Needham Technical Center

Inerco Operation and Maintenance Training Document STET

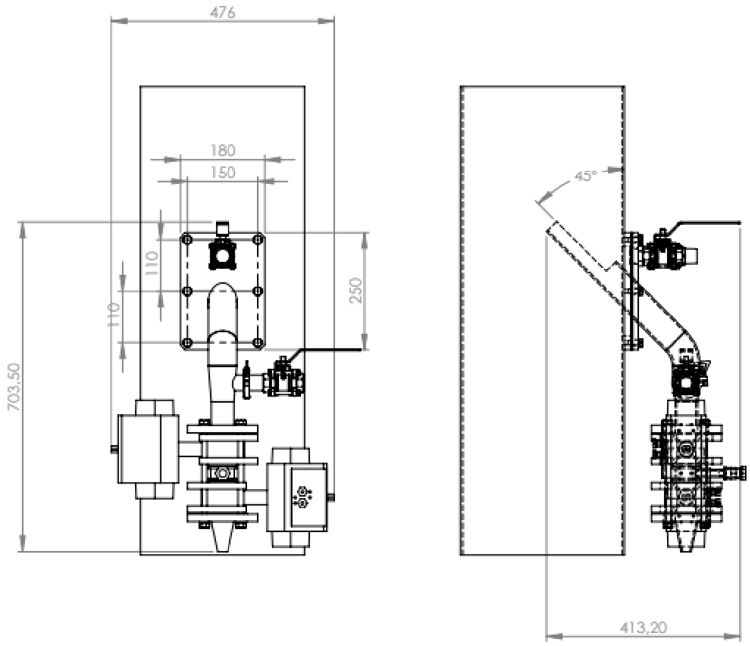
INTRODUCTION

This training document should be used in conjunction with the Inerco supplied Operating and maintenance manual, and serves only as a tool to understand the operation and maintenance of the analyser as installed at an STET separation plant. This training document seeks to deliver the key information from the Inerco manual to operating and maintenance staff, as an aid to daily operation and periodic maintenance / trouble shooting.

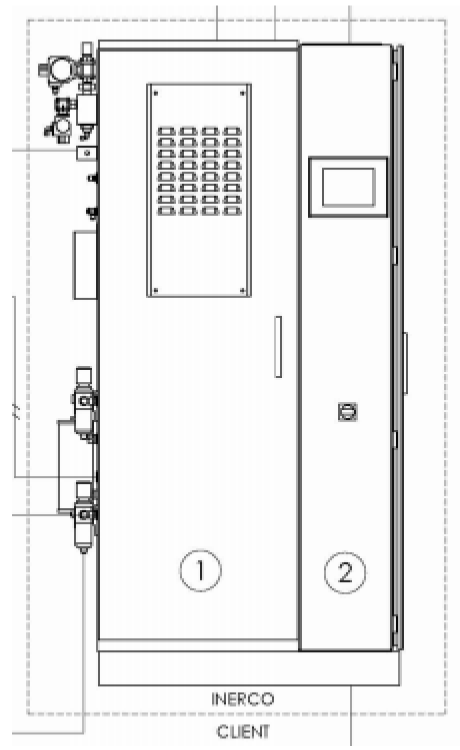
CONTENTS

SYSTEM:

The Inerco ABACO LOI system comprises of 2 key elements, the sampler, and analyser:



Sampler



Analyser

The sampler allows for the collection of an ash sample from the outlet of the separator. The sampler is blown clean, refilled, and the sample collected transferred by pneumatic transport to the analyser.
The analyser weighs a small sample into a crucible, and calcines at 750°C to burn off any carbon contained within the sample. The calcined material is re-weighed, and the loss of mass converted into an LOI figure.
Any unused sample, and the calcined material is then pneumatically transferred back to the sampler where it is returned to the ash flow from the separator, leaving the analyser clean for the next sample.
Sampling to LOI result and cleaning typically takes 7 minutes, whereupon the next sample is taken.

P&ID

The analyser P&ID is shown in the diagram below. Understanding the P&ID is key to gaining an understanding of the operation of the analyser, knowing which valves open at different stages of the sampling and analysing process. To aid this, in the operating section of this document, the P&ID will be shown indicating which of the valves are open and closed at each stage.

The location of each valve / equipment item on the P&ID will also be shown in pictures from a plant installation.

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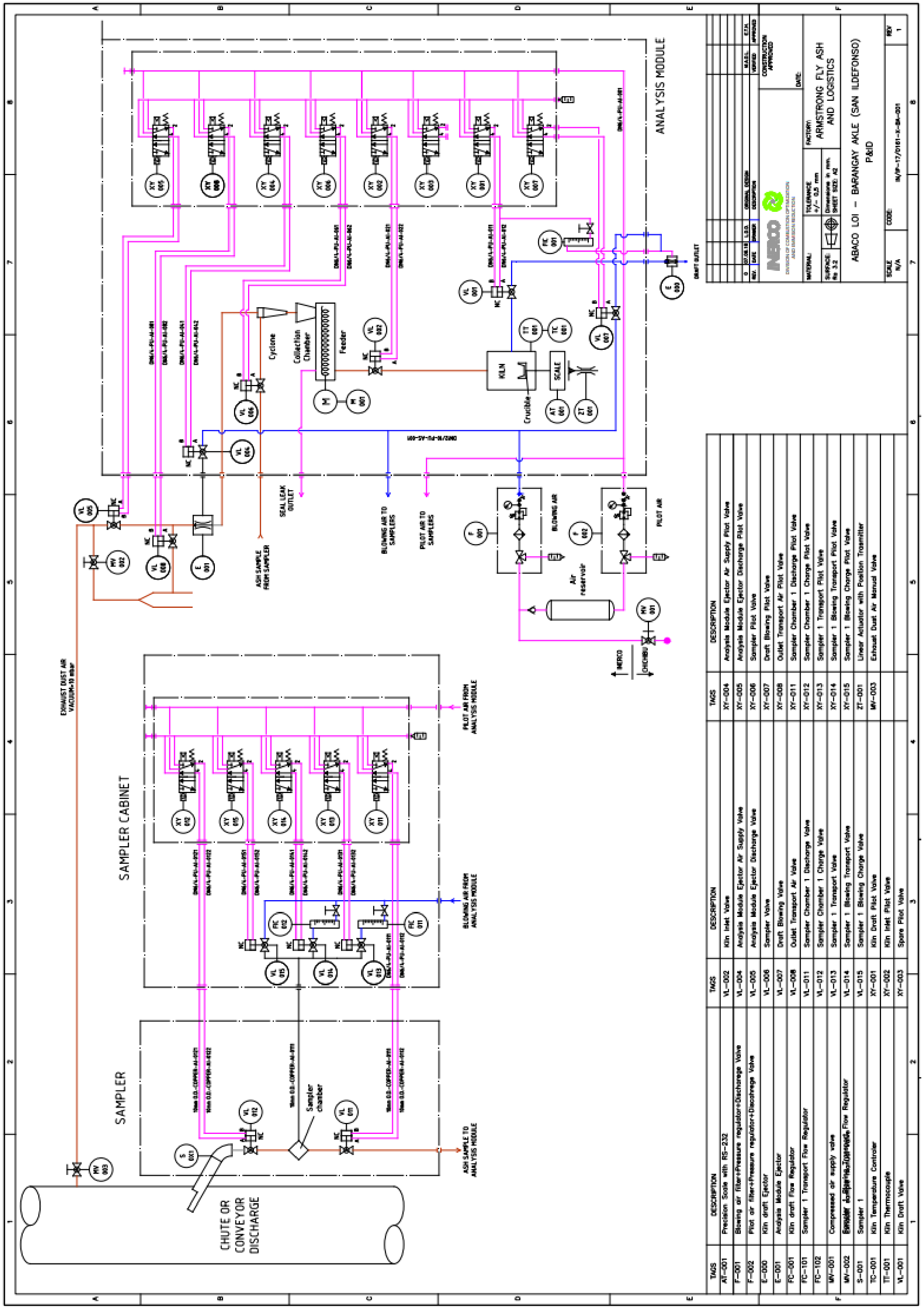
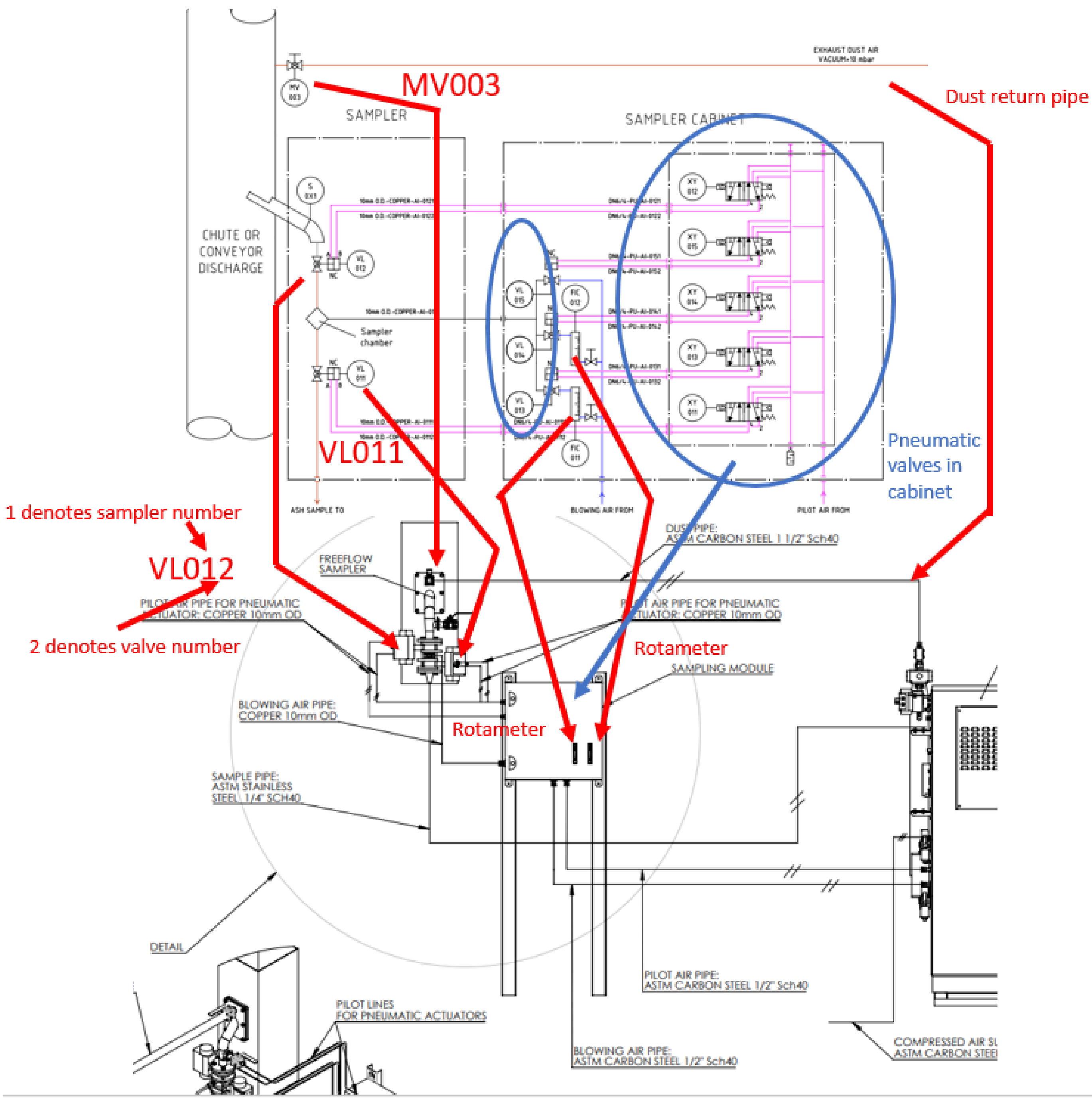
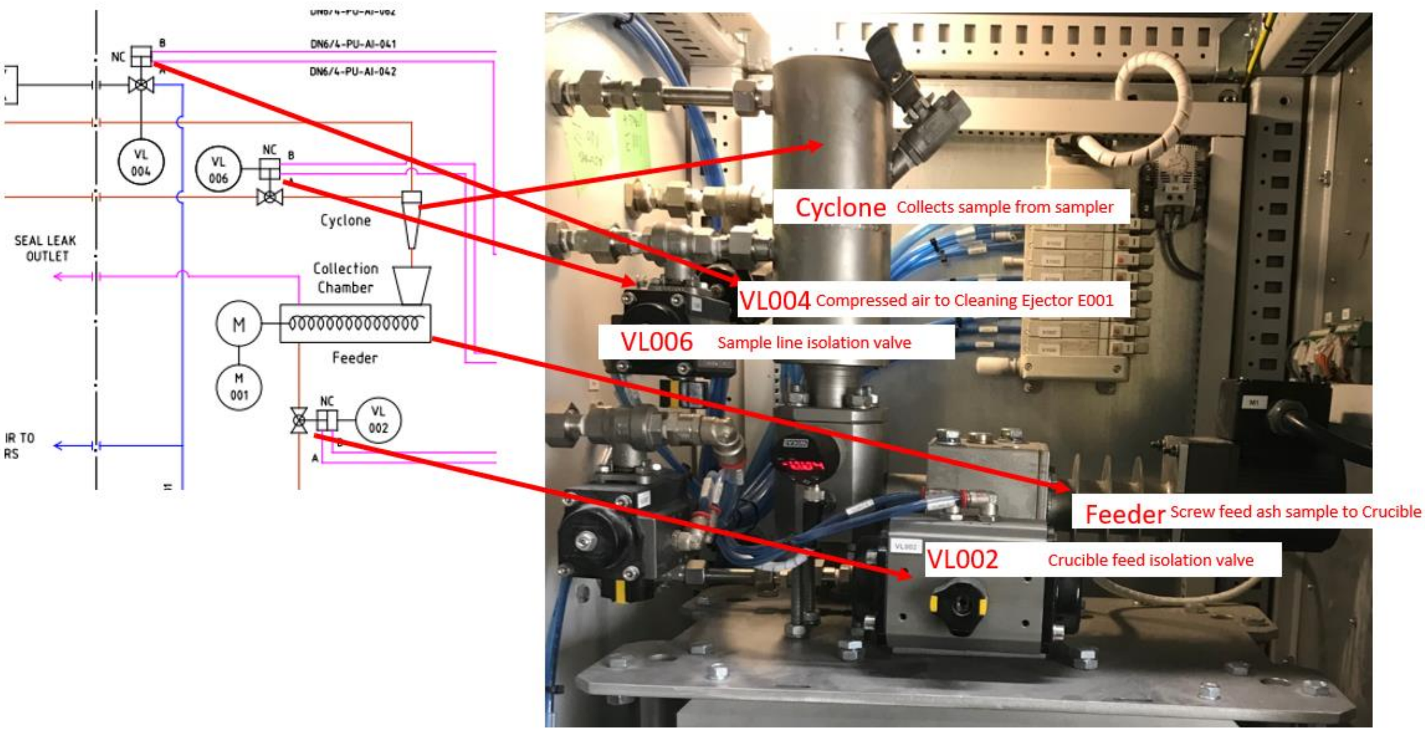


Equipment Locations

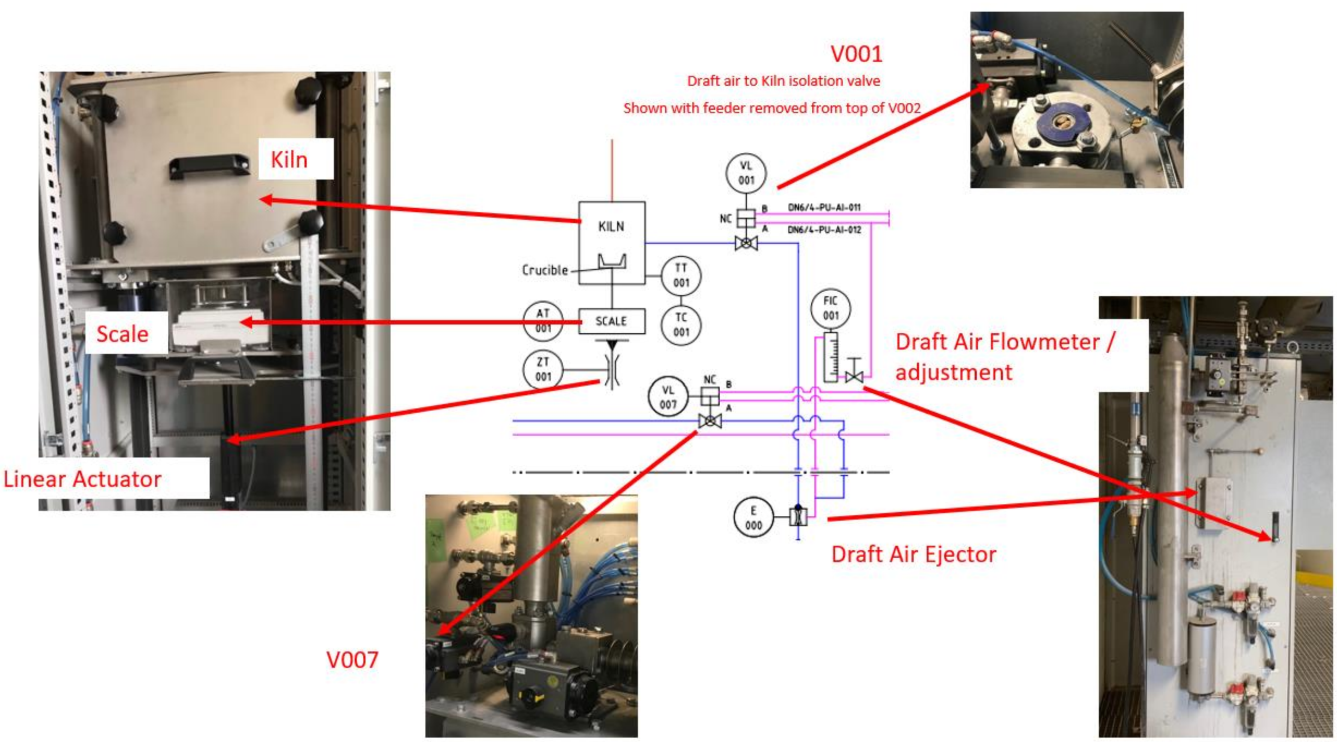
Sampler:



