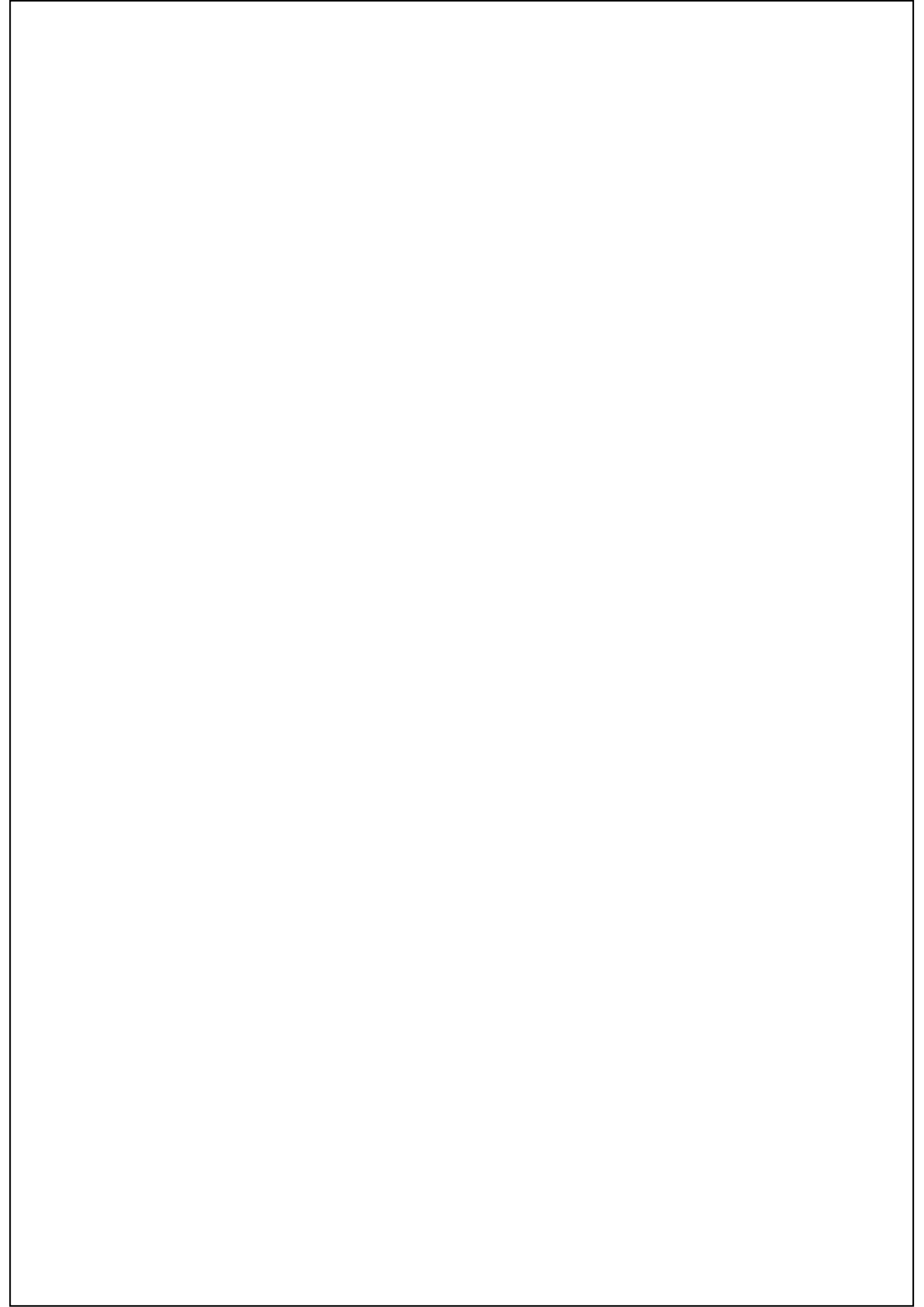




Swagelok®

LLL survey

Report Date:
LLL 2019





VENDOR: SWAGELOK LLL		
CLIENT: LLL		
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EXECUTIVE SUMMARY

This report is a summary of the 6-day Onsite Inspection Survey at UNIT 'L' of the LLL facility near LLLLL covering the compressors. We conducted an onsite inspection from the LLth through to the LLth 2019 on unit L and other areas of the facility.

