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm
SYMBOLS
PIPE WITH FLANGE
DOUBLE BLOCK & BLEED
FLOW OUT
FLOW IN
VENT
RETURN
PURGE
PI
VERTICALLY MOUNTED SAMPLE EXTRACTION PROBE WITH DOUBLE BLOCK & BLEED PROCESS INTERFACE VALVE
INFORMATION ONLY
CONCEPT DRAWING
Swagelok
FIELD ENGINEERING DRAWINGS ARE FOR THE ACCURATE COMMUNICATION OF INFORMATION ONLY THEY MUST NOT BE USED FOR QUOTING OR CONSTRUCTION PURPOSES
SRC
ACH
A3

ABC-001 PHASE DIAGRAM



REFPROP - NIST Reference Fluid Properties (DLL version 9.1) - [2: methane/ethane/propane/butane/pentane/hexane/hydrogen/carbon dioxide/hydrogen sulfide/oxygen]

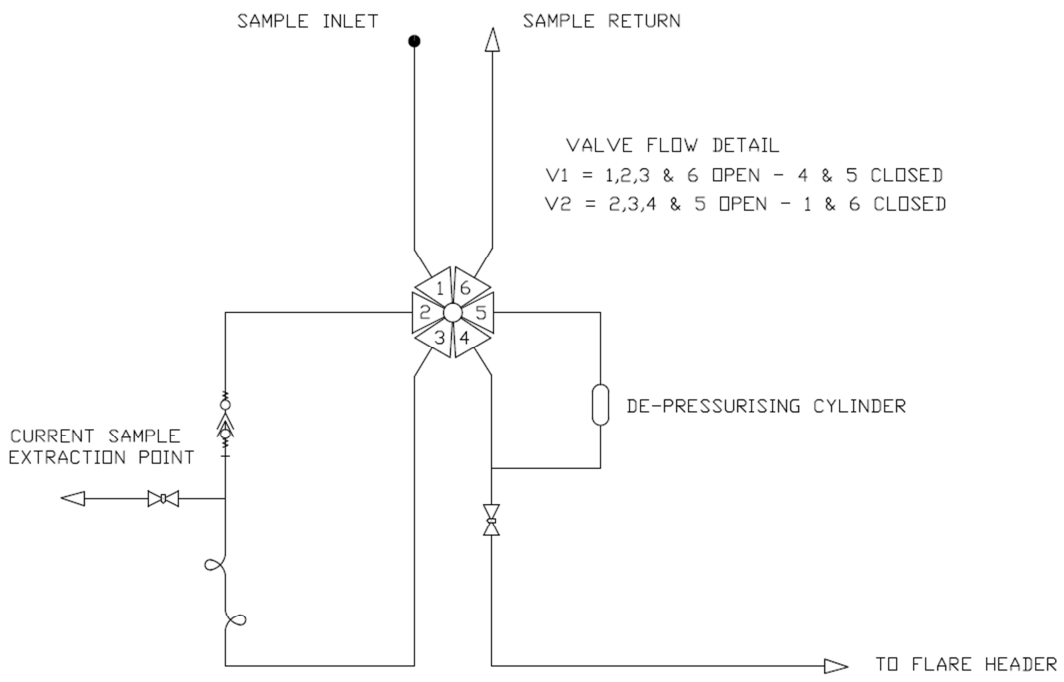
File Edit Options Substance Calculate Plot Window Help Cautions

	Temperature (°C)	Pressure (bar)	Density (kg/m³)	Enthalpy (kJ/kg)	Entropy (kJ/kg-K)	Cp (kJ/kg-K)	Joule-Thom. (°C/bar)	Quality (kg/kg)	Phase
1	90.000	2.0000	2.7082	603.53	3.0060	0.98020	0.75281	Superheated	Gas
2									

At supplied process temperature and pressure values the sample should be in the gas phase.

2. ABC-002

ABC-002				Cat
Sample Pressure	2 bara	Sample Temperature	51 deg C	
Safety	Enviro	Quality	Functional	
3	3	3	3	



Sketch Drawing for Existing System

FINDINGS

1. Sample extraction point located on the top of a horizontal process pipe too close to other components.
2. No probe to avoid pipe wall or solids accumulation.
3. No visible standard operating procedure (SOP) for operator to follow.
4. Operator exposed to potentially hazardous media.
5. Currently using suction cylinder to draw the sample.
6. Valve function and flow porting is unclear and not documented.
7. Teflon core stainless steel braid hose used on inlet to sample collection container.

RECOMMENDATIONS

1. Best practice tapping points should be located approximately 10 pipe diameters downstream of the last process upset.
2. Consider adding probe to avoid pipe wall or solids accumulation.
3. Mount local standard operating procedures (SOP) to improve repeatability.
4. Consider closed loop sampling.
5. Mount local valve flow and porting detail to aid operator understanding and trouble shooting.
6. Replace Teflon core hose with stainless steel core hose, only upstream of the sample cylinder.