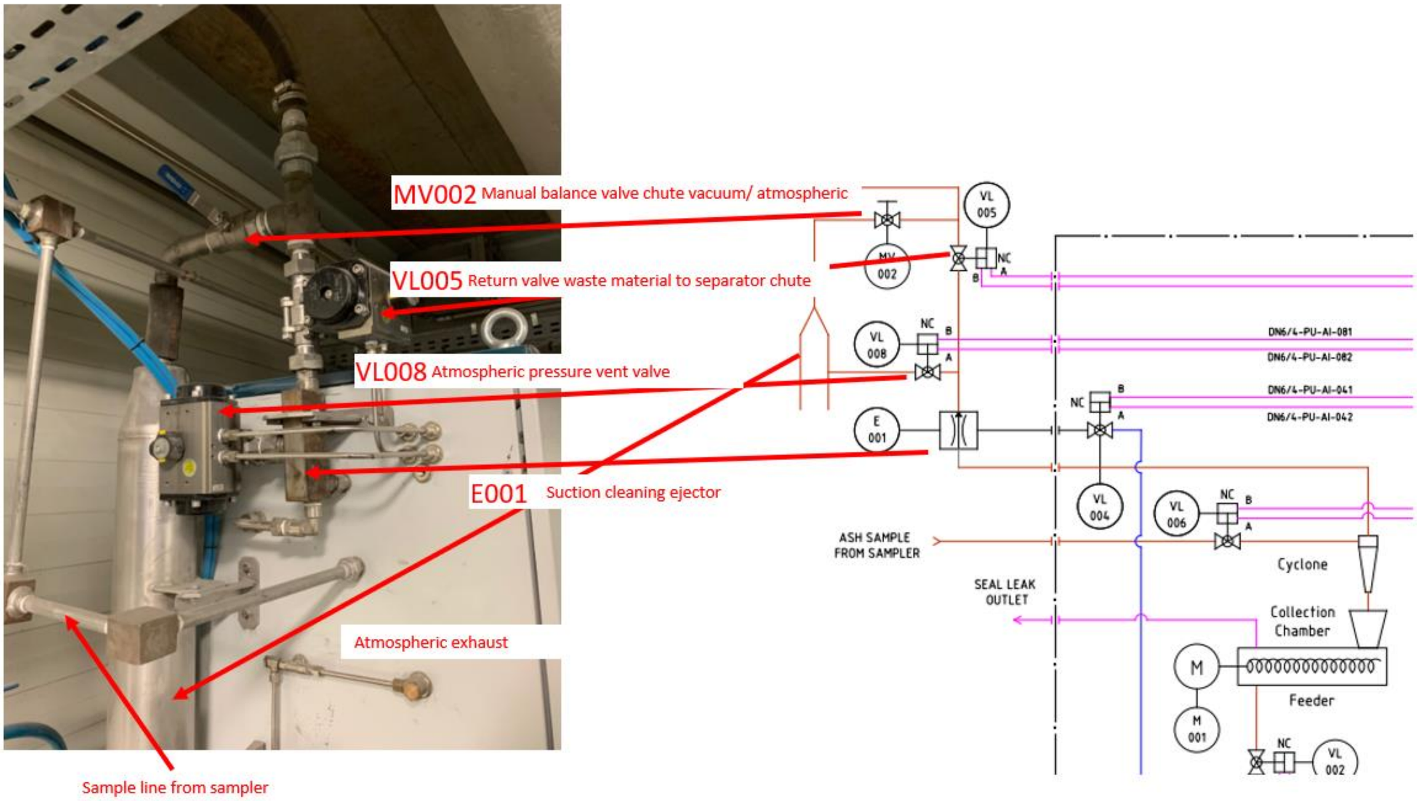
Analyser Feeder Area:



Analyser Kiln and Scale Area:



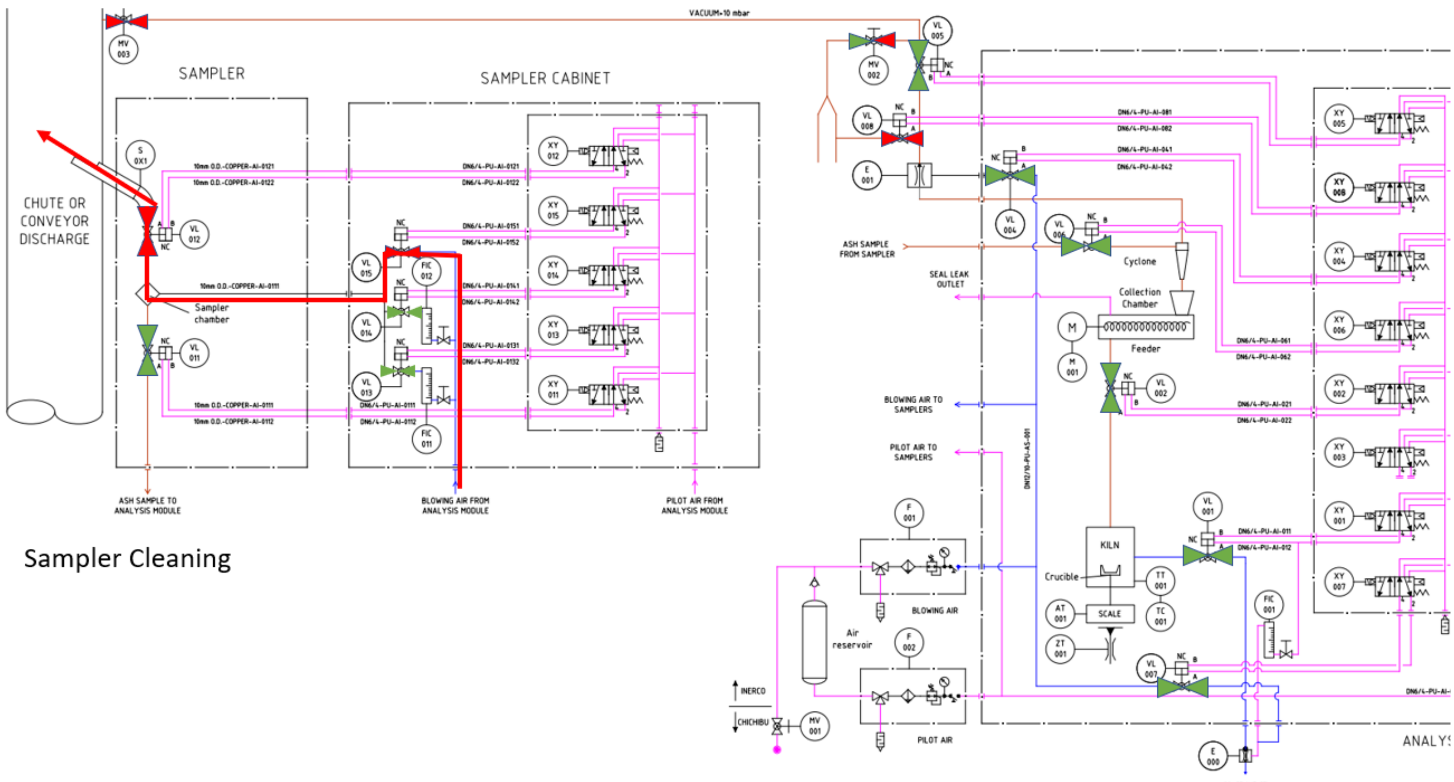
Analyser Venting Area:



Operating Sequence

The following section details the operating sequence from sampler cleaning through to calcination and eventual crucible cleaning. Each part of the sequence is described separately, with a P&ID diagram showing the status of all valves during the operation, green = valve closed, red = valve open.

Sampler Cleaning:



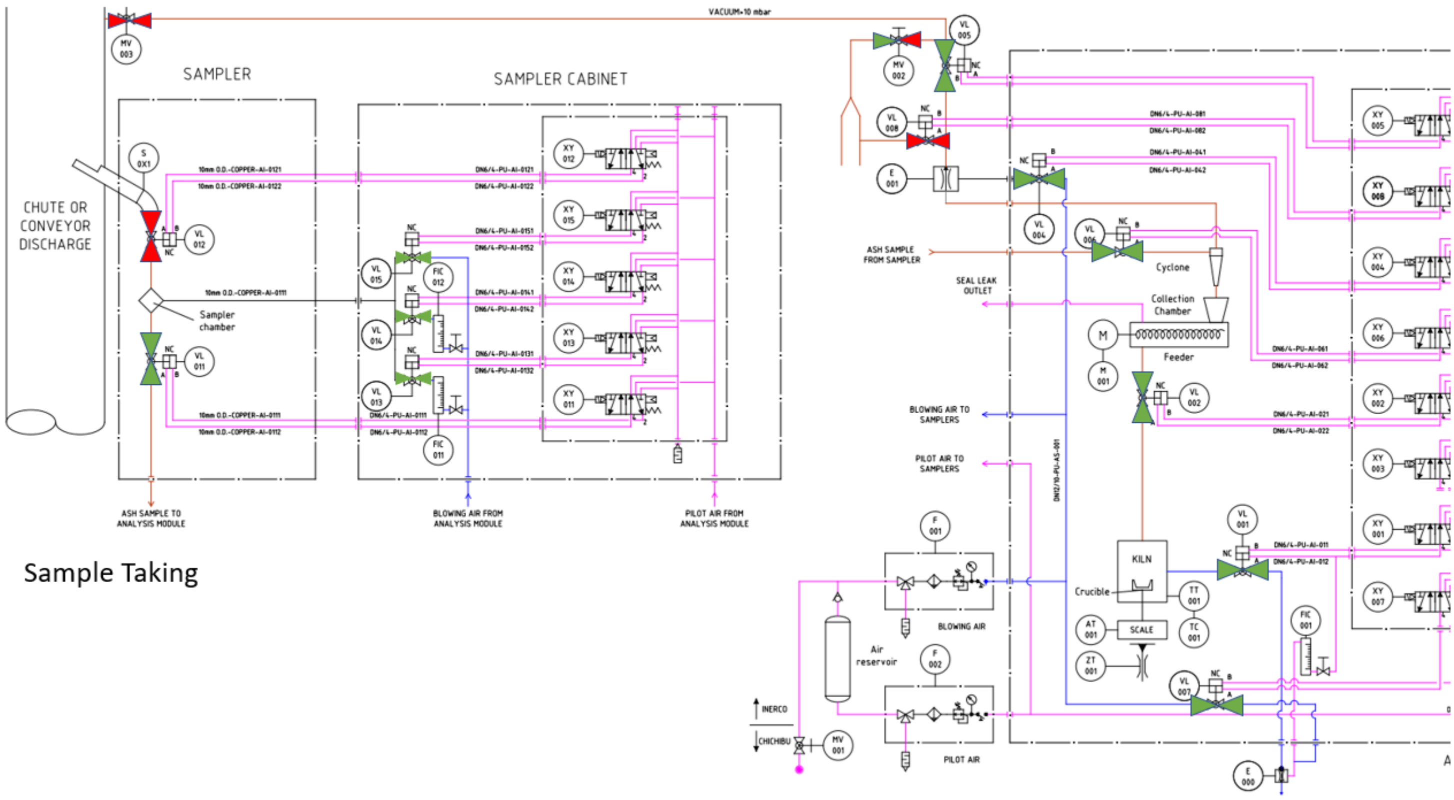
Sampler Cleaning

The purpose of the sampler cleaning step is to clear any residual ash from the sampler chute collection tube. The product from the separator continually falls down the chute, filling the collection tube, so to ensure the sample collected is representative of the material in the chute at the moment of the sequence start, any residual material collected over the period since the last sample was collected is blown back into the chute with compressed air. Valve VL015 opens to allow full flow of air to clear the system. (Note VL013, and VL014 are restricted air flows through a rotameter, and would not give sufficient flow to clean the sampler.)

The mix of high air flow and ash creates wear conditions, which will lead to eventual leakage in valve VL012, requiring replacement.

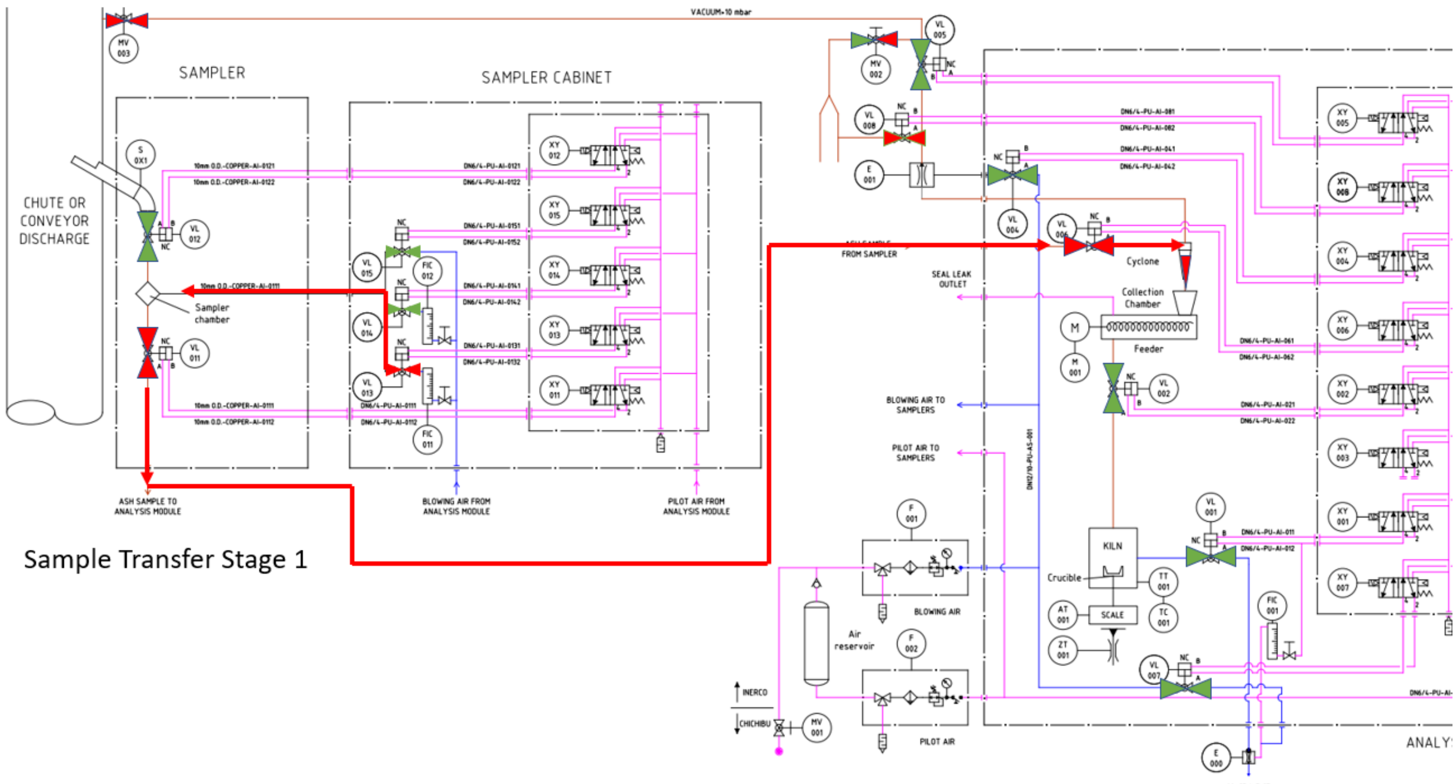
When the air is turned off, ash from the chute fills the sampler collection tube, and sample chamber (space between valves VL011 and VL012), as per the sample taking section below:

Sample taking:



Sample Taking

Sample Transfer Stage 1:



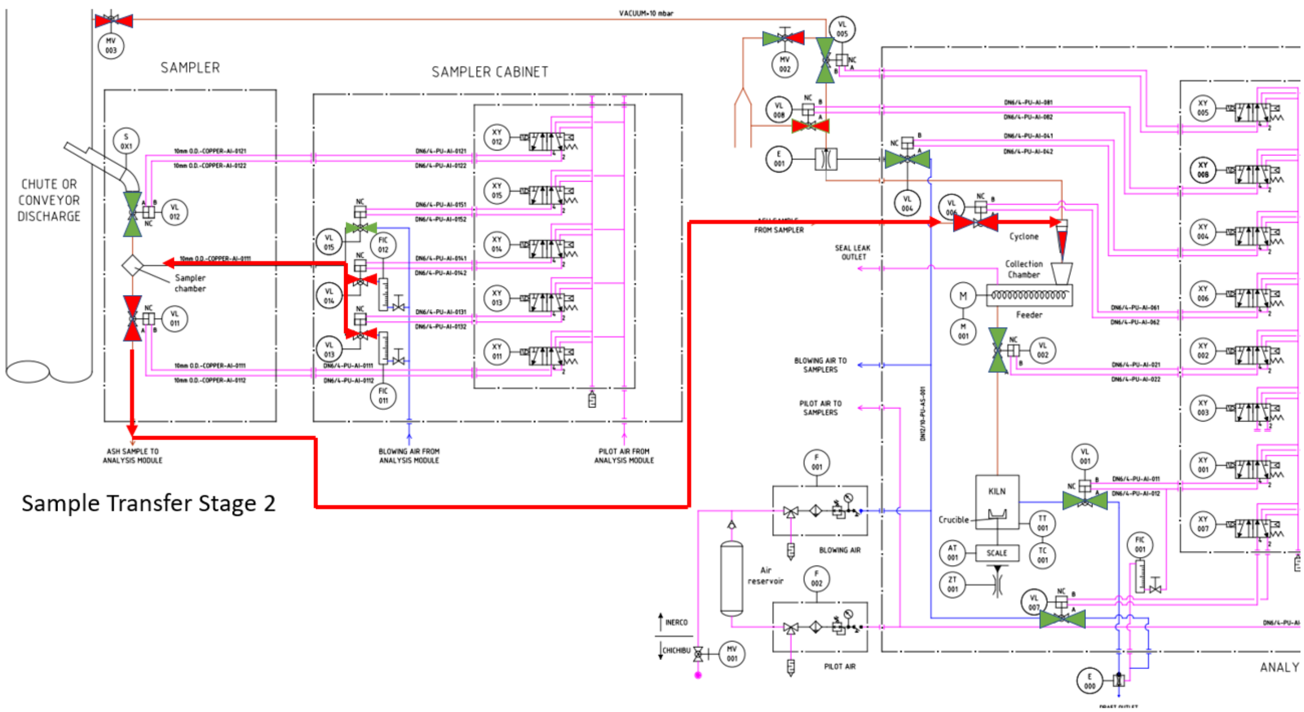
Sample Transfer Stage 1

With the current sample collected in the sample chamber, the next step is to transfer this to the analyser cabinet. The sample is blown to the analyser by pneumatic transfer, and the sample is collected at the analyser in the collection chamber, after separation from the air flow in the cyclone.