The scope of work for the inspection was to provide a report on the health of all the tubing, valves, seal panels of the gas compressors on site and where possible the connecting process lines adjacent to the compressor buildings. We were to review and identify where practices could be improved and where safety was a concern.

During the onsite inspection we identified 317 issues covering 5 compressors and the associated outside areas adjacent to each compressor building . Large leaks were mainly concentrated on the air distribution and a few small leaks were found on hazardous gases. These were reported directly back to the operators on site who were attending with us and in the reports that were periodically issued.

In LLL the most pressing issue's were leakage, firstly of hazardous gases and then compressed air. Second most urgent issue would be the quantity of under tight fittings that we encountered. Over a third of the issues encountered were of under tight connections. These are possible future leaks that should be considered important.

From a total of 3174 inspection points at LLL, the percentage loss of containment rate breakdown was as follows:-

INSPECTION POINTS	QUANTITY	LEAKS	% RATE
Tube fittings	1246	54	4%
Tapered Threads	1216	41	3%
Valves	488	3	1%
Flanges	204	0	0%
*Other	20	4	20%

*Other includes items such as regulator bodies.

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ONSITE INSPECTION SCOPE OF WORK

The scope of work that was set by ÖWÜVUT ÖÜ staff and the Swagelok Field Engineers was as follows:

- Conduct an inspection of the small bore tubing system for defects at ÝÝÝ
- Review all tube fittings for intermix from an external perspective
- Review PTFE use on tapered fittings
- Leaks would be detected using **Snoop**® leak detection liquid
- Inspection of all external surfaces of the small bore system for corrosion or damage
- Review of tubing support and tube runs
- Document any loss of containment and categories depending on media
- Provide a guide on system health and industry best practices
- Provide information on training on any areas that it's deemed necessary



The process of performing a system engineering service begins with a dedicated Swagelok Field Engineer working with your Instrument team. The capabilities of this 3rd party system expert encompass the following:-

- System problem solving
- Information on industry best practices
- Knowledge of Swagelok small bore tubing training
- Swagelok custom solution assemblies

The skill set demonstrated is applicable to both analysis of system components and the assessment of a complete system.

7.1.1.1 Personnel

7.1.1.1

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Thank you for allowing Swagelok onsite inspection services to be of assistance to you. 7.1.1.1 is to be congratulated on taking the initiative to evaluate their 3rd party delivery systems for leakage, performance and corrosion.

Please do not hesitate to contact us if you require additional information or clarification on any item contained in this report.

A follow up visit is recommended within one month of system repairs being completed to ensure that the facilities reliability, safety and performance are maintained to the highest integrity.

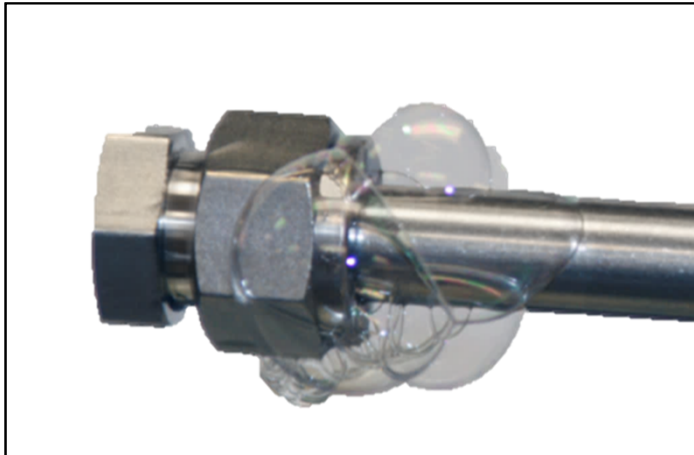


LOSS OF CONTAINMENT DETECTION EQUIPMENT

Unfortunately the ultrasonic leak detection equipment could not be used in the noisy environment of the compressor buildings. As a result all leaks were discovered using the reliable snoop detection spray.