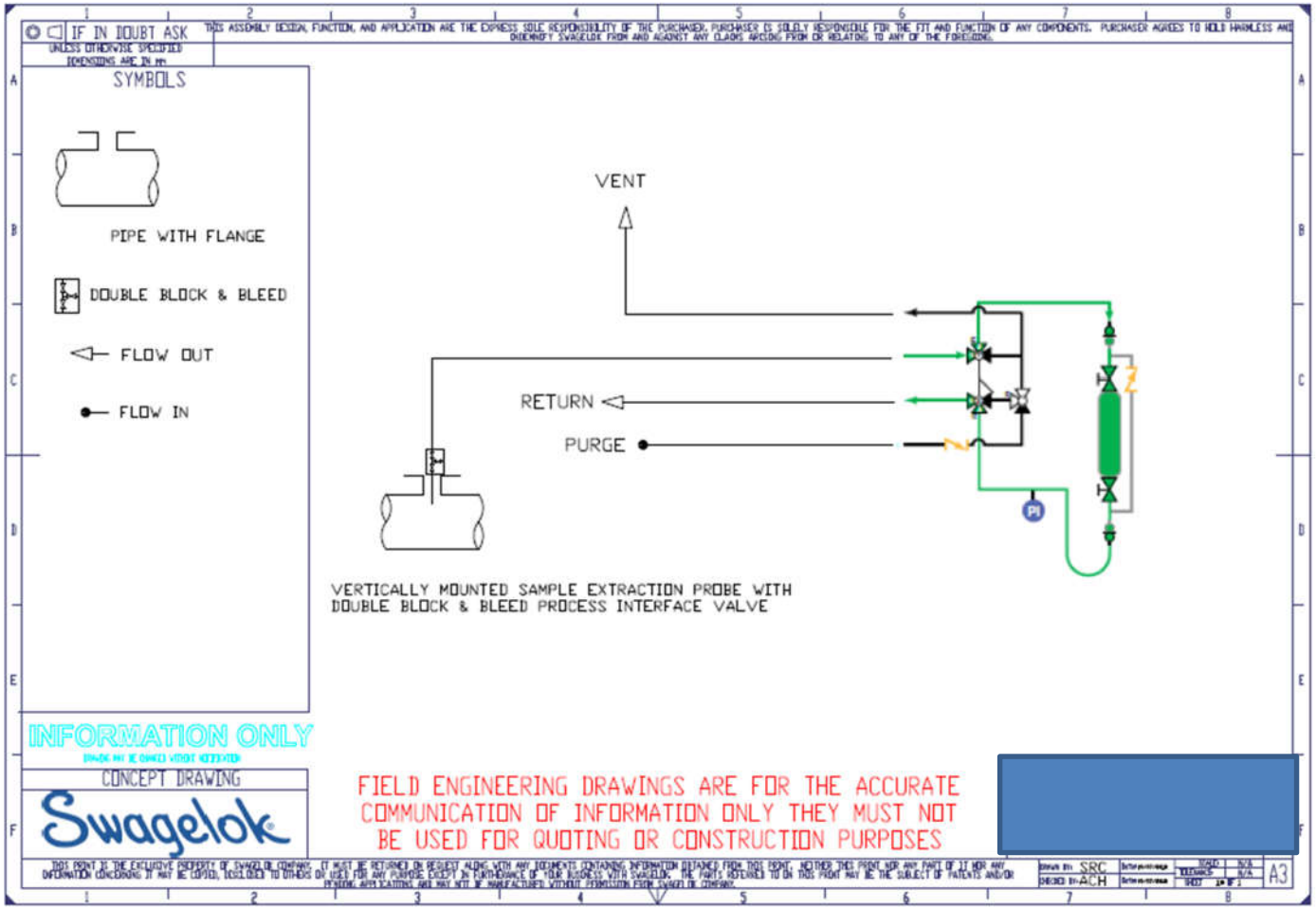
Sample Extraction Point 	The tapping point for this system is on the top of a horizontal process pipe, very close to other components on that process pipe. This is not an ideal position to be drawing a sample from. Best practice indicates tapping a process pipe at least 10 pipe diameters downstream of the last process interruption and 2 pipe diameters upstream of the next process interruption. We would recommend the use of a correctly engineered sample extraction probe to help exclude particulate and liquid droplets from the sample system.
Sample Panel 	There is no instrumentation to indicate pressure, temperature or flow for the sample system. This makes it nearly impossible to tune the system for optimal performance. It also makes it very difficult to follow a known sampling procedure which allows for the collection of a clean and representative sample for analysis. There are no standard operating procedure (SOP) instructions mounted on the sample panel, this will lead to samples being taken in different ways and affect the repeatability of the sampling process. The sample panel uses hoses on the delivery side of the sample collection container; best practise would see hoses only mounted on the outlet side of the collection point. Hoses are hard to purge, especially if convoluted, and are likely to contaminate a current sample with old sample. The hoses being used are Nylon which is a permeable material and could be allowing atmospheric moisture and other contaminants to permeate into the sample.
	The 5 way valve used at the sample collection panel, for stream selection, has two operating positions but there is no local indication of which ports are flowing in either operational position. This will make the process of troubleshooting difficult as the operator

	has no way of knowing what function the valve has at each position.

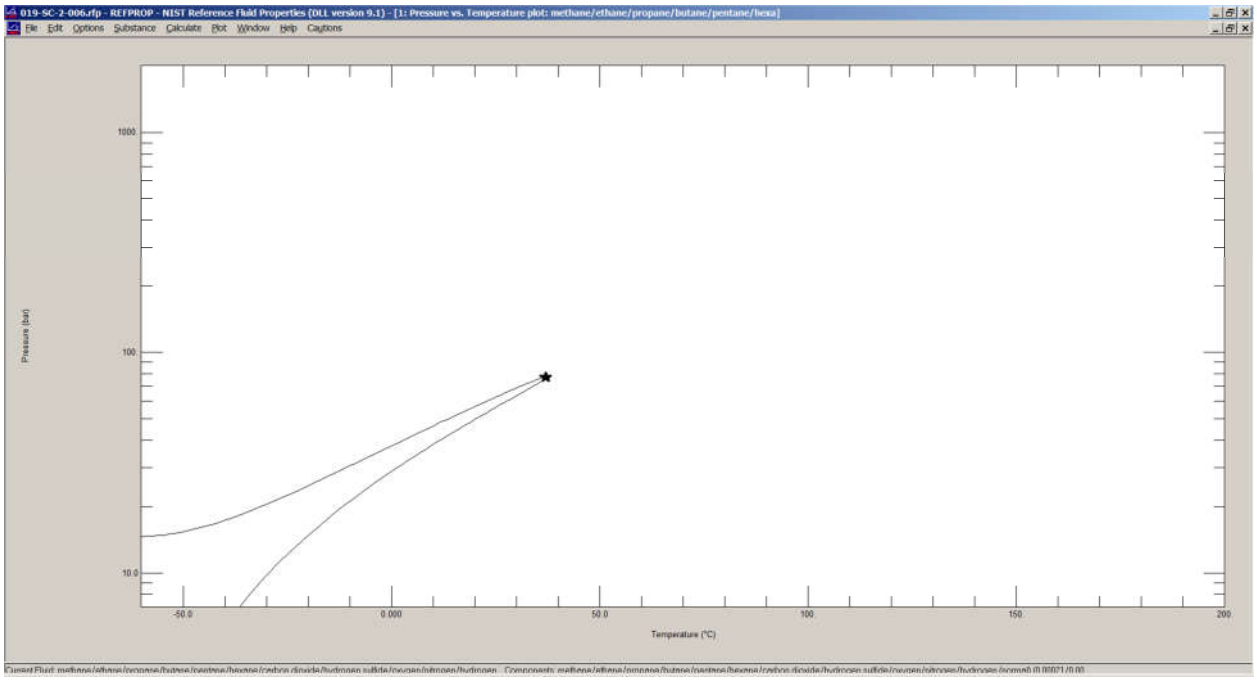
Grab Sample Evaluation and Advisory Services Report