The air flow used for transfer is critical to the accuracy of the LOI result eventually returned. If the air flow is too high, then the lighter carbon particles in the sample will be segregated from the mineral particles, and much of the carbon will pass out through the top of the cyclone to the vent, leaving a lower LOI sample in the collection chamber. If the flow is too low, the sample will not transfer through the small diameter sample pipe to the analyser. The air flows are set during the analyser commissioning, following manual additions of sample to the sampler of a known LOI. The calibration of the analyser LOI is performed by adjustment of the air flow through rotameter FIC011, on the door of the sampler cabinet. Air flow is adjusted until analyser results match known LOI of reference sample. If LOI reads higher than reference, flow is increased. If LOI reads lower than reference sample, flow is decreased.

During the transfer, vent valve VL008 is opened to vent transfer air from the cyclone. This vents into the exhaust port, which is open to atmosphere next to the analyser cabinet. To prevent dust escape, the manual valve MV002 is opened a little to allow vacuum pressure from the separator discharge chute (dust collector should be on during analyser operation) to remove any dust. This arrangement allows the use of very little negative pressure at the exhaust, which helps maintain transport air flow rate at the correct level (it may alter transfer flow and/or carbon segregation if vented to fluctuating negative pressures in separator discharge chute).

Sample Transfer Stage 2:

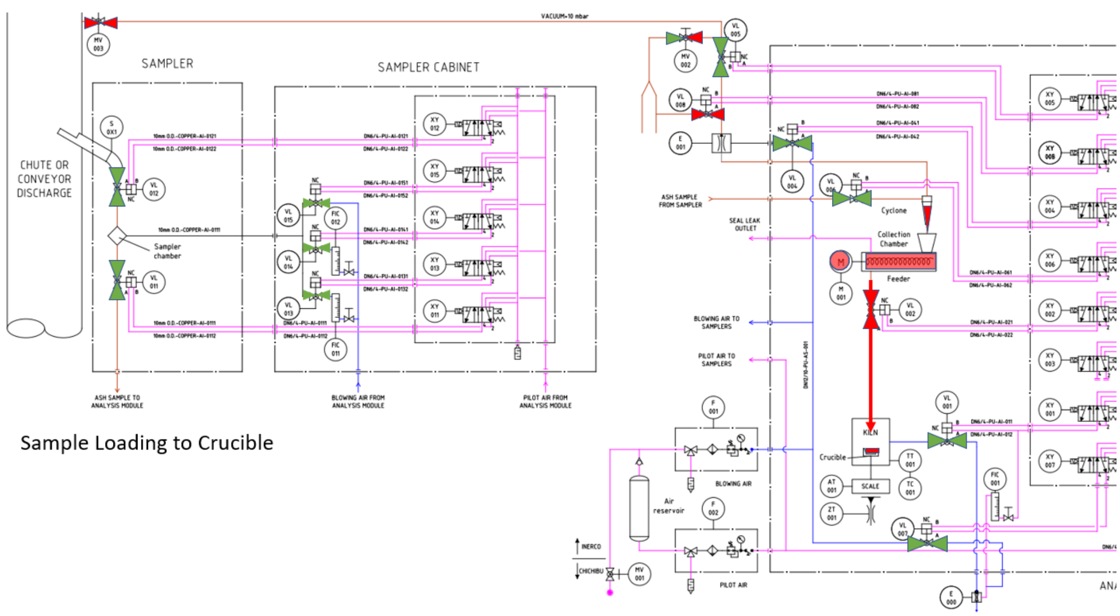


Sample Transfer Stage 2

After a pre-set time, the sample transfer moves to step 2, which increases air flow through the sample pipe to clean the line. During this step, both FIC001 and FIC002 will show an air flow. Flow for FIC002 will be set during commissioning, and is typically a little higher than that on FIC001.

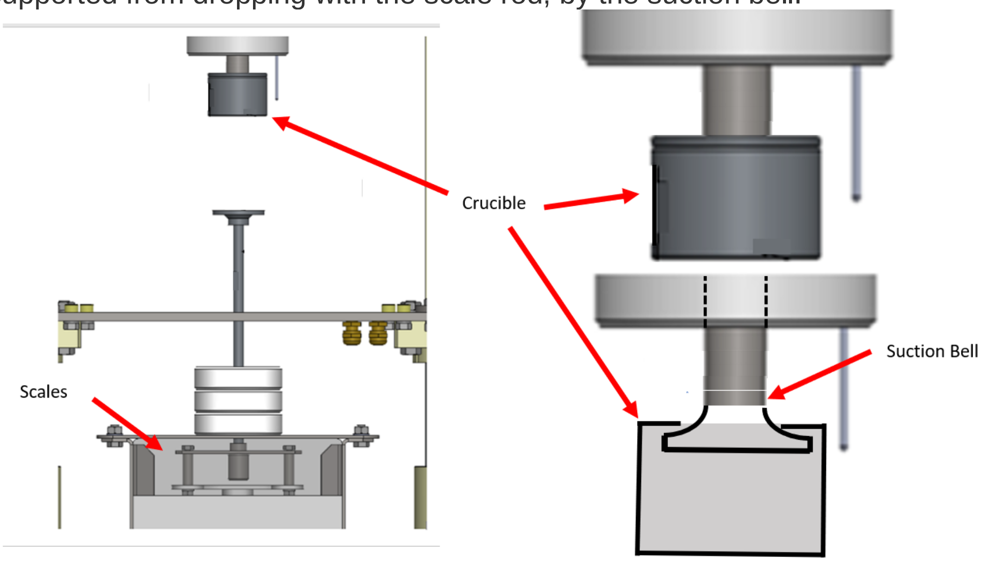
Flow indication during stage 2 transfer.

Sample Loading to Crucible



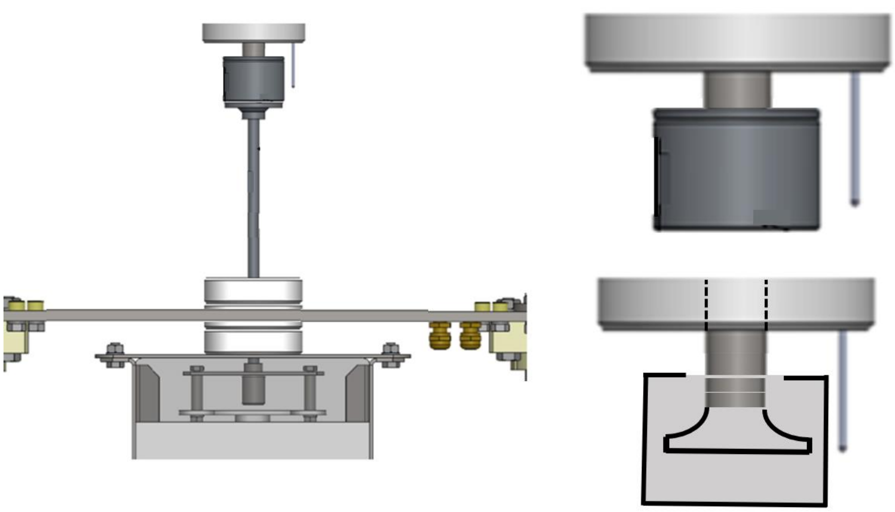
Sample Loading to Crucible

With the sample now in the collection chamber in the analyser cabinet, the sequence moves to loading a weighed sample to the crucible in the kiln.
In the rest position, the scale is lowered so it is not taking the weight of the crucible, which is free-moving, but supported from dropping with the scale rod, by the suction bell.



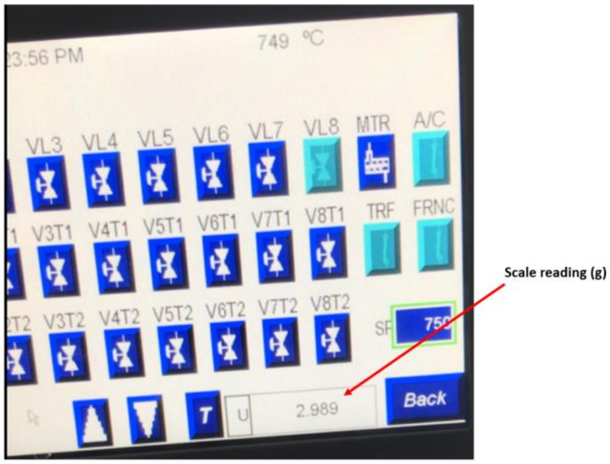
During this stage, the scale reading on the HMI panel of the analyser will typically read -500g, since the crucible weighs approximately 500g.

Before loading the sample to the crucible, the scale position moves up, to take the weight of the crucible:



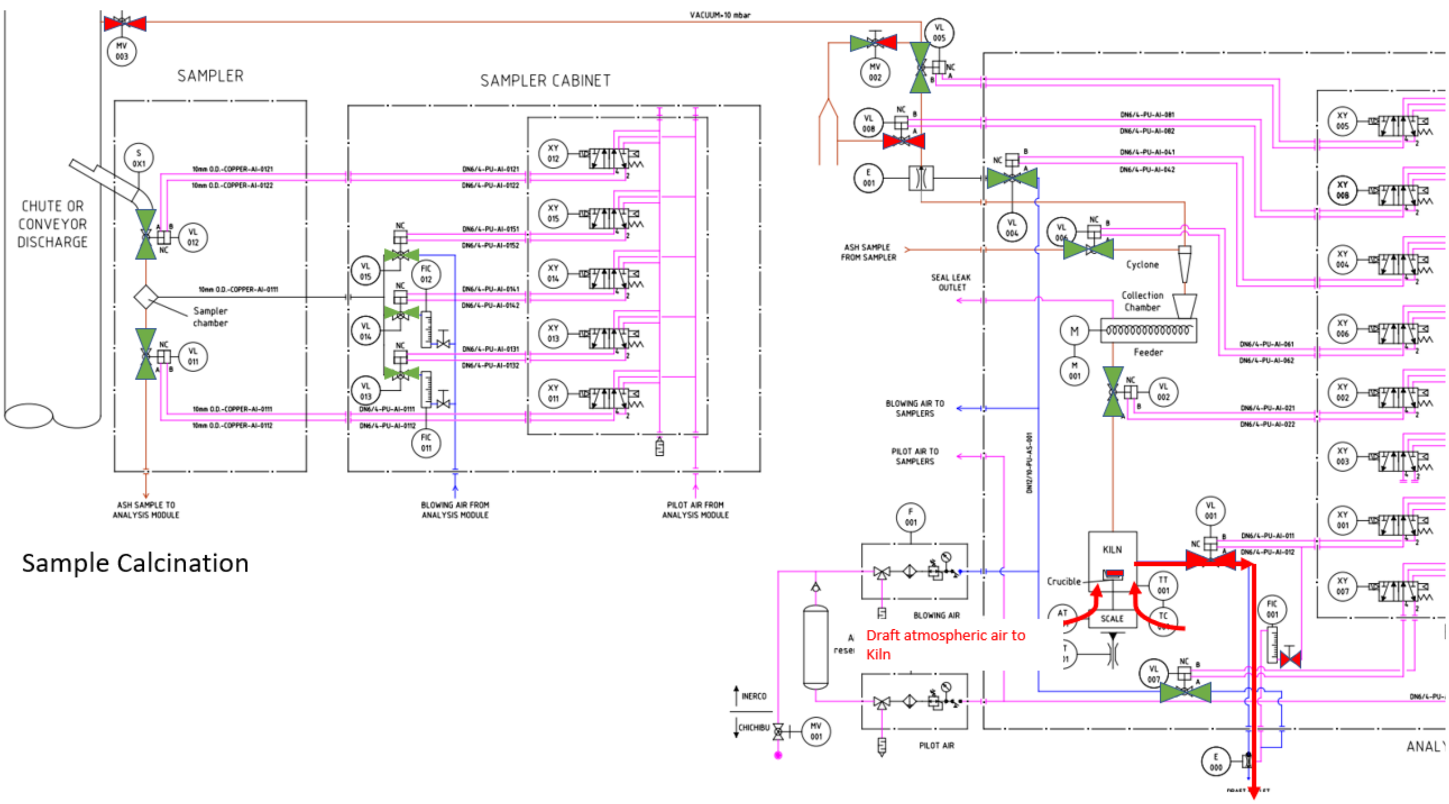
Now the crucible weight is being measured by the scale, so the reading on the HMI is approximately 0,00g. The scale weight is tared by the computer to ensure a 0.00g reading prior to loading the sample.

Valve VL002 opens, and the feeder motor starts. The feeder is a small screw feeder, which transfers ash from the sample chamber, and drops it through VL002, through the suction bell, and into the crucible. The PLC monitors the sample weight, which can be seen increasing on the HMI screen during feeding, and stops the feeder and closes VL002 to leave a sample of approximately 3.000g in the crucible. The PLC logs this weight as the starting weight for the sample.



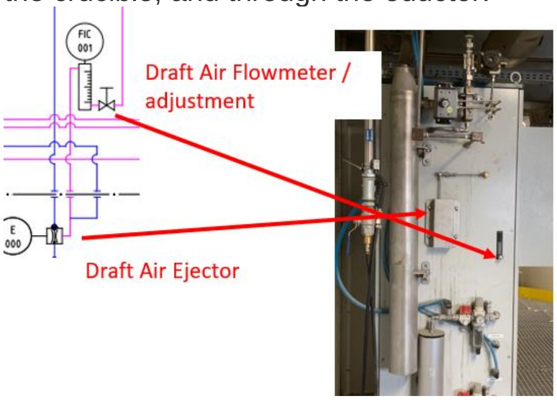
Should the scale / PLC fail to see 3g, an “insufficient sample” warning is displayed. This could indicate insufficient ash at the separator chute, or a transfer problem, with insufficient air, or pipe blockage.

Calcination



Sample Calcination

With the sample loaded to the crucible, and initial weight logged, the sequence moves to the calcination step, to burn off any carbon in the sample. The kiln is maintained at 750°C, and to speed up combustion, a small flow of air (draft air) is introduced around the crucible. Draft air is produced by passing a controlled flow of compressed air from FIC001 through eductor E000. Valve VL01 opens to allow air to be dragged from under the kiln, passed the crucible, and through the eductor.



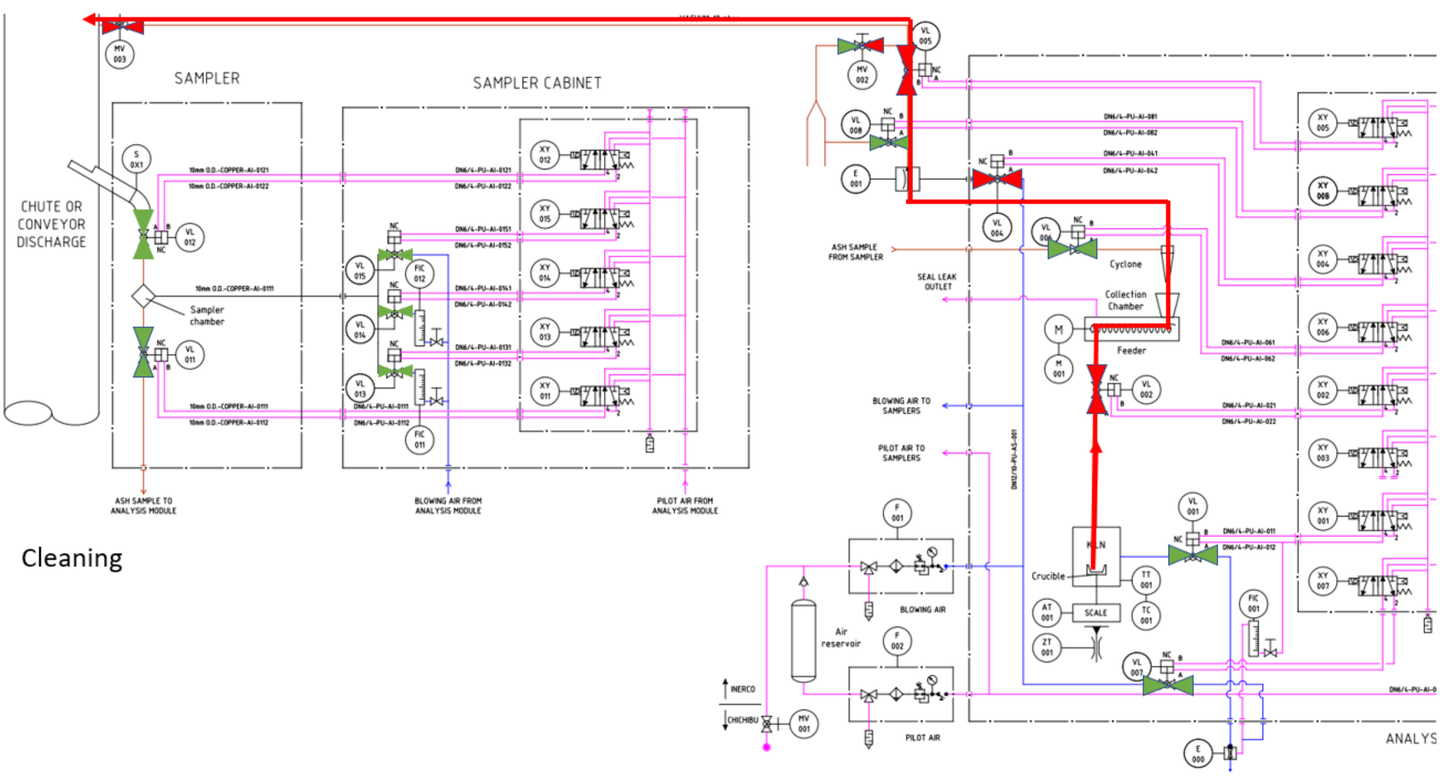
The flow of air to the eductor is set via the "draft Air Setting" procedure, see later in this document. Too high a flow, and ash particles could be blown out from the crucible, rendering the LOI result too high. Too little flow of draft air will slow the calcination, delaying the LOI result.

With draft air on, the resulting flow around the crucible "lifts" the crucible slightly, which is seen as a drop in weight on the scales. If the sample is 3.000g, the weight during calcination with draft air will drop to around 2.000g. Should the weight drop too much above this, the HMI will give a "draft out of range" warning alarm. Decreasing air flow through FIC001 will increase the weight displayed during calcination.

After 4 minutes, the draft air is turned off, and the sample weight returns to its actual value, so will increase back to 3.000g, minus any weight lost due to carbon combustion. (Accurate mass cannot be obtained with draft air on.) The PLC logs the mass after initial combustion.
Draft air is turned on again for 1 minute, before the draft air is turned off again, and sample weight recorded once more. The PLC compares the current mass with that of the previous reading. The calcination continues in these 1 minute steps until the last 2 mass readings are close enough to suggest no further combustion is taking place. Typical runs should see a 4 minute cycle, followed by 2 or 3 one minute cycles before a result is returned.
The PLC then calculates the LOI result, and displays on the HMI, and sends the reading to the separator PLC.

