TITAN VERSA

TITAN VERSA LEAK DETECTORS

OPERATIONS AND MAINTENANCE MANUAL

LACO TECHNOLOGIES

Manual Name: TITAN VERSA Operations and Maintenance Manual
Product Group: TITAN VERSA Leak Detector
Manual Rev. Number: SMT-07-1037, Rev. A2

LACO TECHNOLOGIES

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1. About This Manual

The *TITAN VERSA Operations and Maintenance Manual* applies to all TITAN VERSA Leak Detector models, as well as the following TITAN VERSA Leak Detector accessories: Barcode Reader, Remote Start / Stop module, and Remote Pass / Fail Light. This manual is available for download at www.lacotech.com.

1.1. Target Groups

These operating instructions are intended for customers of LACO Technologies and owners of the TITAN VERSA Leak Detector. All information in this operating manual applies to the current state of the products development. To access previous manual versions, contact LACO Technologies.

1.2. Reference Documents

Table 1 below outlines all applicable documents referenced in this manual. All manuals are provided on the USB storage drive included with shipment. This manual, the *TITAN VERSA Quick Start User Guide*, and the *TITAN VERSA Communication Interface User Manual* are available for download at www.lacotech.com.

Table 1 *Reference Documents*

Document	Document Number
TITAN VERSA Quick Start User Guide	SMT-07-1038
TITAN VERSA Communication Interface User Manual	SMT-07-1039
Pump Manual, Uno 6	PD 0072 BN/B
Pump Manual, Pascal Series, 5-21 m3/h	PD 0072 BN/B
Pump Manual, ISP90	103275OEN
Pump Manual, MVP-030	PU 0065 BN/D

1.3. Displaying Information

See below for the range of warning messages used in this manual. The text in these messages indicates the severity range of each warning message.

1.3.1. Warnings

DANGER: Imminent threat of danger resulting in death or severe injuries. Dangerous situation potentially resulting in death or severe injuries.

WARNING: Dangerous situation resulting in major injuries. Dangerous situation resulting in damage to property or the environment.

CAUTION: Dangerous situation resulting in minor injuries.

NOTICE: Dangerous situation resulting in damage to property or the environment.

2. Safety

2.1. Intended Use

The TITAN VERSA Leak Detector measures and locates leaks on components, assemblies, and systems. It is suited for both vacuum and sniffer test methods.

The TITAN VERSA Leak Detector may only be used for leak testing of gases specified in Technical Data.

To ensure safety:

- Install, operate, and service the TITAN VERSA Leak Detector (i.e., device) only in compliance with the operating instructions outlined in this manual.
- Do not suck up liquids with the device.
- Do not suck up aggressive, corrosive, chemical, flammable, toxic, or explosive substances.
- Do not suck up dusts or solids.

2.2. Unintended Use

NOTICE: Improper use will cause all claims for liabilities and warranties to be forfeited.

Improper use is defined as usage for purposes deviating from the intended uses stated above, especially:

- Pumping harsh, chemical, corrosive, flammable, reactive, toxic, or explosive fluids
- Pumping of liquids
- Pumping of condensing vapors
- Pumping dust or solids particles
- Operation in potentially explosive areas
- Analysis of gas with a hydrogen concentration higher than 5%
- Testing parts that are soiled or that have traces of water, vapors paint, adhesive, detergent or rinsing products
- Use of accessories or spare parts that are not named in this manual

Safe Operation

The product is not designed to carry people or loads, and is not intended for use as a seat, stepladder, or any other similar purpose.

2.3. Owner Requirements

- Operate the device only when it is in technically perfect, working order.
- Operate the device only as specified in a safety-conscious and hazard-conscious manner, and in compliance with these operating instructions.
- Keep this manual accessible at the equipment location.
- Adhere to the following regulations and monitor their compliance:
  - Intended use
  - Safety and accident prevention regulations
  - International, national, and local standards and guidelines
  - Additional provisions and regulations that are specific to the model
  - Use of original parts or parts approved by the manufacturer

Personnel qualifications

- Allow only qualified service technicians to work with and on the device. Qualified service technicians must receive training on the device.
- Allow personnel in training to work with and on the device only under the supervision of trained qualified service technicians.
- Before starting work, ensure authorized personnel read and understand the operating instructions and all other applicable documents (see Reference Documents), especially the information regarding safety, maintenance, and repairs.
- Define the responsibilities, authorizations, and supervision of personnel.

2.4. Operator Requirements

- Read, observe, and follow the information in these operating and working instructions. Operators must take special care to understand and heed safety instructions and warnings.
- Carry out work only with adherence to the complete operating instructions.
- If you have further questions regarding the TITAN VERSA operation or maintenance, please contact LACO customer service:
  - **Phone:** 801-486-1004 | Toll Free: 800-465-1004
  - **Email:** Technical Support: techsupport@lacotech.com

2.5. Dangers

DANGER: While the device was built according to recognized and advanced safety regulations, improper use can result in danger to life and limb of the operator or other persons and damage to the device and other property.

Electrical Dangers

Considerable voltages arise inside the device. Touching parts where electrical voltage is applied can result in death.

➔ Disconnect the device from the power supply prior to any installation and maintenance work. Ensure the electric power supply is reconnected with authorization.