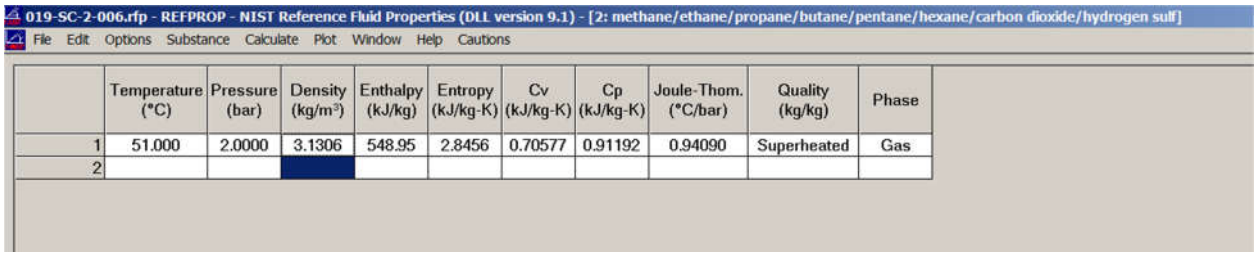
Conceptual Design for ABC-002

Installing a sample probe on the top of a horizontal process pipe will help to eliminate particulate and liquid droplets from entering the system. Installing a closed loop sample station with instrumentation and purging function will help in gathering a more representative sample using a repeatable process, the purging function will ensure operator safety.


IF IN DOUBT ASK
SYMBOLS
PIPE WITH FLANGE
DOUBLE BLOCK & BLEED
FLOW OUT
FLOW IN
VENT
RETURN
PURGE
PI
VERTICALLY MOUNTED SAMPLE EXTRACTION PROBE WITH
DOUBLE BLOCK & BLEED PROCESS INTERFACE VALVE
INFORMATION ONLY
CONCEPT DRAWING
Swagelok
FIELD ENGINEERING DRAWINGS ARE FOR THE ACCURATE
COMMUNICATION OF INFORMATION ONLY THEY MUST NOT
BE USED FOR QUOTING OR CONSTRUCTION PURPOSES
A3

ABC-002 PHASE DIAGRAM



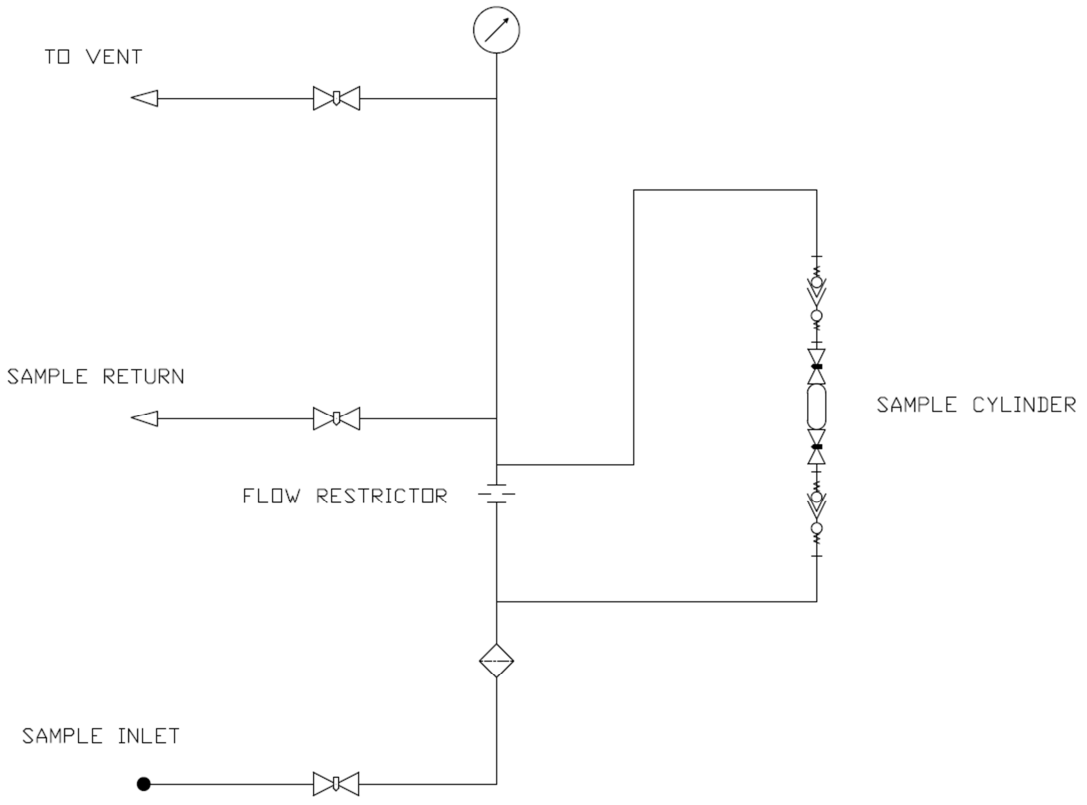


	Temperature (°C)	Pressure (bar)	Density (kg/m³)	Enthalpy (kJ/kg)	Entropy (kJ/kg-K)	Cv (kJ/kg-K)	Cp (kJ/kg-K)	Joule-Thom. (°C/bar)	Quality (kg/kg)	Phase
1	51.000	2.0000	3.1306	548.95	2.8456	0.70577	0.91192	0.94090	Superheated	Gas
2										

At supplied process temperature and pressure values the sample should be in the gas phase.