Cleaning

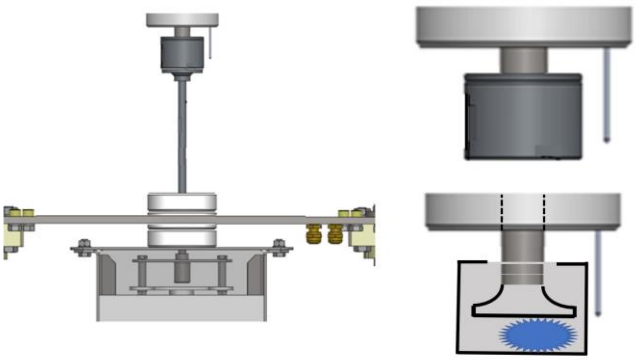
With the LOI result returned, the sequence moves to the cleaning step. Cleaning removes all the remaining previous sample from the collection chamber, feeder and cyclone, as well as any calcined material in the crucible.



Cleaning

The equipment is cleaned by vacuum, produced by air flow through valve VL004 though eductor E001. Initially, valve VL002 remains closed while the collection chamber, feeder and cyclone are cleaned, before valve VL002 opens to clean the crucible. Ash is returned via valve VL005 to the separator chute.
During the crucible cleaning step, the scale reduces in weight as the vacuum through the suction bell “lifts” the crucible. The initial position of the scale is adjusted during the suction pressure setting procedure (see later in this document). The suction should be set so a scale reading of -275 g is achieved during cleaning. Note air flow is not changed, or vacuum pressure, but instead the distance between the suction bell and base of the crucible. The higher the scale is located, the more suction on the crucible, and hence lower the weight displayed. (Note weight is negative at this point.) Should the scale read -500 g during suction / cleaning, this indicates the crucible was too close to the suction bell, and hence is now lifted off the scale rod, and stuck by vacuum to the suction bell. (Imagine a ping-pong ball stuck to a vacuum cleaner hose).

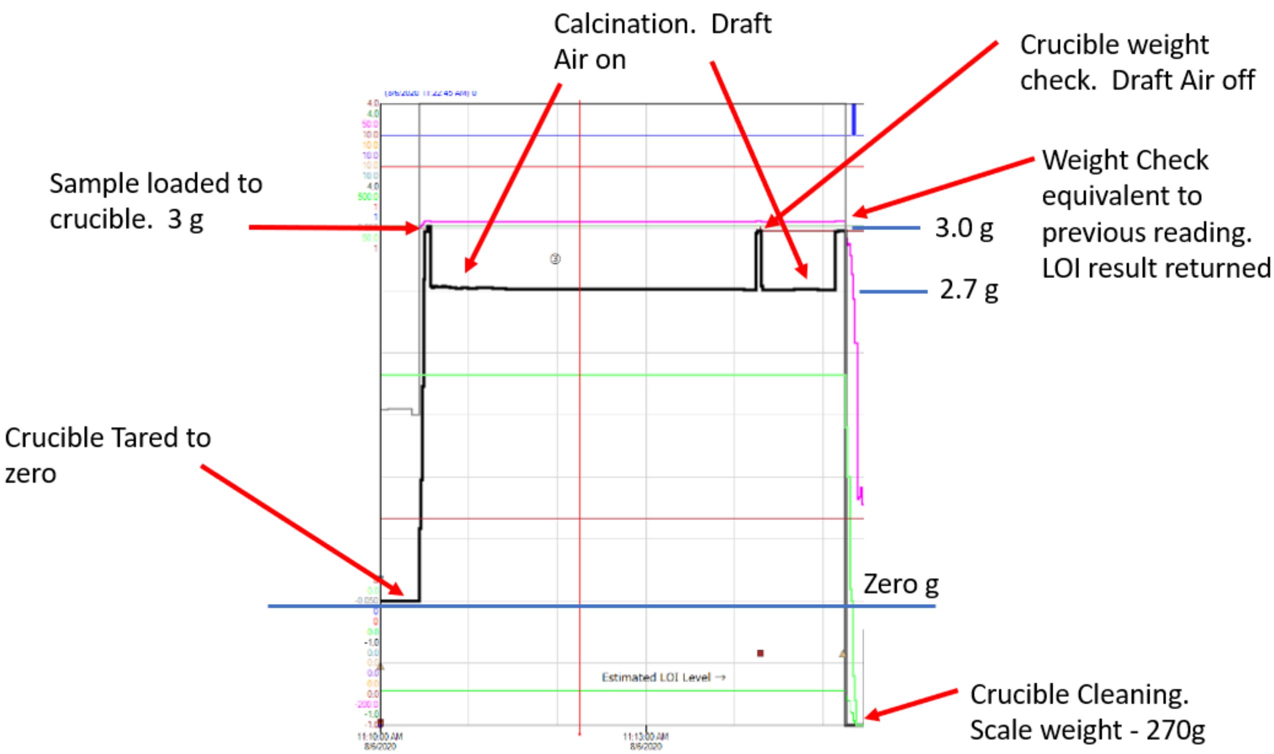
Cleaning the crucible is important to ensure no build-up of material exists in the crucible.



If there are build-ups, as per the picture above, then when the scale moves up, this material can get trapped between the crucible bottom and suction bell, which will cause the scale to read high, or over-range.

With cleaning completed, the sequence can return to cleaning the sampler, and a new sample obtained.

The typical trend of analyser scale weight for 1 cycle is shown below:



The black trendline shows analyser scale weight. Following the crucible clean, the scale is tared to zero, and a 3 g sample is loaded. The trend shows the scale weight drop to 2.7g during calcination, as the draft air rising around the crucible reduces the weight. After 4 minutes, the draft air is turned off, and sample weight re-checked. Another calcination stage of 1 minute occurs, before the weight is re-checked. In this case, the sample weight was the same after the first 1 minute calcination, as after the 4 minute calcination, so all carbon has been combusted, and the LOI result returned. If weight was still reducing after each 1 minute step, the number of 1 minute steps would increase until and end-point was reached.

Note the tolerance is tight on comparing sample weights, and the laboratory scales in the analyser cabinet are extremely sensitive, so any small drift in scale readings due to temperature fluctuations in the cabinet could prevent an endpoint being reached, or increase the number of calcination steps considerably. For this reason, the cabinet is air conditioned for interior temperature stability, and the analyser should be operated with the cabinet door closed.

Infrequent operations:

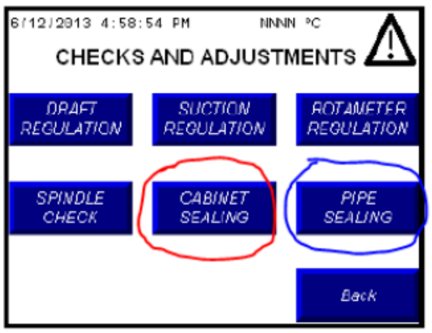
Pressure Test:

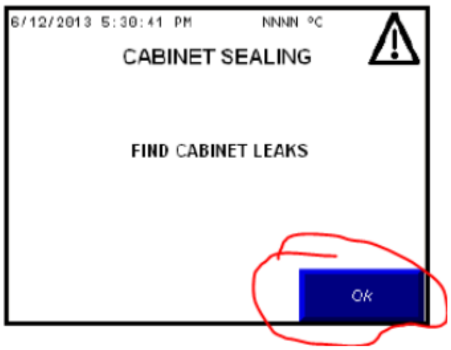
When the analyser is started after powering off, the control system will perform a series of self-checks, including a pressure test of both the sampler cabinet and transfer line. Air leaks are to be avoided to maintain analyser accuracy. Air leaks can be external (leaking from inside pipework to the atmosphere) or internal (valves passing pressure from one side to the other with no leak to atmosphere). External leaks are common after maintenance

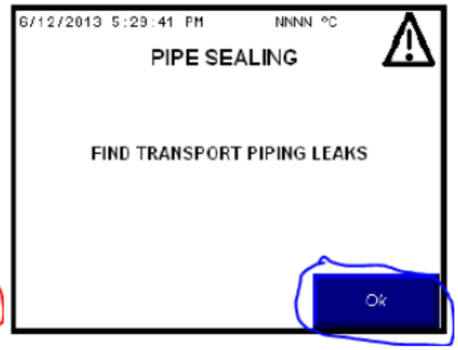
work where pipework has been removed / refitted. Internal leaks will occur when ball valve balls start to erode through ash/air attrition, after hours of operation.
A failed pressure test will alarm on the HMI screen of the analyser, and prevent operation until such time the leak has been found and sealed.

External Leaks

To detect external leaks, the pipework needs to be pressurised. This can be performed by the control system via the checks and adjustments screen. Choose to pressurise either the analyser cabinet or transfer pipework:

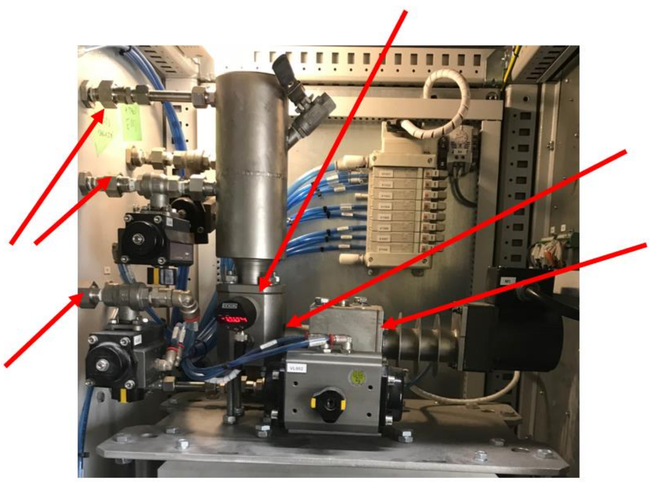


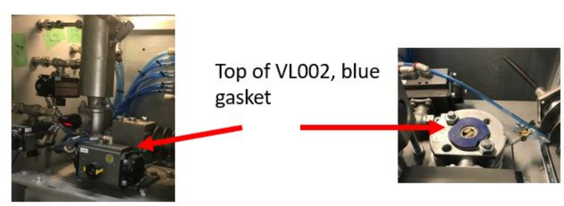




With the pipework pressurised, use a spray bottle of water with a small amount of detergent, and spray around all unions and joints. Look for bubbling areas to detect leaks, and tighten where required. Re-perform pressure test to confirm system will now pass the test.

Typical leak pints are shown below:

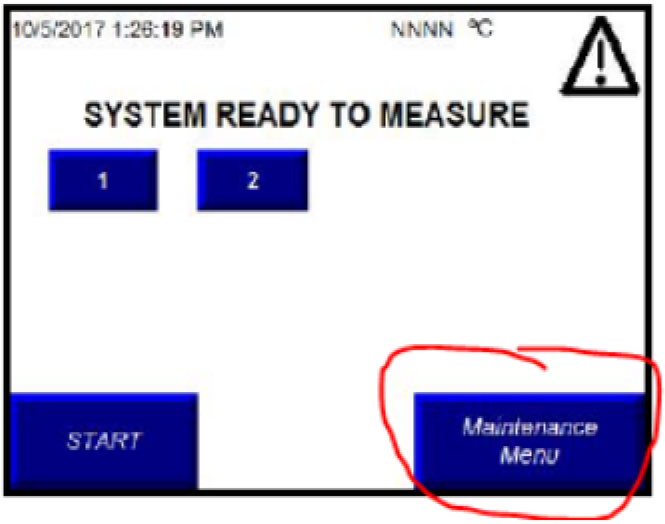


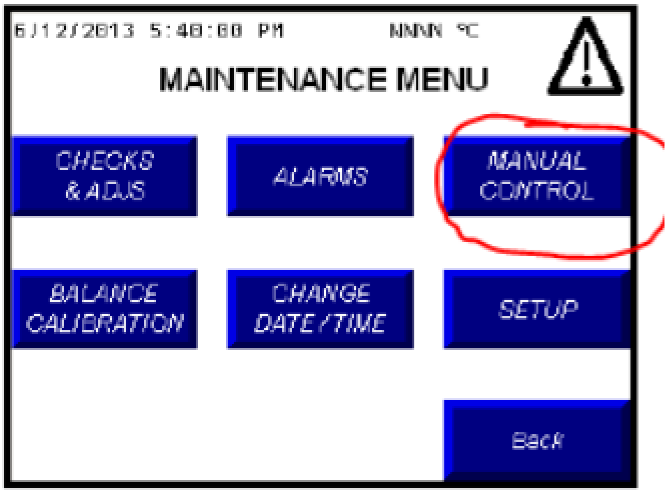


Internal Leaks

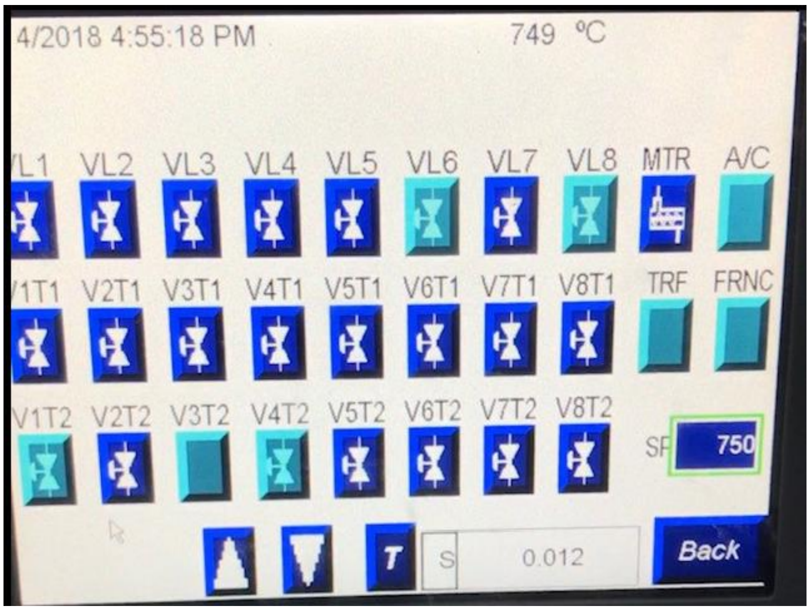
Over time, wear occurs on the balls in the ball valves, which leads to the valve unable to seal correctly. In this case, pressurised air will leak from one side of the valve to the other, making detection with the soapy water method impossible. To detect leaks, the following procedure should be performed, in numerical order, as confirmation that some valves are not leaking is required before testing others.

The procedure is performed manually from the HMI screen. To operate valves and equipment manually, go to the maintenance menu, and select manual control:





This brings up the page below, depicting all valves. Closed valves (or electrical equipment that is off) are shown in dark blue. Pressing the valve on the touch screen will open the valve (or turn on electrical item) and the colour will change to light blue.



The collection chamber under the cyclone in the analyser cabinet has a pressure gauge, which will be used to check for pressure leaks. Some small drop in pressure is acceptable, and the analyser will pass its pressure test with some drop in pressure. If a valve is passing however the pressure will drop rapidly to zero when the compressed air is turned off. The location of the pressure gauge is shown below:

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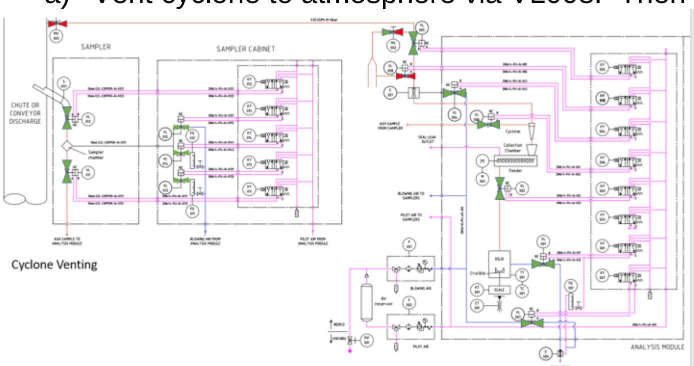
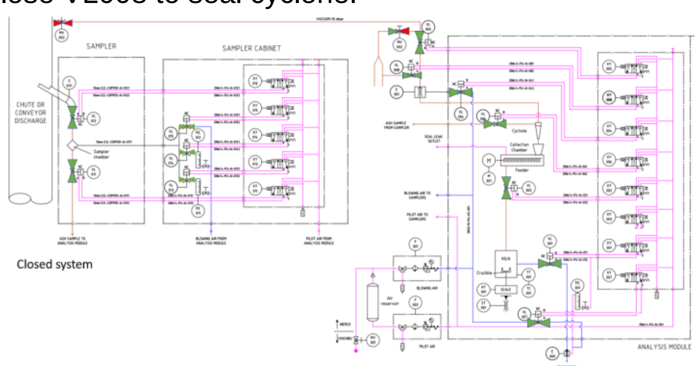
Valve Leak Check Procedure:

1) Test of VL004.

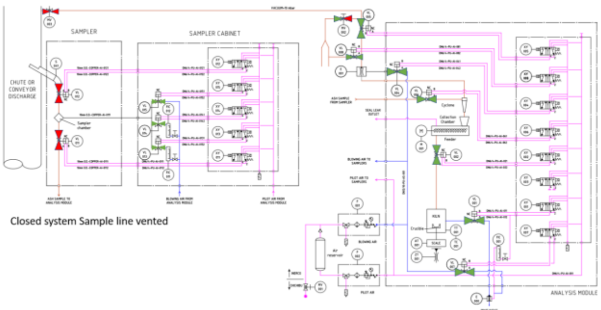
a) Vent cyclone to atmosphere via VL008. Then close VL008 to seal cyclone.



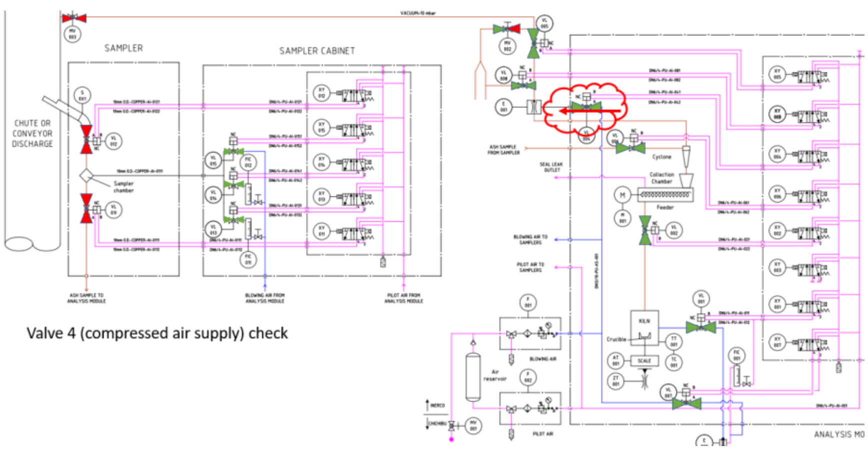


With system closed after venting, pressure on gauge should be zero, and holding.

b) Open VL011 and VL012 on the product sampler. This will ensure transfer line is not pressurised upstream of VL006.