Snoop specifications:

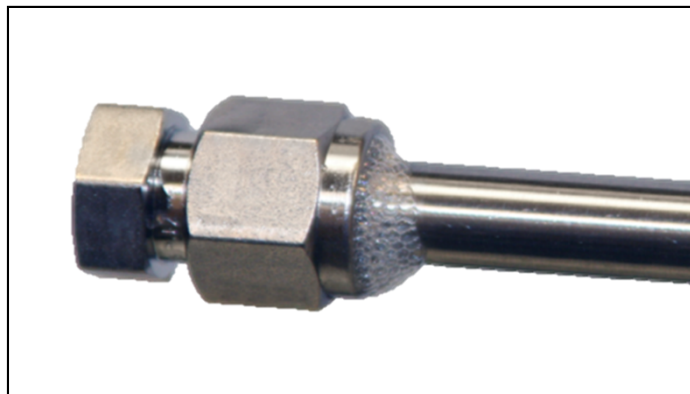
- Leak Detection Threshold: 0.036cc/hr



Major loss of containment



Significant loss of containment



Minor loss of containment

ISSUES BY TAG ID



Issue Tag ID : 0004166 **Category : 2**

Plant Area:	YYYY	Part Material:	316 Stainless Steel
Customer Tag ID:		Connection Type:	Tapered Threads
Location:	Air to solenoid valves	Connection Size:	1/2in
GPS Location:			
Part Description:	Stainless Steel Pipe Fitting, Reducing Bushing, 1/2 in. Male NPT x 1/4 in. Female NPT		
Process Fluid:	Compressed air	Type of Part:	Fittings
Pressure:	14 bar	Manufacturer:	Swagelok
Temperature:	20 C	Part Number:	SS-8-RB-4
Issue:	Medium Leak	Equiv Swagelok Part:	
Description:	1/2" MNPT, 1/4" FNPT Reducing bush. Leakage at the top and the bottom of the bush. 1/2" overtightened fitting to the left run of the tee.		
Other Findings:	Overtightened		
Possible Solution:	Investigate source and root cause of the leak and repair or replace as necessary according to manufacturer's instructions		
Ultrasound dB:		n/a	
Ultrasound ID:		n/a	



IMPORTANT: Always depressurize the system before working on, disassembling or assembling a fluid system. Safe Product Selection: 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.

ISSUES BY CATEGORY



Issue Category : 1 (Number of Issues in this Category : 5)

Issue Tag ID	Part Type	Issue	Plant Area	Cust Tag ID	Description	Fixed
0003322	Fittings	Large Leak	Reinjection compressor ЎЎ		12mm tube fitting, small leak. Wet Gas	<input type="checkbox"/>
0003321	Fittings	Large Leak	Reinjection compressor ЎЎ		12mm tube fitting into manifold, large gas leak. Investigate after depressurisation and purging of lines.	<input type="checkbox"/>
0003141	Fittings	Large Leak	Reinjection compressor ЎЎ		12mm tube fitting, large leak on gas line. Seat leakage from valve.	<input type="checkbox"/>

Issue Category : 2 (Number of Issues in this Category : 16)

Issue Tag ID	Part Type	Issue	Plant Area	Cust Tag ID	Description	Fixed
0004848	Valves	Medium Leak	20-4200 Fuel gas comp A		1.5" Globe valve with leak from stem. Adjust packing when depressurised.	<input type="checkbox"/>
0004850	Fittings	Medium Leak	20-4200 Fuel gas comp A		1" MNPT fitting into flange, small leak. Reinstall components or replace with integral twin ferrule ended flange.	<input type="checkbox"/>
0005365	Piping	Medium Leak	Reinjection compressor ЎЎ		1" piping, 7 leaks found in one run.	<input type="checkbox"/>
001748	Fittings	Medium Leak	Reinjection compressor ЎЎ		12mm tube fitting, medium leak. Re-install fitting.	<input type="checkbox"/>
0004165	Fittings	Medium Leak	Reinjection compressor ЎЎ		12mm tube fitting, 1/4" MNPT connection, medium leak.	<input type="checkbox"/>
001747	Fittings	Medium Leak	Reinjection compressor ЎЎ		12mm tube fitting, medium leak in 3 places. Piping connector medium leak in 1 place.	<input type="checkbox"/>