3. XYZ-003

XYZ-003				Cat
Sample Pressure		**Sample Temperature**		
Safety	**Enviro**	**Quality**	**Functional**	
2	2	4	2	



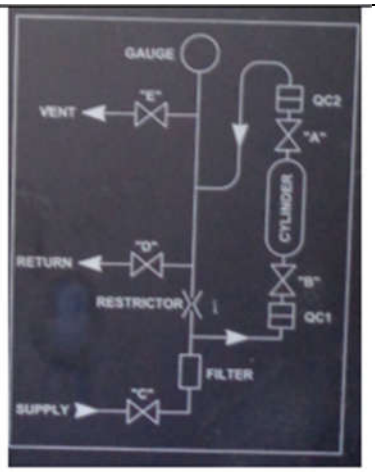
Sketch Drawing of Existing System

FINDINGS

1. Sample taken from top of horizontal process pipe too close to a pipe elbow.
2. No probe at process tap to avoid pipe wall or bottom accumulation.
3. Manifold is assumed to be as detailed in the cabinet diagram.
4. No local instrumentation.

RECOMMENDATIONS

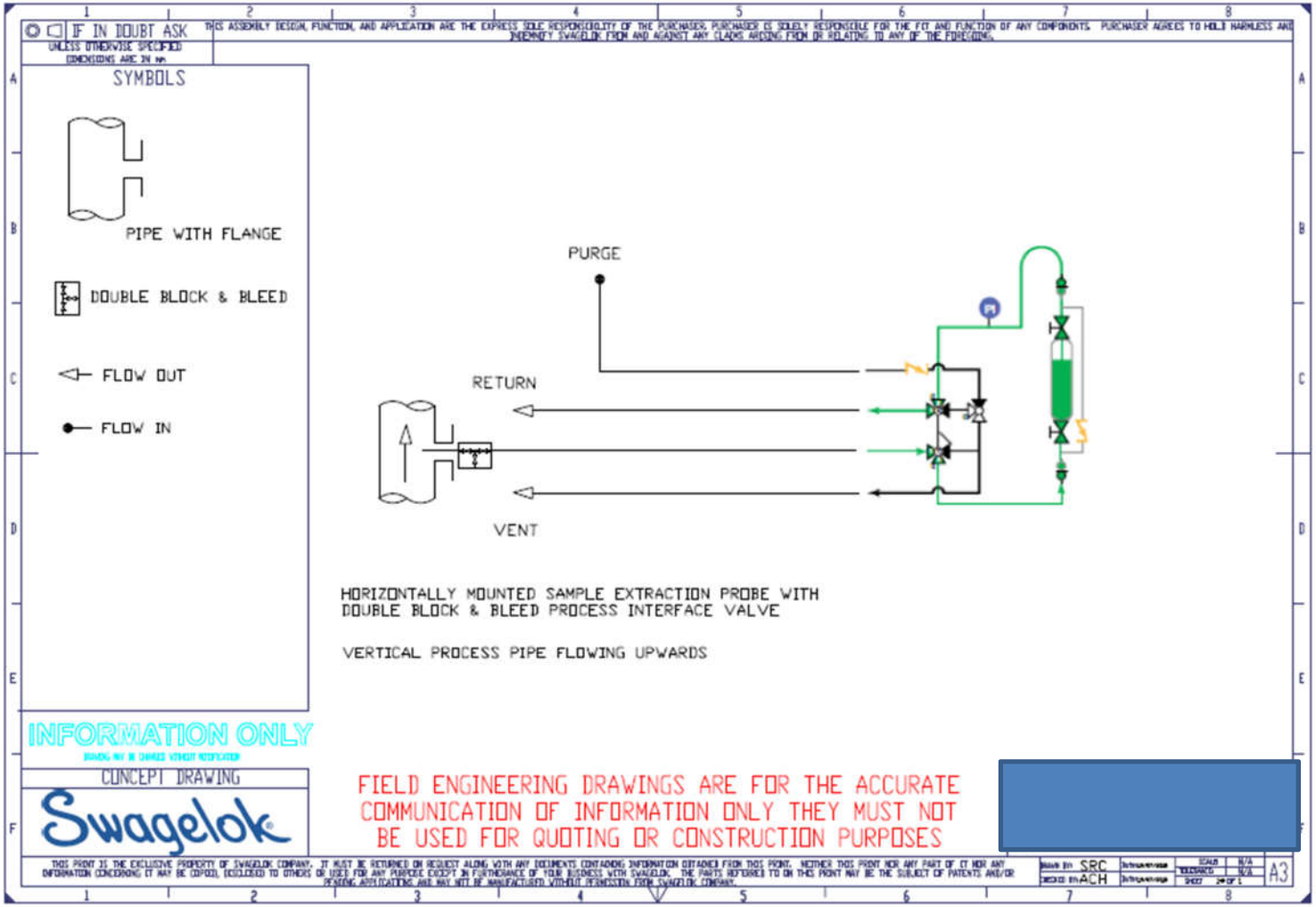
1. Move sample tapping point to a “best practice” location.
2. Consider adding probe to avoid pipe wall or solids accumulation.
3. Consider using closed loop sample station.
4. Install flowmeter, pressure and temperature gauges locally, downstream of sample collection container.