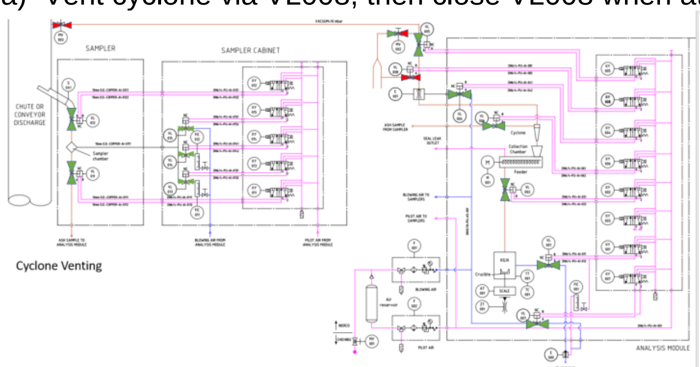
c) Watch pressure gauge. If the pressure builds up, then valve VL004 is leaking air. If no pressure builds up, VL004 is OK, so proceed to next test:

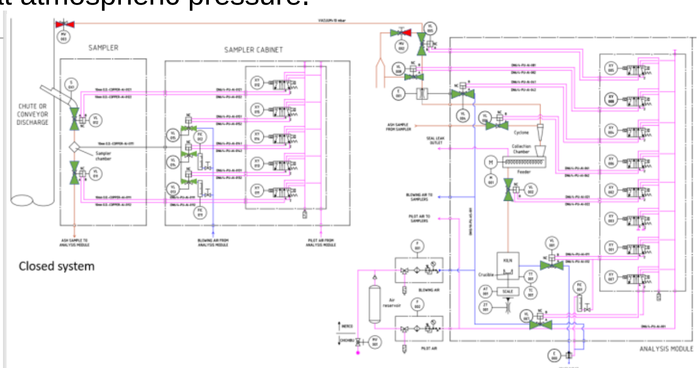


Valve VL004 is the compressed air supply, so if this is leaking into the closed system, pressure will rise. Replace VL004 if necessary, and continue leak test procedure.

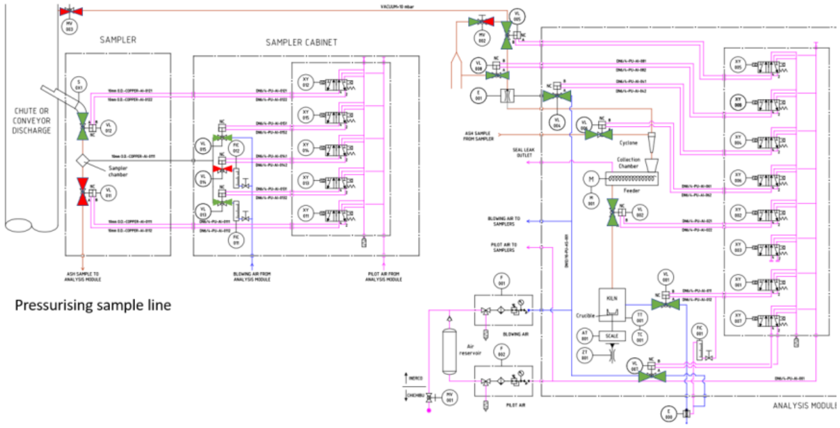
2) Test of VL006:

a) Vent cyclone via VL008, then close VL008 when at atmospheric pressure.

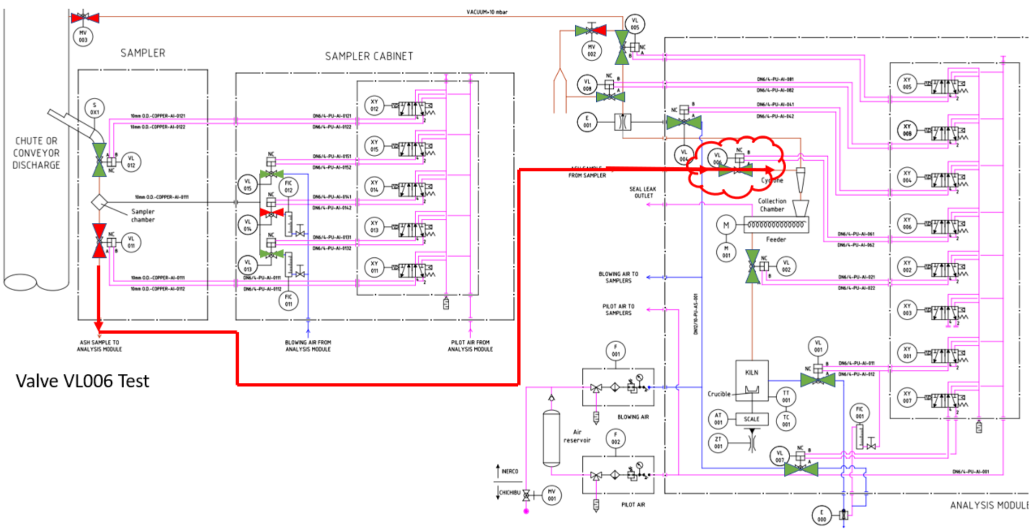




b) Open VL011 and VL014 at product sampler.



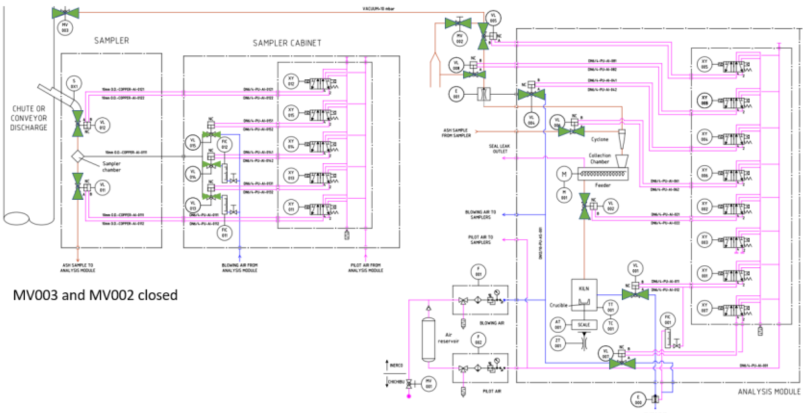
c) If cyclone pressurises, the VL006 leaks. Replace if required.



d) If no pressure increase, then VL006 is OK, so proceed to next test:

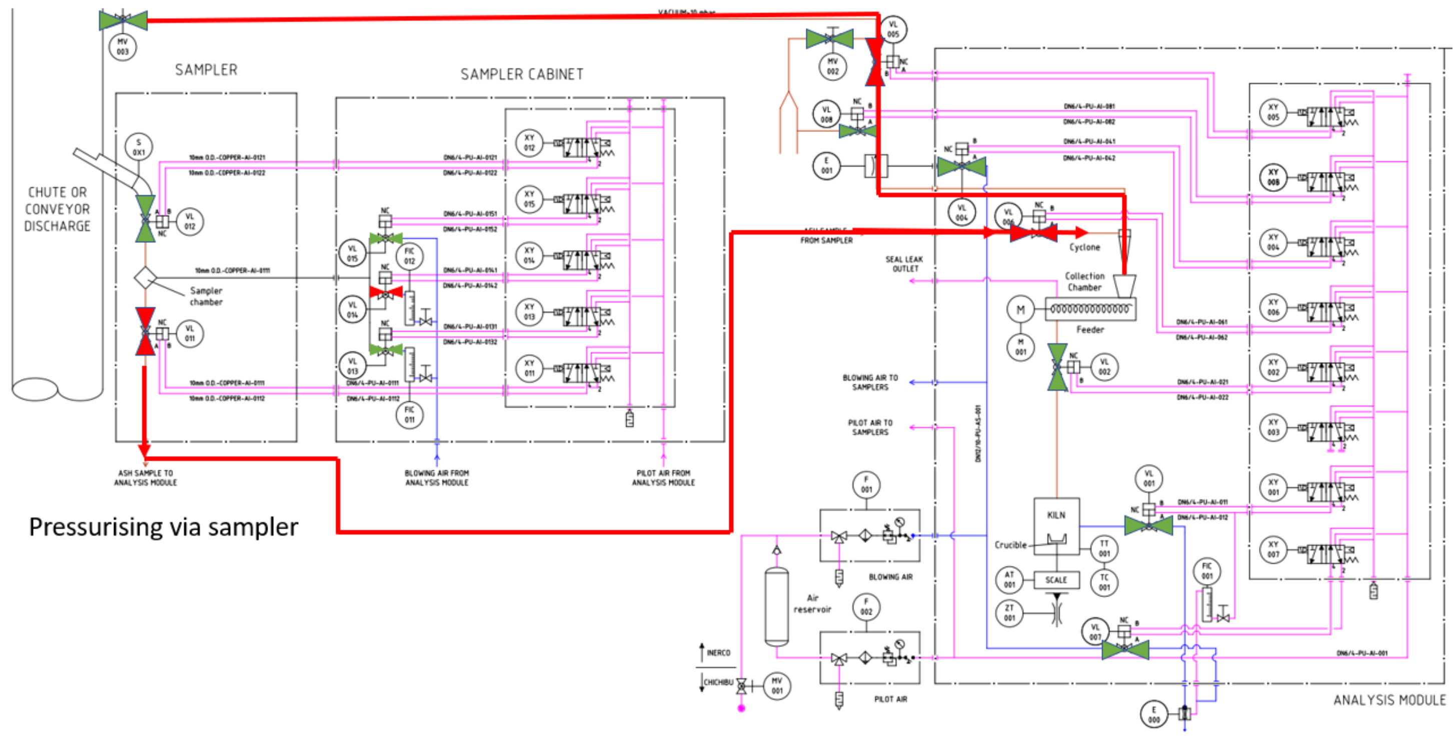
3)Test of VL005

a) Close MV003 at feed chute.
b) Close MV002 above exhaust in analyser room. Note its position, as it will need to be opened to same degree after test.



MV003 and MV002 closed

c) Open VL005 and pressurise cyclone and transfer line back to feed chute with air via VL014, VL011 and with VL006 open. Now line from analyser back to feed chute (waste return) is also pressurised.

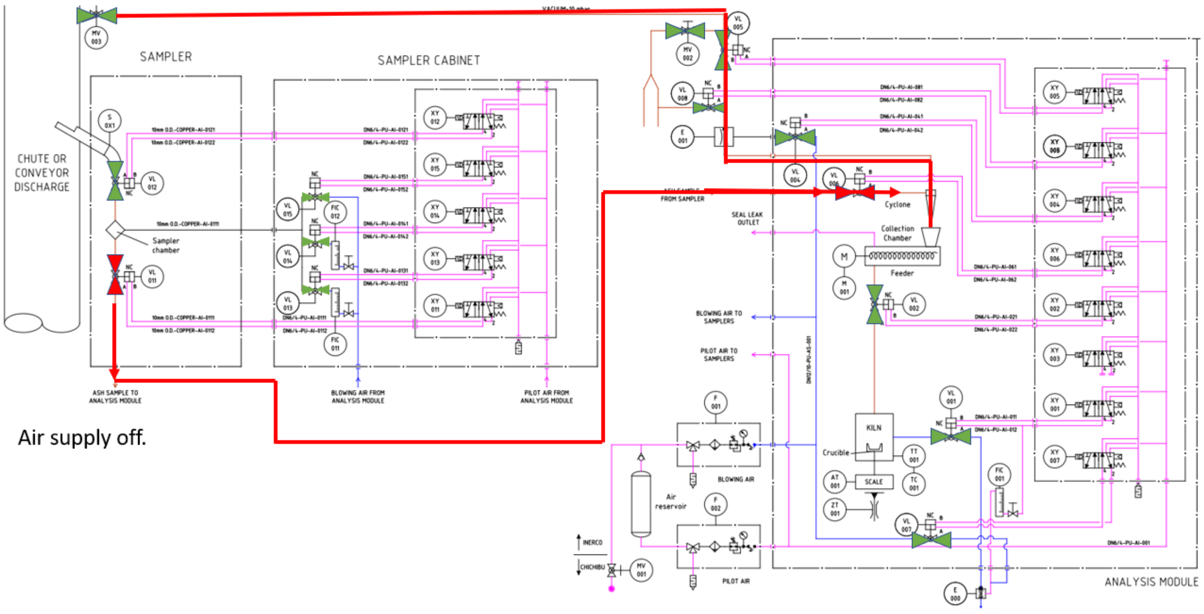


Pressurising via sampler

d) Observe some pressure in cyclone on local gauge.

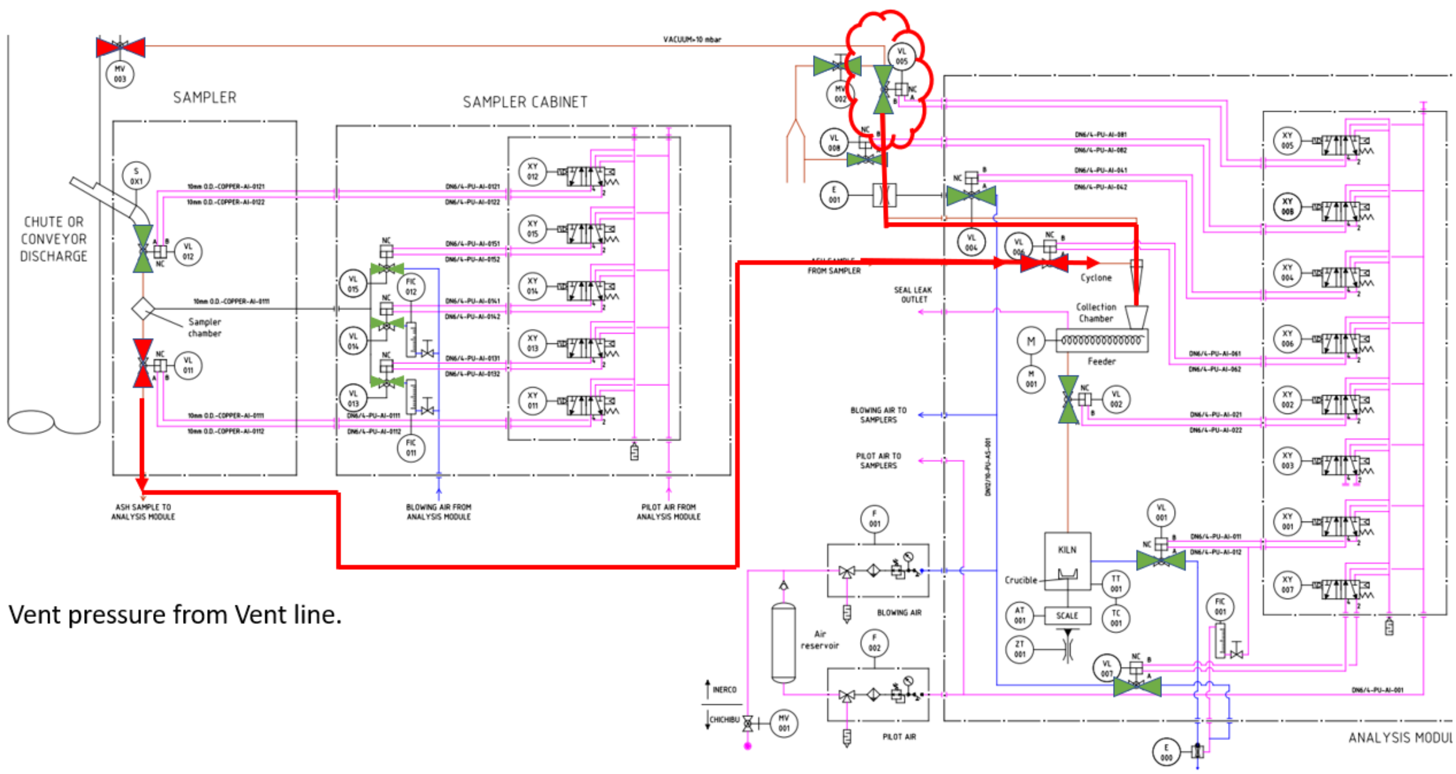
e) While cyclone is pressurised, also check seal on screw/motor. On drawing is SEAL LEAK OUTLET, coming from screw feeder. This is a pipe. Locate the pipe, and see if dust / air is escaping, which could suggest screw seal has failed.

f) Close VL005 and turn off air pressure supply from VL14. If screw seal is not leaking, but pressure drops in cyclone, then VL005 is not leaking. (Line behind VL005 is presurised, so no leak possible through valve.)



Air supply off.

g) If pressure is stable, vent pipe above VL005, by opening MV003. If pressure in cyclone drops now, then VL005 is leaking. (you should hear pressure vent from pipe when opening MV003, to confirm this line was under pressure). Air can now pass through any leaks on VL005 as pressure downstream is less.



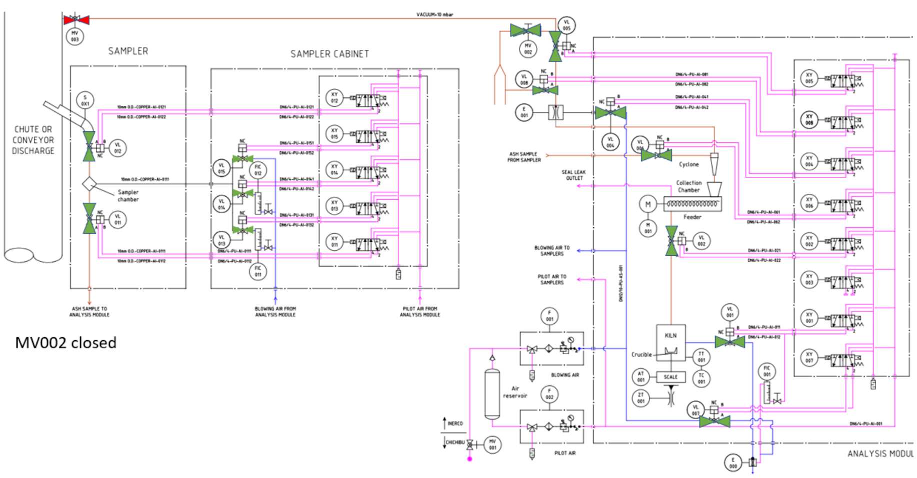
Vent pressure from Vent line.

h) Following test, return MV002 to original position. Vent cyclone by opening VL005.
i) If VL005 is confirmed as not leaking, proceed to next test.