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Issue Category : 3						(Number of Issues in this Category : 81)
Issue Tag ID	Part Type	Issue	Plant Area	Cust Tag ID	Description	Fixed
002307	Fittings	Small Leak	20-4200 Fuel gas comp A		12mm tube fitting, small leak. Needs to be reinstalled	<input type="checkbox"/>
002308	Fittings	Small Leak	20-4200 Fuel gas comp A		12mm tube fitting, small leak. Needs to be replaced.	<input type="checkbox"/>
002310	Fittings	Small Leak	20-4200 Fuel gas comp A		10mm tube fitting, small leak. Needs to be reinstalled	<input type="checkbox"/>
002312	Fittings	Small Leak	20-4200 Fuel gas comp A		20mm tube fitting, small leak. Reinstall component.	<input type="checkbox"/>
002313	Fittings	Small Leak	20-4200 Fuel gas comp A		20mm tube fitting, small leak. Bubbles appearing in snoop around top of nut, very minor.	<input type="checkbox"/>
002314	Fittings	Small Leak	20-4200 Fuel gas comp A		6mm tube fitting, small leak. Re-install the fitting. 12mm tube fitting tee, Under tightened on all connections. Re-install tube fitting and tee.	<input type="checkbox"/>
002315	Fittings	Small Leak	20-4200 Fuel gas comp A		10mm tube fitting, small leak - needs to be reinstalled	<input type="checkbox"/>
002316	Fittings	Small Leak	20-4200 Fuel gas comp A		10mm tube fitting. Small leak. Tubing also has no support and is bent poorly. A nut is also on tubing from a previous assembly. Re-install components	<input type="checkbox"/>
002317	Fittings	Small Leak	20-4200 Fuel gas comp A		10mm tube fitting to 1/4" MNPT Elbow, Small leaks - need to reinstall	<input type="checkbox"/>
002318	Fittings	Small Leak	20-4200 Fuel gas comp A		1/2 FNPT thread fittings, small leaks in two places. Remove valve and reinstall using correct installation methods.	<input type="checkbox"/>

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0002311	Fittings	Small Leak	20-4200 Fuel gas comp B	1/2 MNPT fitting and ferrule connection. Two positions (flanges next to each other). Both fittings are Under tightened also. Replace with integral twin ferrule flanges.	<input type="checkbox"/>
002309	Fittings	Small Leak	20-4200 Fuel gas comp B	10mm tube fitting, small leak - Needs to be reinstalled	<input type="checkbox"/>
002319	Piping	Small Leak	20-4200 Fuel gas comp B	Small leak on threaded 1/2" piping. Replace threaded piping with twin ferrule and tubing manifold.	<input type="checkbox"/>
002320	Fittings	Small Leak	20-4200 Fuel gas comp B	12mm reducer into 20mm Tee. Small leak. Re-install fitting at next period of depressurisation.	<input type="checkbox"/>
002329	Fittings	Small Leak	20-4200 Fuel gas comp B	12mm tube fitting, small leak. PTFE tape applied to ferrule end. Appears an adapter is screwed into the flange. Change flange for an integral tube fitting end.	<input type="checkbox"/>
002330	Fittings	Small Leak	20-4200 Fuel gas comp B	1/2" tapered fitting with a small leak. Threaded connection requires remaking with correct amount of PTFE tape.	<input type="checkbox"/>
0005376	Fittings	Small Leak	Reinjection compressor ЎЎ	10mm tube fitting, small leak. Tubing requires support.	<input type="checkbox"/>
0005377	Fittings	Small Leak	Reinjection compressor ЎЎ	12 mm tube fitting, small leak. Vibration as tube is not supported. This will lead to fatigue failure if left unsupported.	<input type="checkbox"/>
0005379	Fittings	Small Leak	Reinjection compressor ЎЎ	1/2 MNPT fitting leak, needs supports to guard against vibration. 6mm tube is vibrating and will fail if left without supports.	<input type="checkbox"/>