Sample Extraction Point 	The tapping point for this system is on the top of a horizontal process pipe, very close to a process pipe elbow. This is not an ideal position to be drawing a sample from. Best practice indicates tapping a process pipe at least 10 pipe diameters downstream of the last process interruption and 2 pipe diameters upstream of the next process interruption. Sampling a liquid stream from the top of a process pipe is not recommended; the pipe may not be full and have a vapor space on top of the liquid, resulting in a two phase sample. We would recommend the use of a correctly engineered sample extraction probe to help exclude any vapor and particulate from the sample system.
Sample Panel 	There is not enough instrumentation to indicate pressure, temperature or flow adequately for the sample system. This makes it nearly impossible to tune the system for optimal performance. It also makes it very difficult to follow a known sampling procedure which allows for the collection of a clean and representative sample for analysis. There are standard operating procedure (SOP) instructions mounted on the sample panel but they are not well defined or exact, this will lead to samples being taken in different ways and affect the repeatability of the sampling process. For example, one of the steps in the procedure is to “purge the system for a sufficient time” which is ambiguous and open to interpretation.
 	The manifold used on this sample collection panel appears to be a solid bar; it has been assumed that the representation on the inside of the cabinet correctly depicts the flow through this component. Given this arrangement of the manifold it would be difficult to replace any filter elements and the flow restriction, if ever blocked, would be similarly difficult to diagnose or replace. Both the hose and dead leg for the pressure gauge are on the outlet side of the collection container which is consistent with best practise.

Grab Sample Evaluation and Advisory Services Report

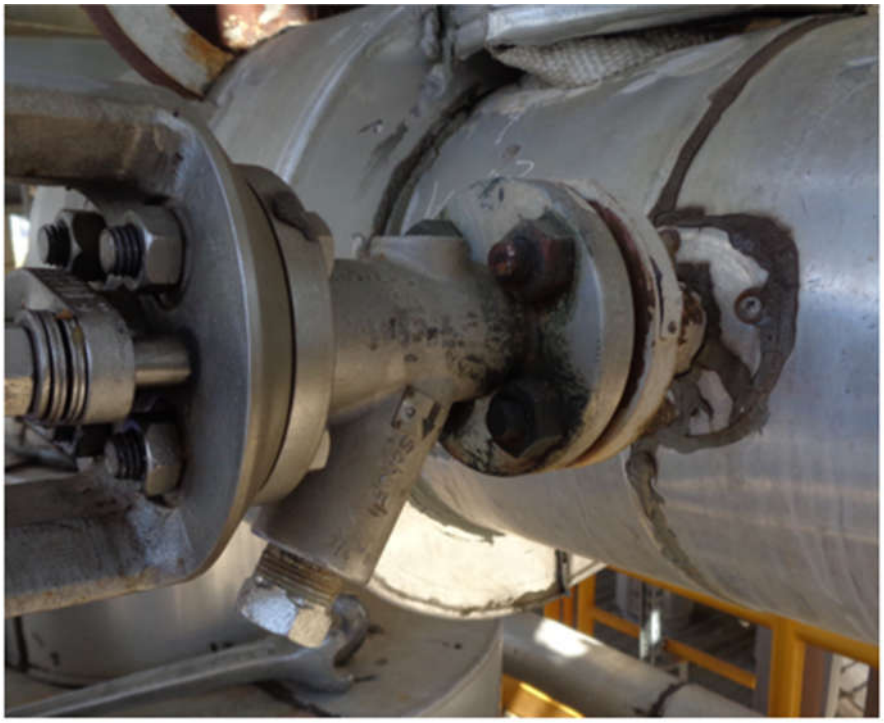
Conceptual Design for XYZ-003

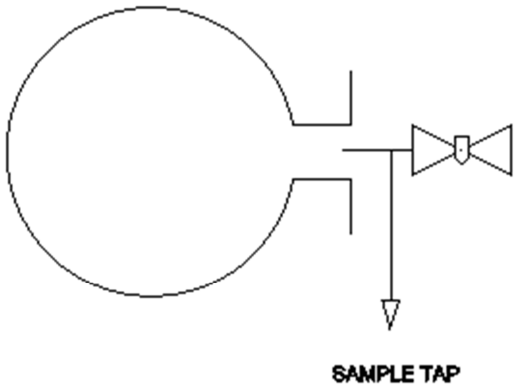
Installing a sample probe horizontally on a vertical process pipe flowing upwards will help to eliminate particulate from entering the system. When installing the probe, it is best practice to be at least 10 pipe diameters away from the last process upset, such as a pip elbow, control valve etc. Installing a closed loop sample station with instrumentation and purging function will help in gathering a more representative sample using a repeatable process, the purging function will ensure operator safety.


IF IN DOUBT ASK
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN mm
THIS ASSEMBLY DESIGN, FUNCTION, AND APPLICATION ARE THE EXPRESS SOLE RESPONSIBILITY OF THE PURCHASER. PURCHASER IS SOLELY RESPONSIBLE FOR THE FIT AND FUNCTION OF ANY COMPONENTS. PURCHASER AGREES TO HOLD HARMLESS AND INDEMNIFY SWAGELOK FROM AND AGAINST ANY CLAIMS ARISING FROM OR RELATING TO ANY OF THE FOREGOING.
SYMBOLS
PIPE WITH FLANGE
DOUBLE BLOCK & BLEED
FLOW OUT
FLOW IN
PURGE
RETURN
VENT
HORIZONTALLY MOUNTED SAMPLE EXTRACTION PROBE WITH
DOUBLE BLOCK & BLEED PROCESS INTERFACE VALVE
VERTICAL PROCESS PIPE FLOWING UPWARDS
INFORMATION ONLY
CONCEPT DRAWING
Swagelok
FIELD ENGINEERING DRAWINGS ARE FOR THE ACCURATE COMMUNICATION OF INFORMATION ONLY THEY MUST NOT BE USED FOR QUOTING OR CONSTRUCTION PURPOSES
THIS PRINT IS THE EXCLUSIVE PROPERTY OF SWAGELOK COMPANY. IT MUST BE RETURNED ON REQUEST ALONG WITH ANY DOCUMENTS CONTAINING INFORMATION OBTAINED FROM THIS PRINT. NEITHER THIS PRINT NOR ANY PART OF IT NOR ANY INFORMATION CONCERNING IT MAY BE COPIED, DISCLOSED TO OTHERS OR USED FOR ANY PURPOSE EXCEPT IN FURTHERANCE OF YOUR BUSINESS WITH SWAGELOK. THE PARTS REFERRED TO ON THIS PRINT MAY BE THE SUBJECT OF PATENTS AND/OR PENDING APPLICATIONS AND MAY NOT BE MANUFACTURED WITHOUT PERMISSION FROM SWAGELOK COMPANY.
DRAWN BY SRC
CHECKED BY ACH
SCALE N/A
TOLERANCES N/A
SHEET 1 OF 1
A3