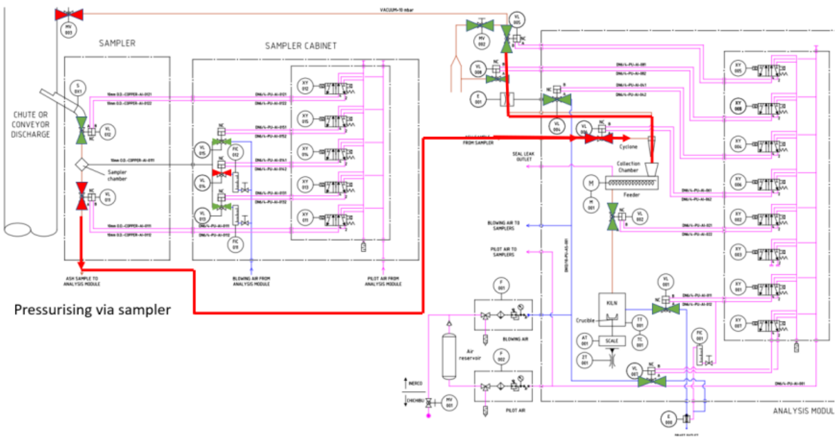
4) Test of VL008

a) Tie rubber glove (laboratory latex) over the exhaust pipe in the analyser room.

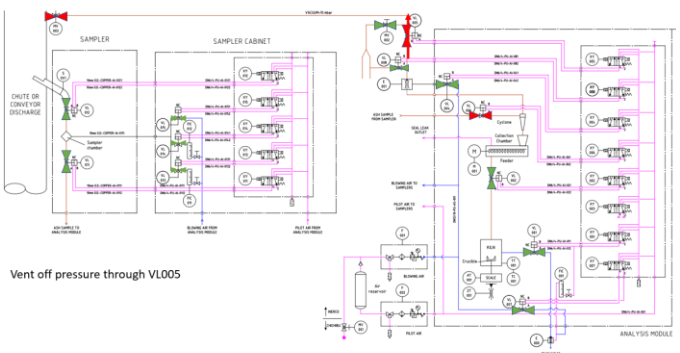
b) Close MV002 (remember original position) VL005, VL002, VL006.



c) Pressurise cyclone again via VL014, VL011 and VL006.



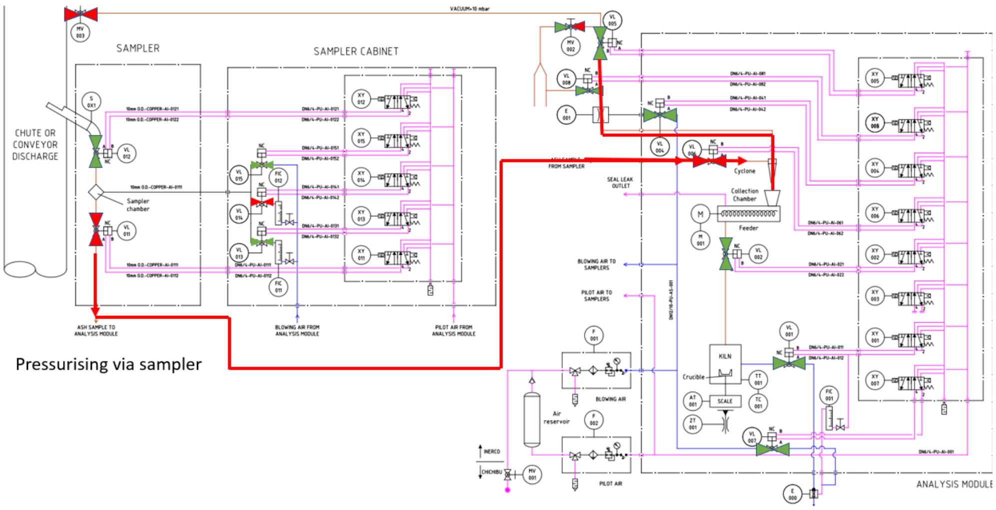
d) Leave this pressurising air on, and confirm pressure in cyclone via gauge.
e) If VL008 is leaking, then the rubber glove will start to inflate slowly.
f) After test, turn off pressurising air by closing VL014, VL011 and VL006
g) Vent cyclone via VL005.



h) If VL008 is proven to be OK, and not leak, proceed to next step. Return MV002 to original position.

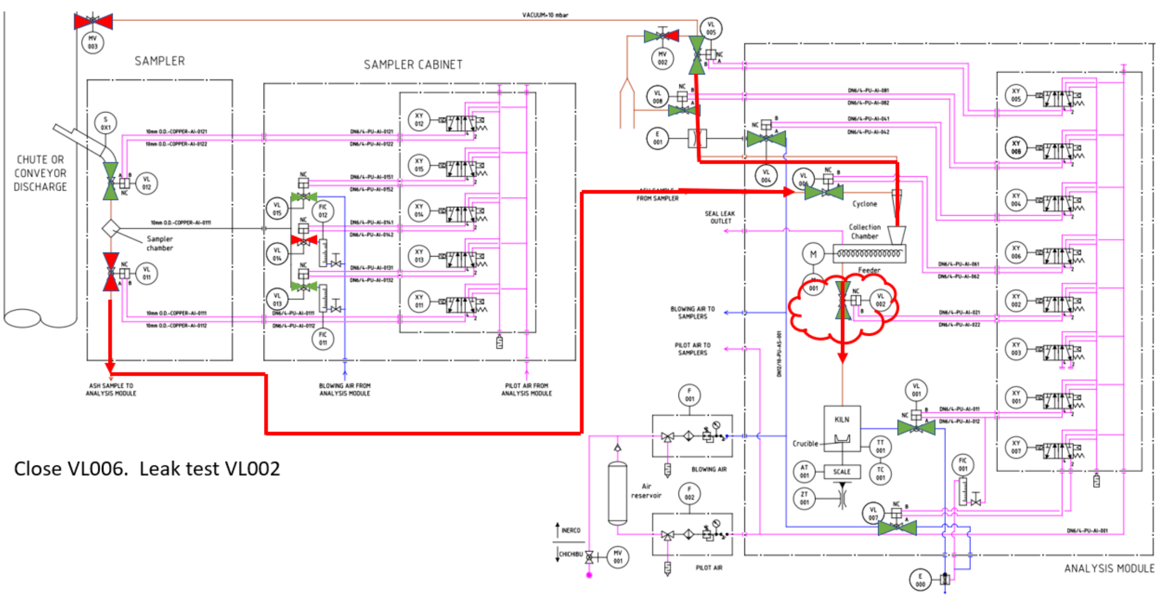
5) Test of VL002

a) If all tests for VL004, VL006, VL005, VL008 and SEAL LEAK OUTLET all show these valves as not leaking, then re-pressurise cyclone via VL011, VL014, VL006.



Pressurising via sampler

b) Close VL006. If pressure still leaks, and there is no leak of air out into the cabinet from around the cyclone, then VL002 is likely the valve that leaks.



Close VL006. Leak test VL002

c) Close VL014, VL011, open VL006 and vent pipework to atmosphere via VL005 following tests.

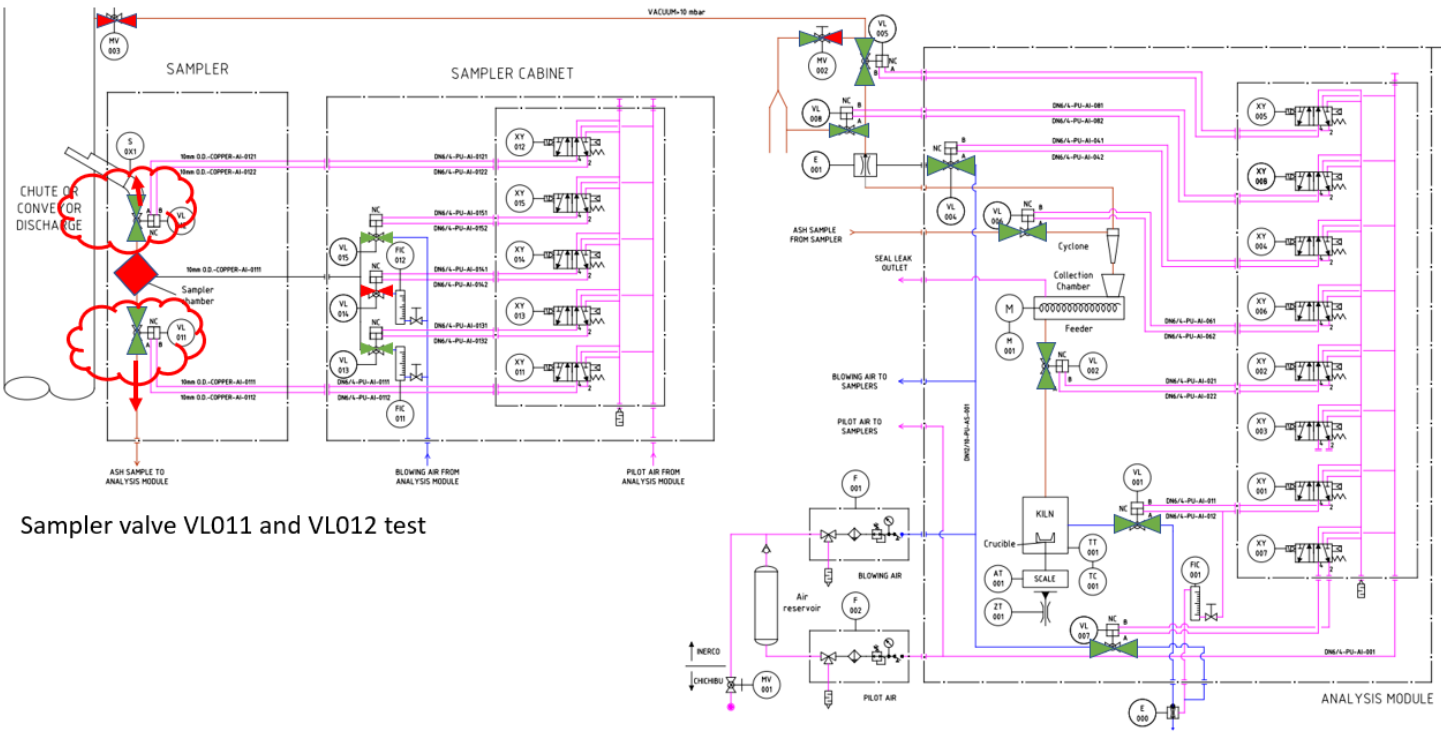
Sampler Valve Leak Testing:

6)

First step of sampler valve leak checking is to test both VL011 and VL012 for leaks together.

a) With VL011 and VL012 closed, open VL014 to pressurise the sample chamber between the valves. When VL014 is opened, observe flow indication on FIC012 on the sampler cabinet door. There should initially be a flow of air, which eventually stops as the sample chamber is pressurized. If the flow is continual on FIC012, then either VL011 or VL012 (or both) is leaking. Proceed to step 7 if leak found to determine which valve is leaking.

b) Following test, vent pipework by opening VL012.

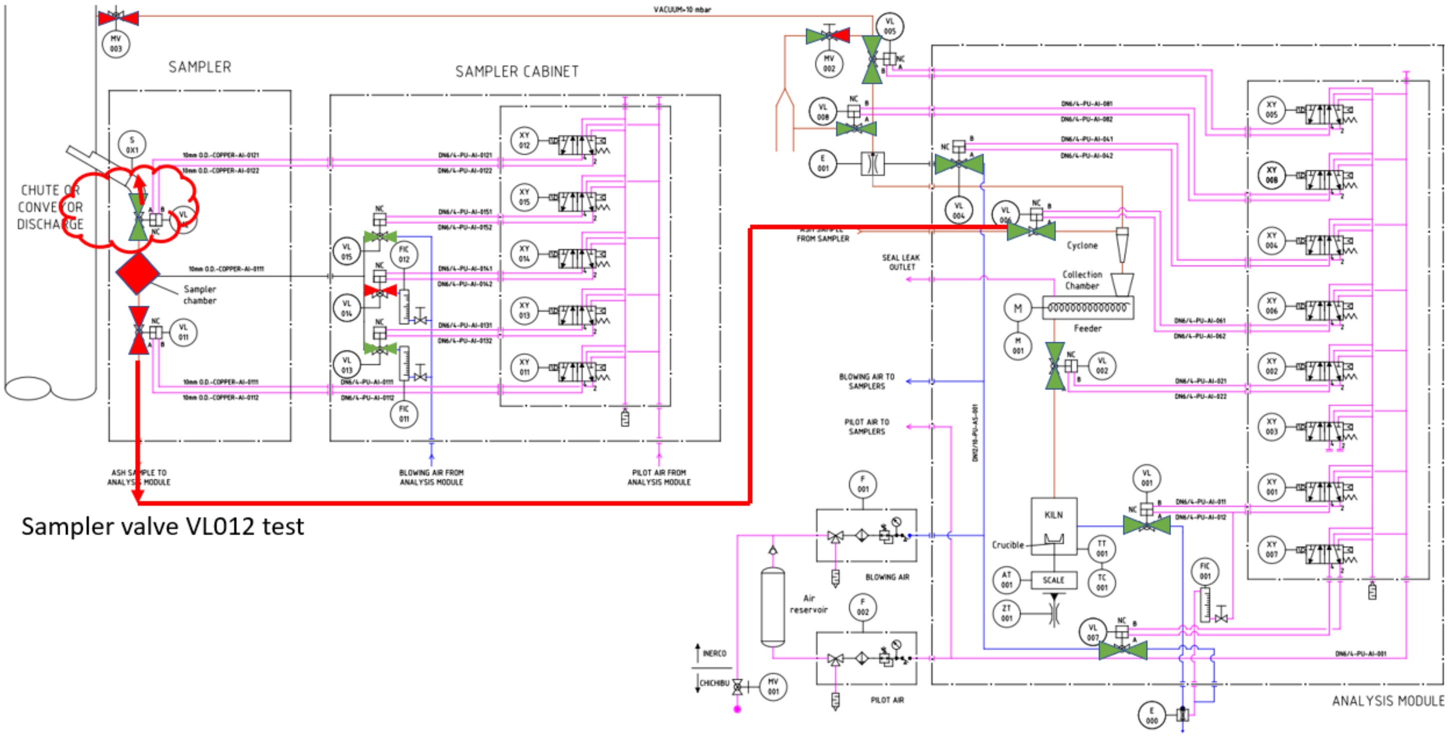


Sampler valve VL011 and VL012 test

7) Leak test of VL012

VL012 is prone to wear due to the action of sampler cleaning, with compressed air in the presence of ash.

a) With VL006 already checked from step 2, the line to the analyser can be pressurized to eliminate VL011 from the test. Open VL011 with VL006 closed. Pressurise the sample line by opening VL014, and observe flow on FIC012. There should be a flow for a little longer than step 6, as the sample line has to pressurize. If flow eventually stops, then VL012 is not leaking. If flow on FIC012 continues indefinitely, then VL012 is leaking, and should be replaced. If no leak is found on VL012, then this would indicate VL011 is leaking, and should be replaced. Repeat step 6 after replacement to confirm.



Sampler valve VL012 test

Suction Regulation

During crucible cleaning, suction is placed via eductor E001, on the crucible via the suction bell. Air flow to the eductor is not controlled, so the suction applied to the crucible is controlled by adjusting the operating height of the scale/crucible.

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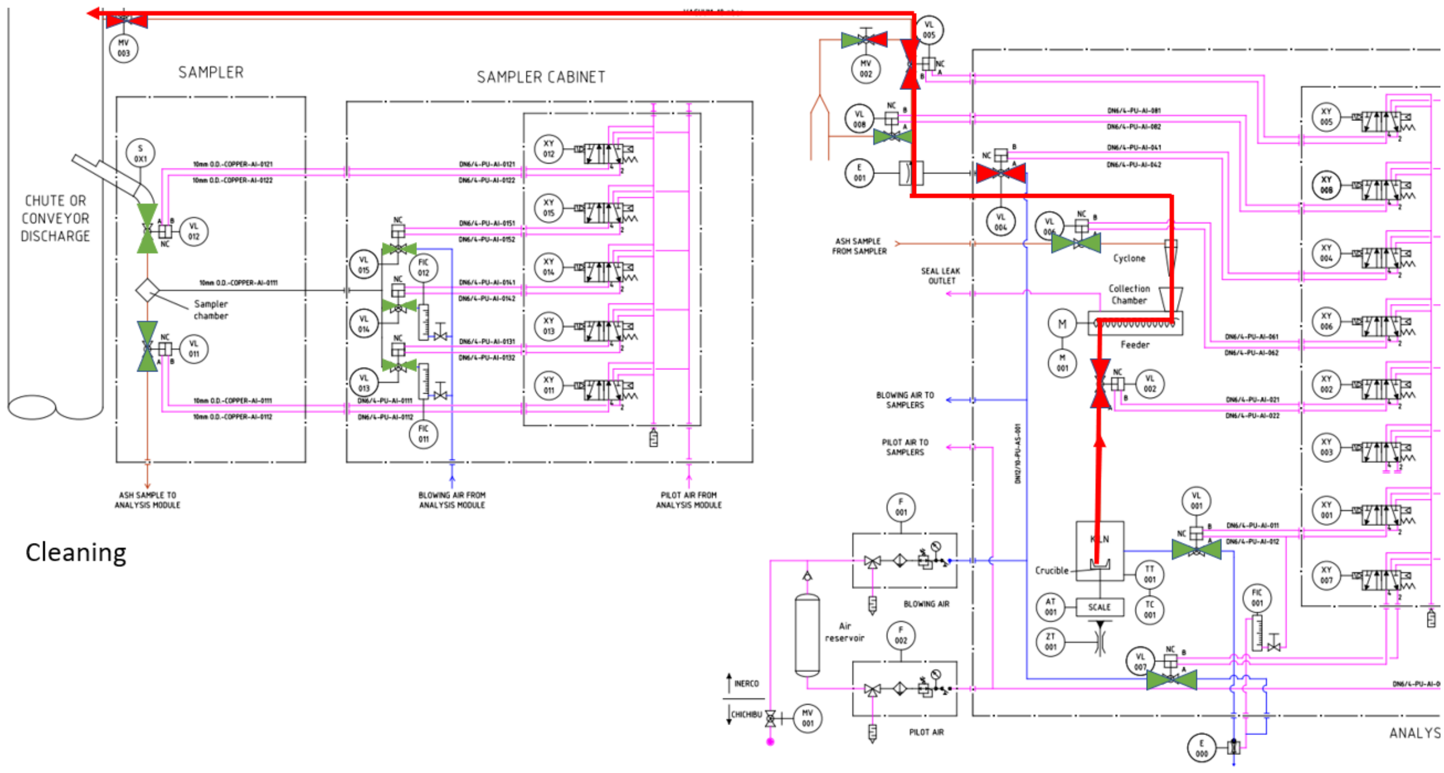
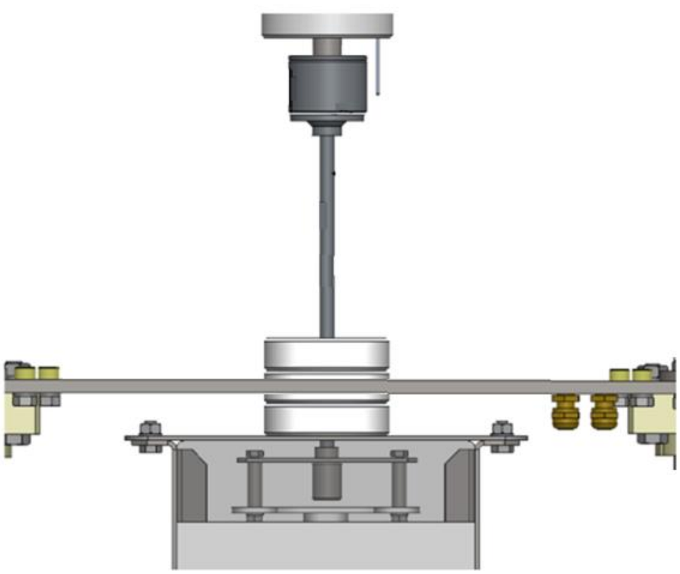
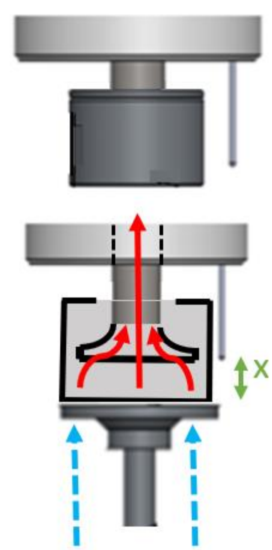