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INSPECTION STATISTICS



Issue Category Summary

Category	Total
Category: 1	5
Category: 2	16
Category: 3	81
Category: 4	121
Category: 5	4
Total	227

Issue Type Summary

Issue Type	Total
Under tightened	109
Small Leak	81
Support	47
Medium Leak	16
Over tightened	12
Vibration	11
Installation	9
Damage	6
Intermix	6
Large Leak	5
Bending	4
Incorrect Part	4
Other	4
Corrosion	3
Total	317

Surveyed Connection Stats Summary

Connection Type	Surveyed	Leaks	%
Other	20	4	20
Tube Fitting	1246	54	4
Tapered Threads	1216	41	3
Stem Valves	488	3	1
Flange	204	0	-
Total	3174	102	

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Issues by Part Type		
Part Type	Issue Type	Qty
Fittings	Under tightened	103
	Small Leak	65
	Support	21
	Over tightened	11
	Medium Leak	8
	Large Leak	5
	Installation	5
	Intermix	5
	Damage	4
	Incorrect Part	4
	Other	3
	Corrosion	2
		Total
Measurement Devices	Small Leak	3
	Installation	1
	Support	1
	Damage	1
		Total
Other Parts	Other	1
		Total
Piping	Small Leak	8
	Medium Leak	7
	Under tightened	2
	Support	1
	Corrosion	1
	Vibration	1
		Total
Regulators	Small Leak	3
	Under tightened	1
		Total

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Tubing	Support	23
	Vibration	10
	Bending	4
	Installation	3
	Under tightened	1
	Intermix	1
	Total	42
<hr/>		
Valves	Small Leak	2
	Under tightened	2
	Medium Leak	1
	Overtightened	1
	Support	1
	Damage	1
	Total	8

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INSPECTION SUMMARY

We have completed 6 day Onsite Inspection of the compressors that were operational at the time of our visit, with additional process areas outside of the buildings. Quite a lot of the connections outside were under winterisation cover, so we could not inspect anything that was insulated.

However from what we surveyed we hope this report can afford H YW gŕca Yf a greater understanding of areas for improvement for safe, efficient and well managed pressure systems. With an emphasis on correct installation procedures of small bore components in conjunction with the training that Swagelok can offer, it will result in improved SBT system health.

Areas that H YW gŕca Yf should focus on for LLLL are the following:

A lot of the connections we came across were under tight, this was by far the largest noted issue. A lot of these under tight connections could be issues in future and develop into leaks.

There were more use of tube supports at this facility and tubing being supported than at LLL . However the tube supports were mainly metal straps clamping tubes together. This can cause issues with corrosion and fretting as the tubes rub together. If the clamps are tightened too much this could cause tubes to deform.

A correctly specified tube support will spread the load over a wider area.

This should also decrease the possibility of catastrophic failure due to vibration.

There were many instances where tubes were supported by other tubes, this is also bad practice and where ever possible a structural point should be available for the tubes to be supported from.

The advice here is to make it mandatory for anyone that is dealing with SBT installations to have completed a training course and passed an exam. This will teach the installers about things like gap gauges and their correct use.

In some cases of threaded connections there was excessive amounts of PTFE tape. Often upon closer inspection this reveals a problem with the female component. The reason for adding lots of PTFE tape to fix a leak only masks the issue and does not get to the route cause.

Some connections appeared to have male BSP parallel connections into female NPT ports. This is something we would advise against, especially in cold temperatures.

The general tube bending appeared to be of a good standard for the most part. Some areas's did let the standard down and were clearly rushed or done by under qualified staff.

On a positive note,

H YW gŕca Yf ŕg to be congratulated for allowing us access to LLL and supporting us in conducting our survey there. Although there is room for improvement on the SBT systems the staff at site were all very helpful and supported us throughout the survey.

Swagelok would be delighted to further consult and engage with H YW gŕca Yf on solutions to remedy the issues found and highlighted within this report.

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