4. XYZ-004

XYZ-004				Cat
Sample Pressure		**Sample Temperature**		
Safety	**Enviro**	**Quality**	**Functional**	
3	2	1	2	





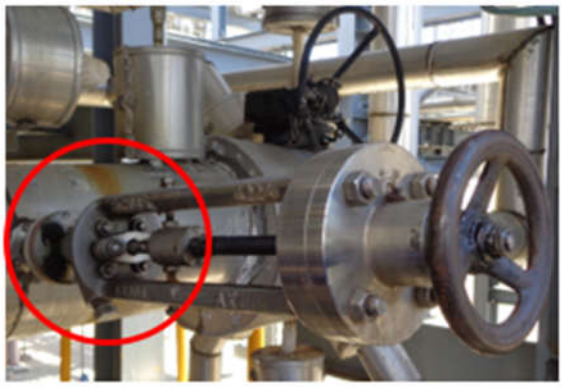
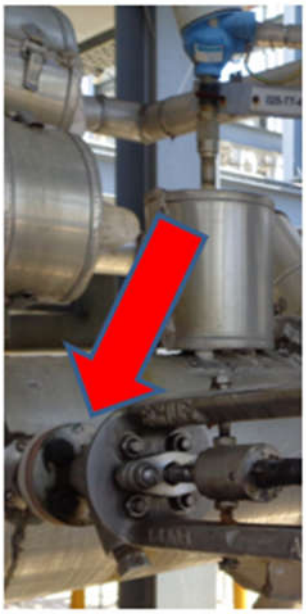
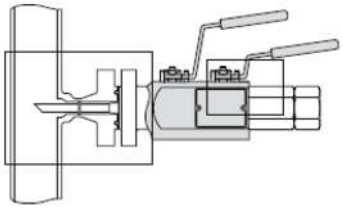
Sketch Drawing of Existing System

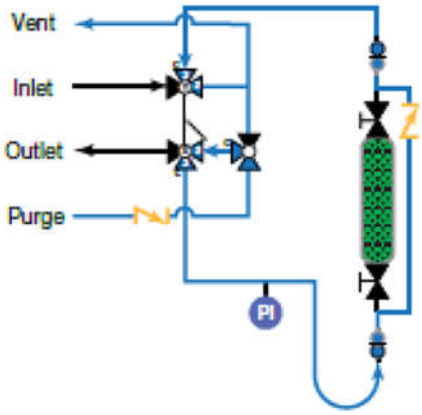
FINDINGS

1. No sample system, sample taken directly from the process tap.
2. No visible standard operating procedures (SOP) available.
3. No probe at process tap to avoid pipe wall or bottom accumulation.
4. No way to purge the system, other than to atmosphere, before sampling.

RECOMMENDATIONS

1. Consider installing a closed loop sample station.
2. Mount local standard operating procedures (SOP) to improve repeatability.
3. Consider adding probe to avoid pipe wall or solids accumulation.
4. Consider installing a closed loop sample station.

Sample Extraction Point 	Currently this sample is taken from the port attached to the tap, where the process interface valve is positioned. The sample is taken using a plastic sample bag and uses process pressure to fill. There is no way to purge the process nozzle other than venting to atmosphere prior to filling the sample bag, exposing the operator to potentially harmful fumes.
	There is no instrumentation to indicate pressure, temperature or flow for the sample collection point. This makes it very difficult to follow a known sampling procedure which allows for the collection of a clean and representative sample for analysis. There are no standard operating procedure (SOP) instructions mounted at the sample point, this will lead to samples being taken in different ways and affect the repeatability of the sampling process. If possible, when replacing this sample collection point we would advise moving the temperature transmitter to the process nozzle the valve currently occupies and installing a correctly engineered sample extraction probe where the temperature transmitter is currently. This will ensure sampling a vapor from the top of the process pipe using a probe, which is considered best practice.
 	The new sample extraction probe should utilise a double block and bleed process interface valve to ensure operator safety when the sample point is shutdown for maintenance. Run a sample transport line to a closed loop sample station for gas utilising a nitrogen or instrument air purge, again to ensure operator safety and avoiding any harmful fumes when collecting the sample.



A closed loop sample station, with purging option, similar to above should be considered for the replacement of this sample collection point.

Appendix 1:

GRAB SAMPLING BEST PRACTICES

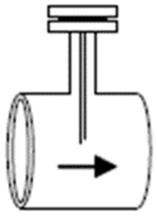
1. SAMPLE PROBE

When a sampling probe is not used, the sample fluid is taken from a slowly-moving layer close to the inner wall of the process pipe. That slow- moving layer, sometimes known as the *boundary layer*, is in laminar flow and carries most of the solid particles. The withdrawn sample therefore contains a larger proportion of solid matter than is present in the process stream.

When the process fluid is a gas, any entrained liquid tends to wet the pipe walls, forming a liquid layer that slowly moves along the pipe wall.

Again, when a probe is not used, the proportion of liquid in the withdrawn gas sample is significantly higher than is present in the process stream. This may cause a large error in the analytical measurement.

Industry standards recommend that a probe should be installed at every manual sampling tap. When a sampling probe is used, the sample is drawn from the fast-flowing fluid near the center of the process pipe ensuring a clean and current sample.

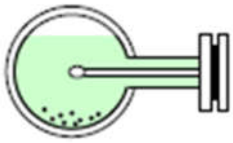


Horizontal Sample Probe

2. SAMPLING FROM THE BOTTOM OF THE PROCESS LINE

Ideally, all laboratory sampling nozzles should be horizontal [1,2]. Sampling from the bottom of the line ensures that all the solid matter in the process fluid ends up in the sample container. The survey team was unable to evaluate the effect of solid matter in samples because it depends on the methods used for laboratory analysis.