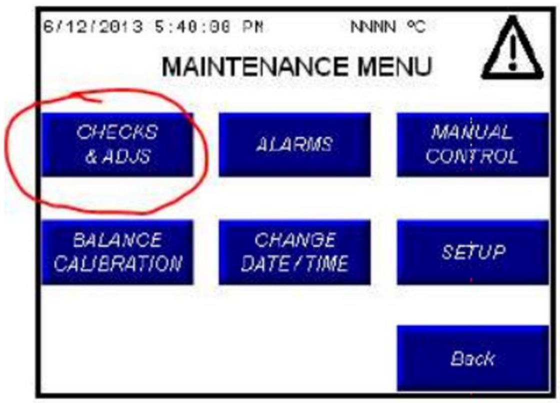
Cleaning

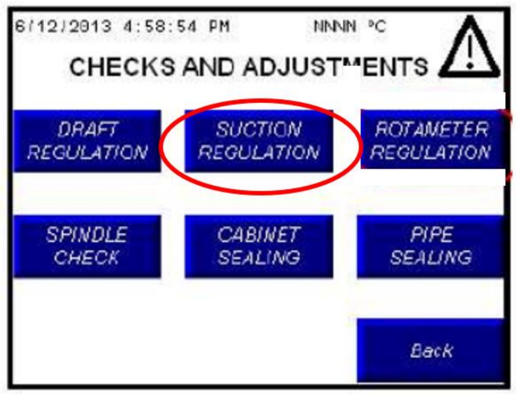




The suction "lifts" the crucible enough to notice a drop in weight on the analyser scales. The weight loss seen is dependant on the distance x, between scale crucible support and suction bell base. The distance (x) can be mechanically adjusted to set the correct weight displayed during cleaning. Having the correct weight ensures the correct amount of suction is produced to clean the crucible effectively.

Suction regulation will be set up during commissioning, but can change over time, and may need to be reset. A suction out of range alarm will be displayed if the suction drifts out of range.
To perform a suction regulation, go to maintenance menu, select checks and adjusts, then suction regulation:

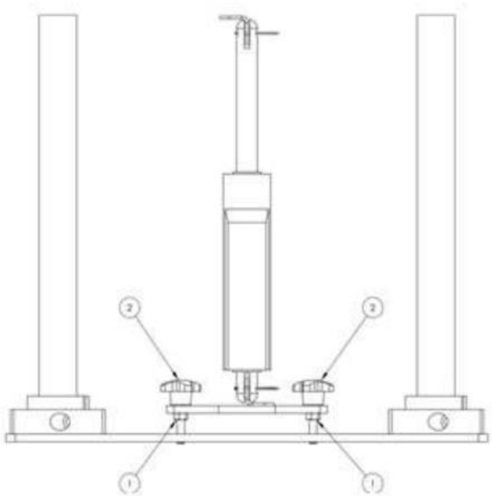




Note the equipment must be at full operating temperature of 750°C for 3 hours before performing the suction regulation. This ensures all equipment is fully expanded due to the heat. Failure to perform at high temperature will lead to further alarms during operation, as the suction level will change when fully hot. The control system has delays to prevent suction regulation if sufficient time has not passed since the furnace is at full temperature, so patience is required to perform this test.
When successful, the suction regulation screen is brought up:

At this stage, the scale height is moved by the linear actuator to the cleaning position, and air is put on to the eductor, which produces the vacuum, and the weight will drop to negative on the screen. Target weight is -275g, but experience will show accurate control is difficult, so aim to be in the range of -225g to -350 g.

Adjustment is made at the base of the scale linear actuator.



Loosen nuts 1, and turn nut handle 2 on both sides to adjust height. Make small ¼ turn adjustments at a time, as the adjustment is very sensitive. After adjustment, re-tighten nuts 1.

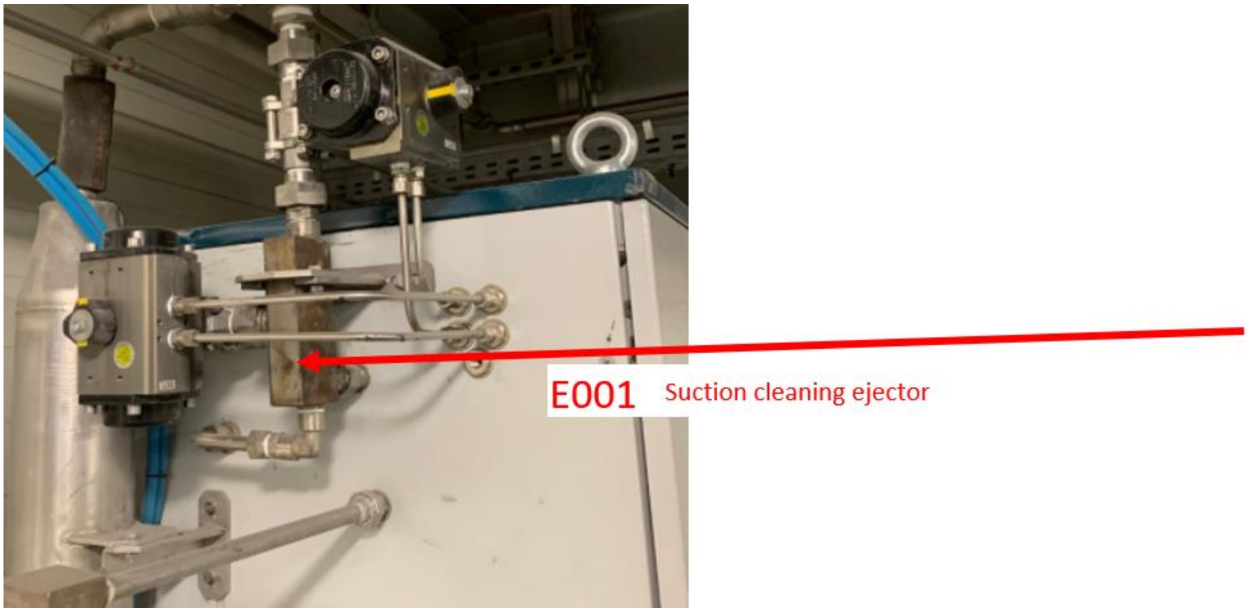
When suction regulation is pressed, vacuum is on, and air rushes over the crucible, which slightly cools it. For this reason, leave air on only for long enough to reach a stable weight, then turn off by pressing OK.

The stable reading will dictate if further adjustment is needed.

To increase suction (increase negative value) the actuator base should be raised.
To reduce suction (lower negative value) the actuator base should be moved down.

After each adjustment, wait 3 minutes for temperature to warm up following previous air flow during suction test.

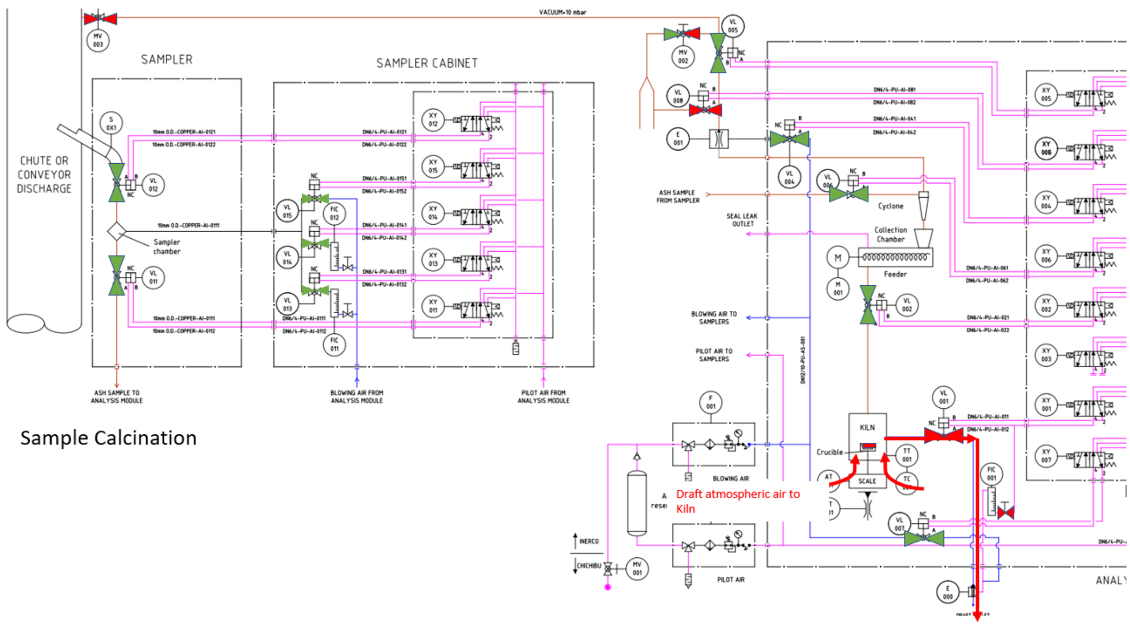
If vacuum is showing very low, this could indicate a blocked eductor. Removal of eductor and cleaning out any ash may be required.

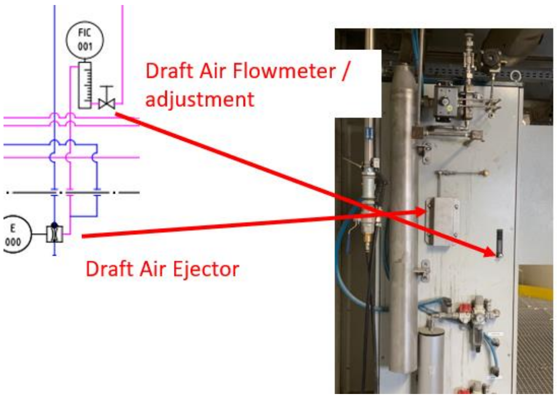


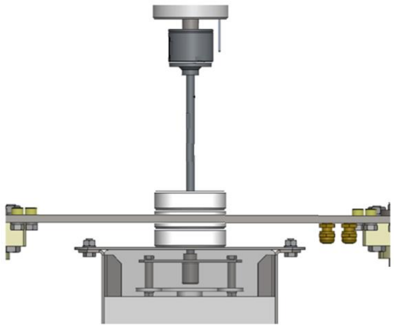
After cleaning, suction regulation will need to be set again.
If ash is found in any pipework during eductor cleaning, the pipework should be fully cleaned.

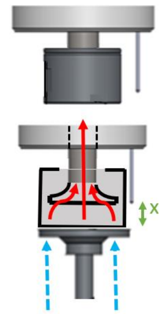
Draft Regulation

During calcination, a small air flow is produced around the crucible to speed combustion of the carbon. The air flow is produced by inducing a vacuum through eductor E000.



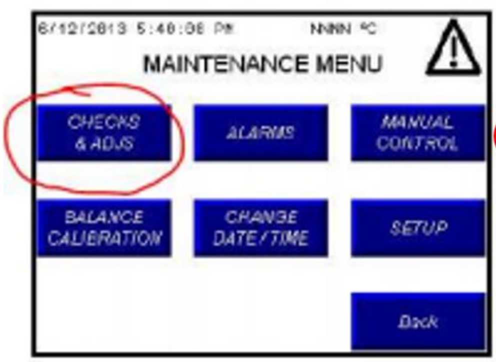


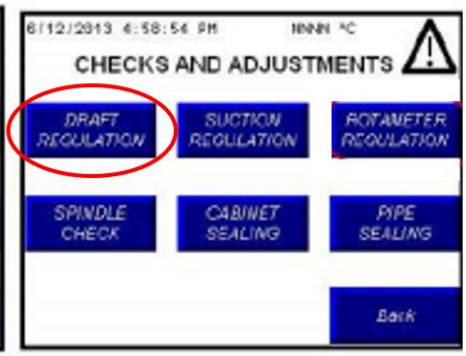




With draft air on, the air flow “lifts” the crucible enough to be detected as a loss in weight at the scale. Too little air flow will prolong analysis time, as combustion will take longer. Too much air flow risks blowing material out from the crucible, which would reduce measurement accuracy. The distance from crucible base to suction bell (x) will affect the draft air reading, but this is set for the suction setting, not draft air setting. The control of draft air is made by adjusting the compressed air flow to the eductor (E000), on rotameter FIC001, which increases or decreases the vacuum produced, hence affecting induced air flow.

To set the draft air, go to the menu on the HMI, and select checks and adjusts, followed by draft regulation. This will bring up the draft regulation screen. Again, ensure furnace is up to temperature before starting adjustment. Also note, draft air should be set after suction regulation, as the change in distance (x) will affect draft air flow.





Adjust air flow until weight display on HMI matches the target shown on the HMI. Adjustment should be easier and more controllable than suction regulation.

An alternative “quick and dirty” method to adjust draft regulation is to alter the flow on FIC001 during calcination. If sample weight is 3.000g, initial weight displayed during calcination should be 3.000-0.800g = 2.200g.

If draft air is out of range, a draft out of range warning alarm will be displayed.

If draft regulation is difficult to set, it is possible the eductor E000, or line from valve VL001 to Eductor E000 is blocked or partially blocked. Careful removal and cleaning will be required.

Eductor E001 is adjustable, but set at analyser construction to the correct value. If disassembling to clean, be sure to note original setting before re-installing, to ensure correct levels of vacuum are produced after restart. Flow levels on FIC001 should be 1/3 to ½ way up the rotameter scale, so if flow is wildly different to achieve the draft regulation target, this could indicate a blockage or eductor setting problem.

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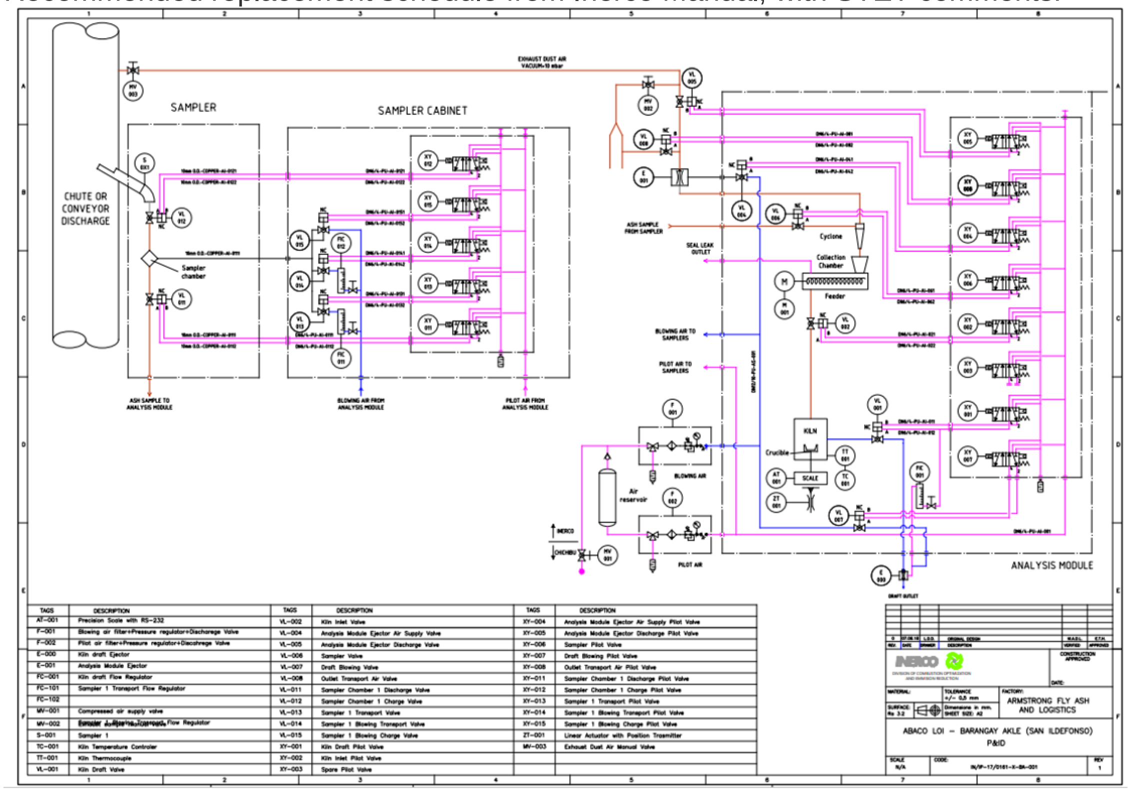
Recommended Maintenance Schedule:

Recommended replacement schedule from Inerco Manual, with STET comments:



ABACO-LOI SYSTEM

ANALYSIS UNIT

Frequency	Component	Ref.	Number	Action	Theoretical lifetime	Comments
1-monthly	Scale	-	1	Calibration	-	
3-monthly	½" wafer valve	VL-002	1	Replacement	20,000 analyses	3 per year based on 24/7 operation
	¼" GAS valve	VL-006	1	Replacement	20,000 analyses	3 per year based on 24/7 operation
	Feeding screw	-	1	Replacement	30,000 analyses	2 per year (Should last longer inspection will dictate if replacement needed.)
	Viton retainer	-	2	Replacement	When replacing feeder screw	
	Viton O-ring seal	-	2	Replacement	When replacing feeder screw	
	Graphite seal	-	2	Replacement	When replacing VL-002 valve	6 per year based on 24/7 operation. Can be damaged during install. Recommend increased spares stock.
	ISOPLAN1100 joint	-	3	Replacement	When replacing VL-002 valve	9 per year based on 24/7 operation
6-monthly	Analysis unit	-	-	Cleaning	-	
	½" GAS valve	VL-005	1	Replacement	33,333 analyses	2 per year based on 24/7 operation
		VL-008	1	Replacement	33,333 analyses	2 per year based on 24/7 operation
12-monthly	¼" GAS valve	VL-001	1	Replacement	66,667 analyses	1 per year based on 24/7 operation
		VL-004	1	Replacement	66,667 analyses	1 per year based on 24/7 operation
		VL-007	1	Replacement	66,667 analyses	1 per year based on 24/7 operation
	Air filters	-	2	Replacement	1 year	2 per year based on 24/7 operation

SAMPLER

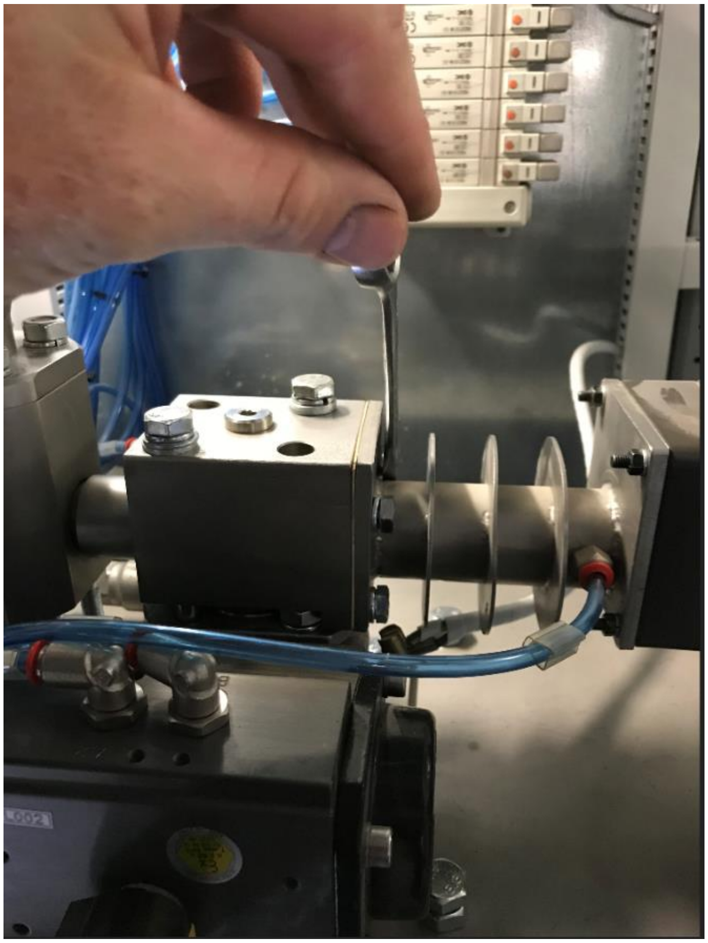
Frequency	Component	Ref.	Number	Action	Theoretical lifetime	Comments
6-monthly	1½ " wafer valves	VL-011	1	Replacement	33,333 samplings	2 per year based on 24/7 operation
		VL-012	1	Replacement	33,333 samplings	2 per year based on 24/7 operation
	¼" GAS valve	VL-013	1	Replacement	40,000 samplings	2 per year based on 24/7 operation
		VL-014	1	Replacement	40,000 samplings	2 per year based on 24/7 operation
12-monthly	¼" GAS valve	VL-015	1	Replacement	200,000 samplings	Every 3 years based on 24/7 operation

STET Recommends following spares stock:

Item	Recommended Quantity	Price 2017 $ Each	Description	Component
GAS wafer Valve 1/2"	6	190	Spare valve for pipework (half inch)	VL002
GAS threaded screw-in Valve 1/2"	8	63	Spare valve for pipework (half inch)	VL005, VL008,
GAS threaded screw-in Valve 1/4"	12	12.5	Spare valve for pipework (Quarter inch)	VL001, VL004, VL006, VL007, VL013, VL014, VL015
Feeding Screw	2	54	Spare feed screw	
Viton retainer	2	28.5		
Filter Cartridge 5 micron	2	7.5	Compressed air filter	
Filter Cartridge 0.3 micron	2	22	Compressed air filter	
ISOPLAN1100 Seal	9	4.5	Large seal for under valve 2	
Viton o-ring	18	10	Seal for block between cyclone and kiln inlet	
Graphite seal	24	5	Blue seal for valve 2	
Gas thread wafer valve 1-1/2"	10	165	Spare valve for pipework (one and a half inch)	VL011, VL012 on sampler

Crucible Cleaning/ VL002 Replacement

The following instructions can be used for removal and replacement of VL002, or removal and cleaning of crucible.



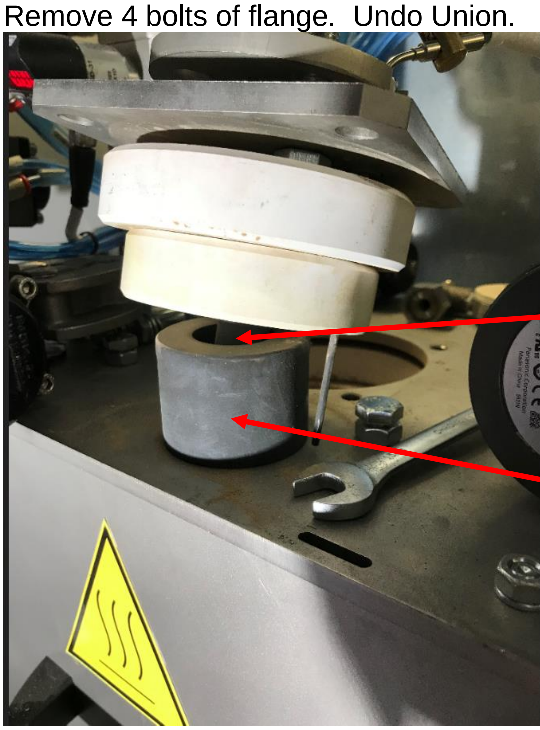
Remove 4 bolts holding motor/screw feeder. Then pull out motor and screw.

Prise off block from this point with screwdriver or prybar.

Remove block. Prise off block from cyclone side.
Remove valve V002

Union

Remove 4 bolts of flange. Undo Union.



Suction Bell (attached to flange)

Crucible

Pull up flange to remove.

Use movement of crucible, to grind any ash sintered deposits in crucible. Blow out debris with compressed air. There is about 10mm travel from crucible up and down before it hits the fixed suction bell, so any debris that is stuck in crucible can cause it to affect scale reading.


watch
shake
turn
break
sinter ash

Refitting is reversal of removal.

Fit cylinder to block (check direction, as only one end will fit into cyclone.) Then push block into cyclone. Do not fit blue Gasket (under block) until after block is fitted to avoid damage. Then slide gasket in with help of screwdriver from behind, as in picture below:

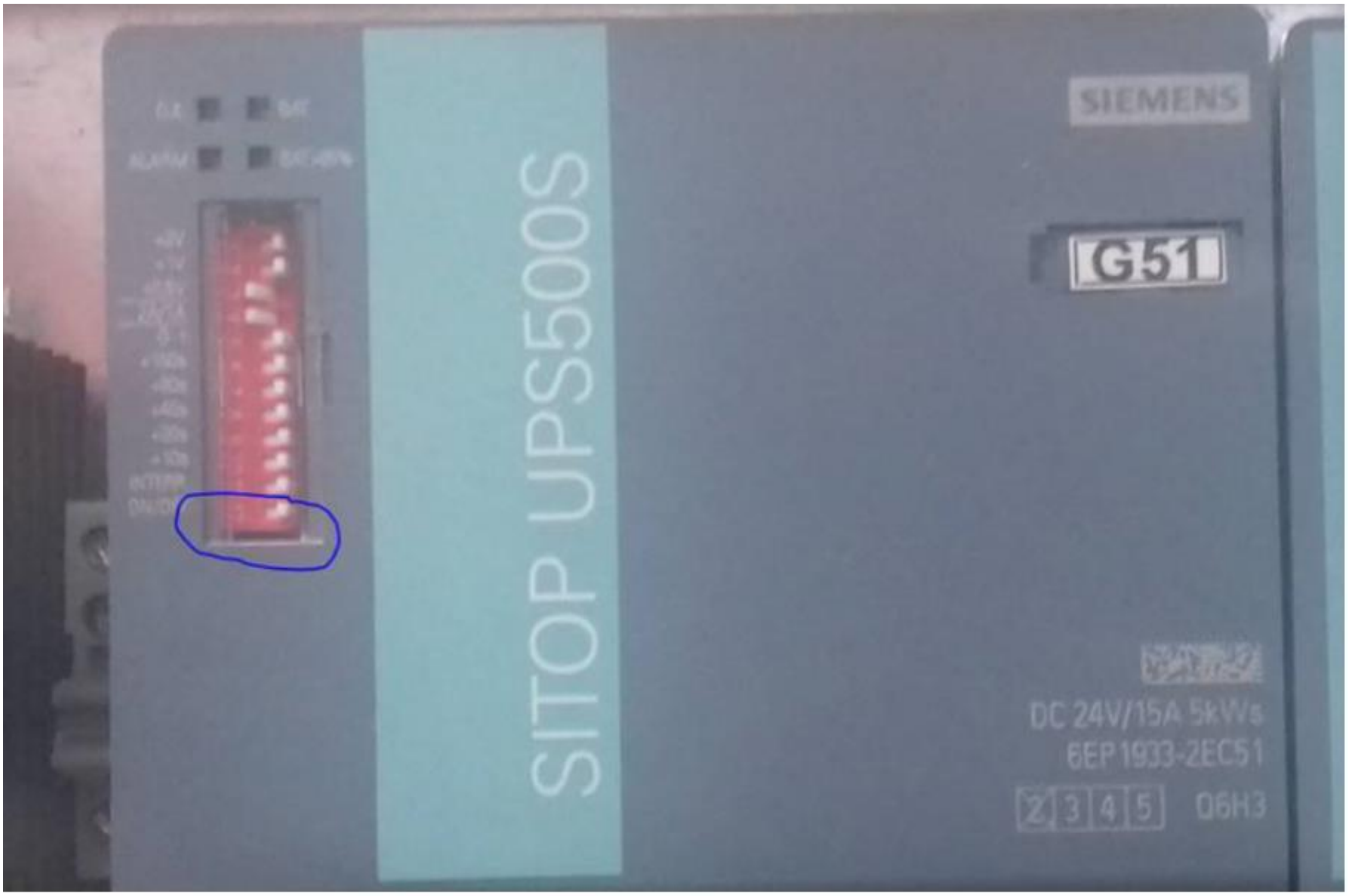
#

Sliding in blue gasket.

 Blue gasket (gasket under block is cut-down to fit due to nuts on valve top.

Furnace Cooling Alarm Reset

Occasionally the furnace cooling alarm will display, which cannot be reset through the HMI, only by turning off power and restarting the analyser. As the analyser has a UPS supply, this must be switched off and on also to reset the furnace cooling alarm. With power off to the analyser, locate the UPS in the electrical cabinet attached to the side of the analyser cabinet. On the toggle switches on the UPS, toggle off and on the switch shown in the picture below. Repower the analyser, and the alarm will be reset:



Calibration

Manual Sampling Addition

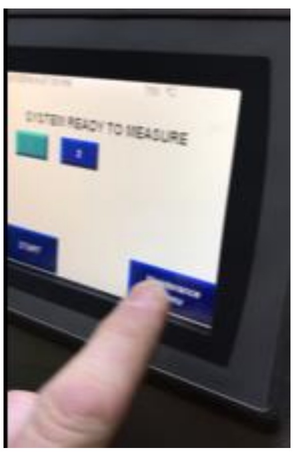
During commissioning, the analyser will be calibrated to read the correct LOI. During operation, it is advised to perform periodic manual testing of separator product LOI to compare to the analyser results. This will ensure product quality (LOI) in the product silo does not drift up out of specification, or down (LOI lower in product silo than analyser results), where yield could be improved to control to specification target LOI.
A daily manual sample from the separator, plotted against the analyser LOI for the same period would give over time an indication of any drift in LOI result. Small variations above and below are to be expected, but a long term trend would show if average LOI results are drifting up or down.

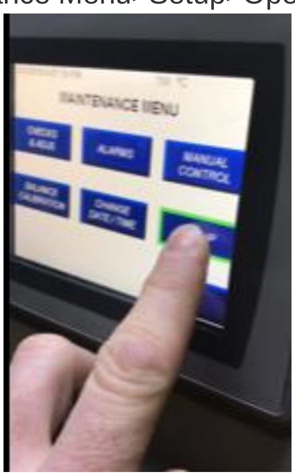
Should re-calibration be required, the following procedure can be used to introduce a known-LOI sample of ash to the sampler, and analyser result compared.

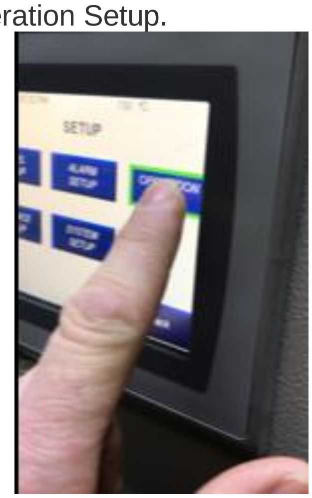
The calibration should be performed with the separator off, but dust collection system on.

With analyser running manually, perform the following steps:

1) Select Maintenance Menu>Setup>Operation Setup.







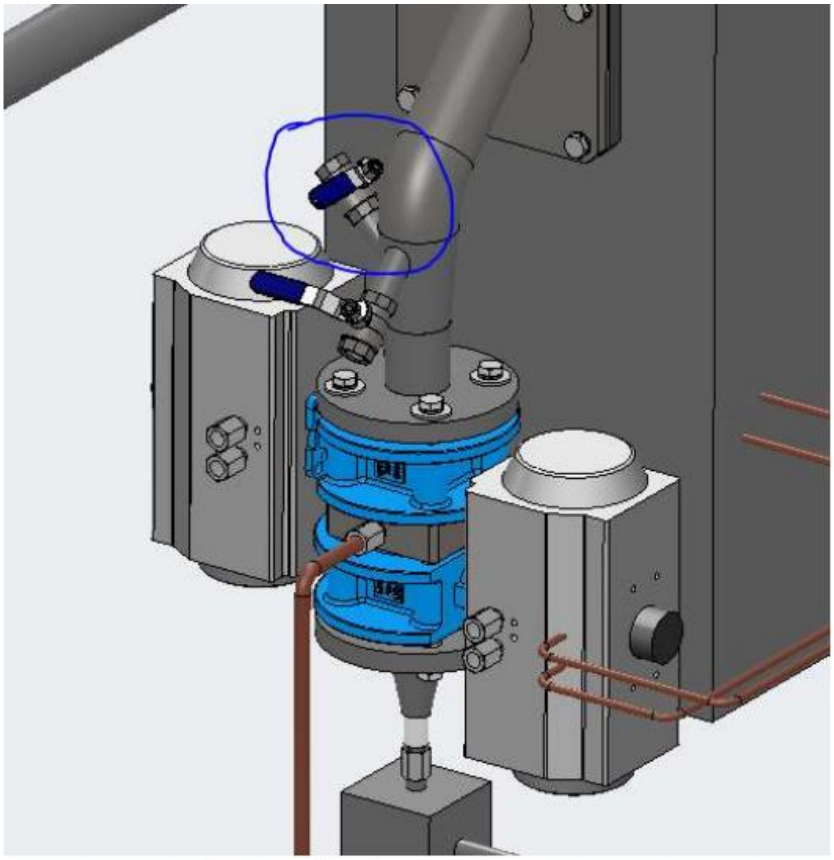
2) Select timer TR2, and change from 10 seconds to 90 seconds.

This is the time the sample valve VL012 opens to collect a sample. For normal operation, the setting should be 10 seconds. For introducing a manual sample, it takes time to feed the sample in manually, so increase the timer TR2 to 90 seconds to allow you time to feed in enough known LOI ash.

3) Select Timer TL2, and change from 10 seconds to 60 seconds.

This is the sampler cleaning time. For normal operation, 10 seconds is set, which is sufficient to clean the sampler. For manual sample addition, you need time to get from the HMI screen after you press start (to take sample) to the sampler itself, so increasing the cleaning time to 60 seconds gives you time to move to the sampler.

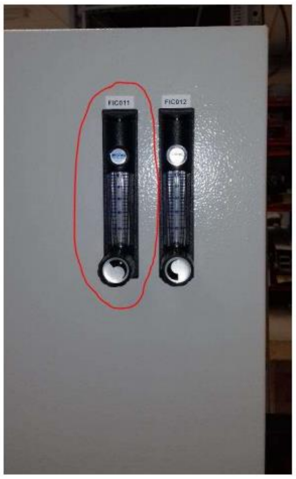
4) Press start on the main screen, to start sampling, and move to the sampler with you sample of known LOI ash. Feed a sample into the sampler manually through the manual valve as shown below. A funnel can be used to help load the sample. Dust collection vacuum in the chut will help ash enter the sampler system.



5) Close manual valve when sample is loaded, and after 90 seconds, the transfer will take place to the analyser. Observe analyser HMI to ensure a full 3g sample is loaded to crucible.
6) Wait for analyser LOI result:

   If measured LOI is lower than calibrated sample LOI, reduce transport air flow at rotameter FIC01.

   If measured LOI is higher than calibrated sample LOI, increase transport air flow at FIC01.



Make small adjustments to air flow, and re-test a calibrated sample. Continue until measured LOI to calibrated sample LOI is +/- 0.1%.

7) Return timers changed in steps 2 and 3 to original setpoints.