If the sampling tap cannot be moved and the collection of additional solids is affecting the analysis, we can



Horizontal Sample Probe

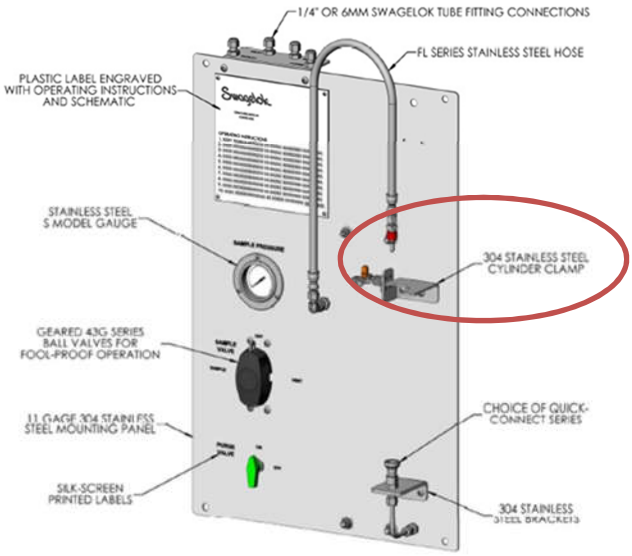
insert a probe into the existing sample supply nozzle.

3. SAMPLE CYLINDER MOUNTING

Sample stations often fail to feature a hands-free solid sample cylinder fixture and rely on the operator to hold the cylinder while during the fill process.

This may constitute a safety issue. Without the cylinder holders, cylinders hang freely from the Quick-Connect couplings. By manually holding the cylinder in place, the operator may subject that coupling to enough torque to sever the connection, resulting in an explosive release of process fluid into the face of the operator.

Sample cylinder fill stations should always feature a cylinder fixture and cylinder guides should be replaced. Instructions should be issued to operators explaining how to insert a cylinder without breaking the guides.



Grab Sample Panel

4. SAMPLING ACROSS A CONTROL VALVE

Typical sample taken across a control valve

In most installations, there is a bypass pipe running between the control valve inlet line and the control valve outlet line.

The sampling panel takes its sample supply from the upstream side of the throttling valve and returns it to the downstream side. The setting of the throttling valve controls the differential pressure at the panel, but in most

cases there is no indication of flow rate or return pressure. Sometimes the throttling valve is closed during sampling to create more differential pressure, but the valve inlet piping then becomes a significant dead leg that contaminates the collected sample.

There are two problems with the observed arrangement:

- The sample flow rate changes with control valve action. When the control valve is wide open, there is no flow at all. Unfortunately, most of the observed systems don't have a flow indicator, so it's impossible for the operator to know the sample flow.

- The sample flow bypasses the control valve (or flow orifice), thereby affecting process control. Several of the bypass lines do not have flow-control valves, and where a valve is present it is often left open. The flow through each bypass line is unknown, but it could be enough to disturb process control functions.

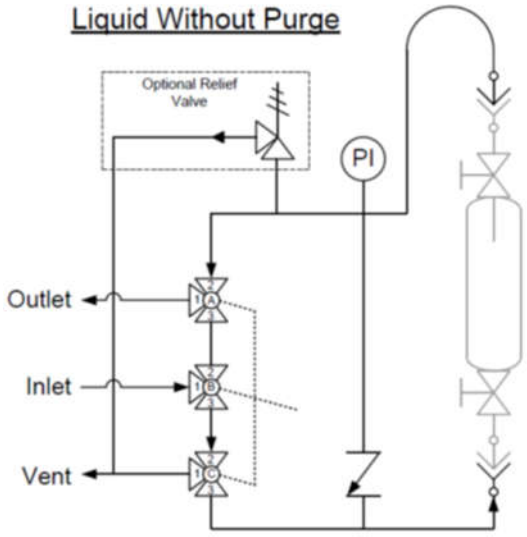
Best practice is to sample from the more-constant pressure at the discharge of a process pump. The sample flow is usually returned to the pump suction, but it may be discharged to flare or oily sewer.

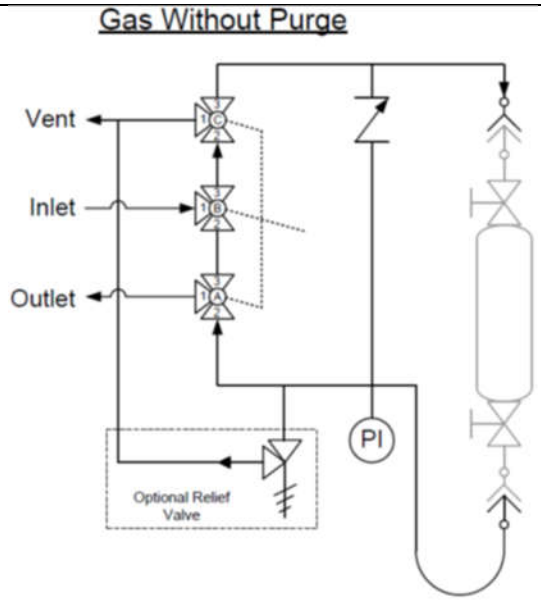
5. HOSES ON SAMPLING CYLINDER INLETS

We note that corrugated hoses are often used to connect sampling cylinders onto the panel.

This type of hose can occlude old sample in the corrugations, thus contaminating the extracted sample. It may be impractical to effectively remove this contamination without purging the hose with turbulent flow for extended periods.

This contamination occurs only when the hose is located on the inlet side of the sampling cylinder, as was observed with most systems for sampling process liquids into cylinders. To improve the design of these liquid-sampling panels, we would move the hose to the sample return side. If this solution is impractical on site, we could recommend replacement hoses that do not expose the sample to corrugations.





Grab sample panel hose orientation

6. USING CONTAMINATED CYLINDERS

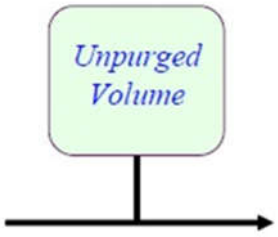
As noted above, the current installation makes it possible for an operator to attempt to take a sample when there is insufficient sample flow – or none at all. Without sufficient flow, it is impossible to flush the old sample from the cylinder and replace it with a new sample. Since the cylinders are returned from the laboratory with the old sample still inside, it's even possible for the old sample to be returned to the laboratory for reanalysis.

The relevant industrial standards require sampling cylinders to cleaned and dried before use.

We have occasionally found a few sampling panels that had zero pressure differential and presumably no sample flow. This may have been due to a wide-open control valve. Some other systems had no flow because they were incorrectly installed.

7. DEAD LEGS

Tees, pressure gauges, temperature indicators, and equalization lines create a dead leg if installed upstream of the sample bottle or cylinder. The old sample trapped in the dead leg diffuses into the new sample being taken, thereby contaminating the fresh sample taken for analysis. If practical, all of these tees should be relocated downstream of the sample vessel.



8. LACK OF INSTRUMENTATION

When proper instrumentation is not used, it becomes more difficult to determine the state of the sample point prior to capturing a sample. This impacts the ability to assess sample safety, quality, and timing of the sample. Safety: An operator cannot assess if there is immediate danger if products are inadequately sized for the current pressure and temperature. A local reading will enable an operator to clearly see that all items that comprise the sample system are adequately sized and rated. If they are adequately sized, a thermal danger can be communicated with a thermometer to alert personnel to use proper PPE if they have not been instructed to do so. A pressure gauge can warn personnel that a line is live and can confirm correct operation or help troubleshooting. Since cylinders are removable, there is a risk that an inadequately rated cylinder can be placed on a sample station. A pressure gauge can aid in preventing this from happening. Quality: The sample pressure can assist in determining the quantity of the sample collected, and confirms that it does not surpass the maximum allowable working pressure of the analytical equipment. When sample phase is important, temperature and pressure will allow the operator to determine the state of the sample. Sample Timing: When pressure readings are clear, pressure drops can be determined, and therefore flowrates. With a given internal volume of a sample line, a velocity can be attained, and therefore, a sample lag. This is important when choosing sufficient purge or flush time when a cylinder is filled.	

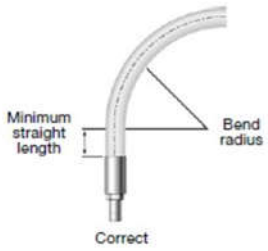
9. HOSE SERVICE LIFE FACTORS

Hoses are regularly used in grab sample systems to connect the sample cylinder to the panel. There are many best practices6 associated with hose use and installation summarized below.

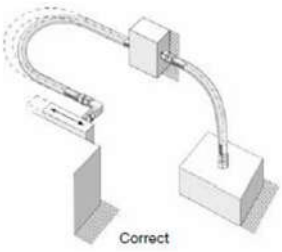
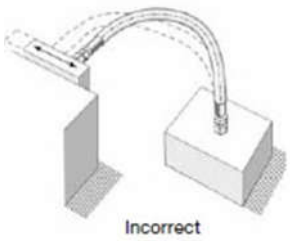
Condition	Correct Installation	Incorrect Installation	Remedy

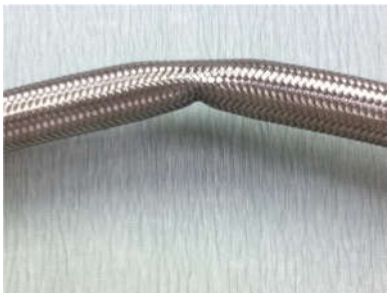
<table>
<tr>
<td rowspan="2">Minimum Bend Radius

Follow minimum bend radius requirements for your hose. Installing hose with smaller bends may kink hose and reduce hose life.

Hose rupture or leakage may result from bending too close to the hose/fitting connection.</td>
<td> 
</td>
<td> 
Incorrect</td>
<td rowspan="2">Reinstall the hose to correct the installation. A longer hose may be necessary to achieve the necessary bend radius.</td>
</tr>
<tr>
<td> 
Correct</td>
<td> 
Incorrect</td>
</tr>
<tr>
<td>Hose Strain

Elbows and adapters should be used to minimize or relieve hose strain, especially at the end connections.</td>
<td> 
Correct</td>
<td> 
Incorrect</td>
<td>Reinstall the hose using an elbow or adapter to alleviate the strain on the hose. A different length hose may be necessary once the elbow or adapter is installed.</td>
</tr>
<tr>
<td>Bending in One Plane

Avoid twisting the hose. Bend hoses in one plane only. For a compound bend, use multiple hose pieces or other isolation methods.</td>
<td> 
Correct</td>
<td> 
Incorrect</td>
<td>Reinstall the hose using correct routing and/or additional hoses so that each hose bends in one plane, avoiding any twisting of the hoses.</td>
</tr>
</table>

Kinking		Replace all hoses with kink damage.
Damage to Cover	 	If the damage is limited to the cover and is deemed not to go all the way through to the reinforcement layer, best practice suggests it is acceptable to leave the hose in place until the next scheduled PM interval. If the damage is through the cover and reveals the reinforcement layer replace the hose.
Damage to Reinforcement Layer		Replace all hoses with damage to the reinforcement layer(s).

REFERENCES

The following references were cited in the Best Practices section.

1. API MPMS 8-1 (2013) Standard Practice for Manual Sampling of Petroleum Products
2. ASTM D4057-12 (2012) Standard Practice for Sampling Petroleum and Petroleum Products
3. ASTM D1265-11 (2011) Standard Practice for Sampling Liquid Petroleum Gas – Manual Method
4. API 555 (2013) Process Analyzers
5. 49 CFR 173.301 General requirements for shipment of compressed gases and other hazardous materials in cylinders,
   UN pressure receptacles and spherical pressure vessels
6. NAHAD Hose Safety Institute Handbook, Design and Specification of Hose Assemblies

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Swagelok Vietnam
Ho Chi Minh Head Office
3E/16Pho Quang Street, Ward 2, Tan Binh District
Ho Chi Minh City, VIETNAM
Phone: 28 3842 0504
Fax: 28 3842 0704

All service marks and trademarks shown are registered by Swagelok Company unless otherwise noted. © 2017 Swagelok Company, May 2017.