Testing live parts results in danger to life.

➔ Before starting a leak test, disconnect electrically-operated test objects from the power supply. Ensure the electric power supply is reconnected with authorization.

The device contains electric components that can be damaged from high electric voltage.

➔ Before connecting the device to the power supply, make sure that the supply voltage specified on the device is the same as the local power supply.

Dangers from liquids and chemical substances

Liquids and chemical substances can damage the device.

➔ Adhere to restrictions of use (see Technical Data).

➔ Do not suck up liquids with the device.

➔ Never contact toxic, caustic, microbiological, explosive, radioactive, or other harmful substances with the device.

➔ Only clean the device using mild household detergents.

➔ Hydrogen and air form a highly explosive mixture.

➔ Do not use tracer gases with a hydrogen concentration of >10%.

➔ Only use the device outside potentially explosive areas.

➔ Do not smoke near device. Do not subject the device to open fire and avoid sparking.

Danger from suction on inlet flange

In vacuum leak test operating mode, there is strong suction on the inlet flange of the device. If parts of the body or other objects are in the vicinity of the inlet flange, they may be sucked in.

➔ Always use the provided inlet screen filter.

➔ Always keep parts of the body or other objects away from the inlet flange.

WARNING: Damage from vapors

If condensable gases or vapors are measured, there is a risk of pump corrosion and damage.

- Do not immediately switch off the device after the measurement. Allow device to run in "Background cleanup" mode for at least an additional 20 minutes. Only then will the pump oil be free of condensed vapors.

WARNING: Overpressure

Overpressure may destroy the vacuum pump, the vacuum system, and the gaskets.

- Do not create an overpressure with the device.
- Only use the device for leak testing.

WARNING: Halogens in gas

If gas whose molecules contain halogen is measured with the device, the cathode layer of the ion source may be attacked. This may result in the burning out of the cathode.

- Do not test gas whose molecules contain halogens such as fluorine or chlorine.

3. Transport and Storage

3.1. Transport

CAUTION: Risk of injury when carrying the heavy leak detector.

Carrying heavy objects may cause injury or back problems. The device may slip from your hand.

- Use auxiliary lifting and transport devices for handling the device.

NOTICE: Risk of damage from transporting

Transporting the device in unsuitable packaging material can damage the device. Parts inside the device without transport restraint can be damaged during transport.

- Store the original packaging. See Table 2 for packing options per configuration.
- Only transport the device in the original packaging or a reusable shipping container. See Table 2 for packing options per configuration.
- Do not expose the device to direct sunlight.

NOTICE: TITAN VERSA Wet Pump Version - Risk of oil damage during transport.

Transport the device upright and level. Otherwise pump oil may flow out of the exhaust line and can damage the device.

- Do not change device orientation from upright and level for transporting.
- To avoid risk, use the plug supplied with the device to close the exhaust line. Remove the plug to be operational again after the transport.

Upon delivery, check that the product has not been damaged during transport.
If the product is damaged, take the necessary measures with the carrier and notify the manufacturer. In all situations we recommend you:

➔ Keep the product in its original packaging so it remains as clean as it was when dispatched by us. Only unpack the product once it has arrived at the destination where it will be used.

➔ Keep the packaging (recyclable materials) in the event the product needs to be transported or stored.

➔ Keep the blanked-off plate on the inlet port when the product is not in use.

3.1.1. Product Configurations

The three product sizes are discussed in Configurations. Each configuration has unique lifting needs summarized in Table 2 below.

Table 2 *Primary Lifting Methods by Configuration*

Configuration	Primary Lifting Method	New Packaging P/N:	Reusable Packaging P/N:
VERSA C ("Compact")	Two-person lift with hands supporting bottom of unit (see Section 3.1.3)	LMSA116490-1	LMSA5959 with foam
VERSA L ("Horizontal")	Use lifting device (i.e. crane) or two-person lift using installed lifting hardware and strap (see Section 3.1.4 and 3.1.5)	LMSA116490-3	TV119209 with foam
VERSA T ("Tower")		LMSA116490-2	TV119209 with foam

3.1.2. Unpack from Shipping Box

Remove contents that have been stored on top of leak detector. Contents include:

- *TITAN VERSA Quick Start Guide*
- *TITAN VERSA Operations and Maintenance Manual*
- Tools and Replacements Box
- Lifting kit bag and replacement hardware

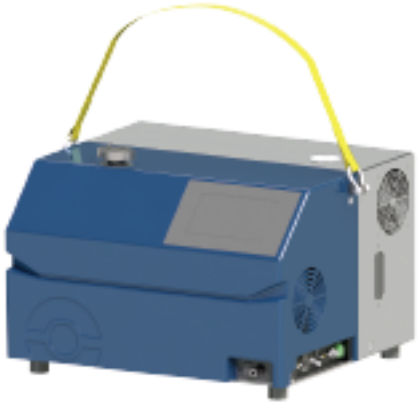
3.1.3. Remove VERSA C Leak Detector

The VERSA C (Compact) model does not include a lifting strap described in the sections below. Remove the unit from packaging using the following process:

1. Remove foam panels from sides of leak detector.
2. Remove protective plastic from leak detector.
3. Using two individuals (one on each side), place hands on bottom of unit, lift unit, and remove unit from packaging.

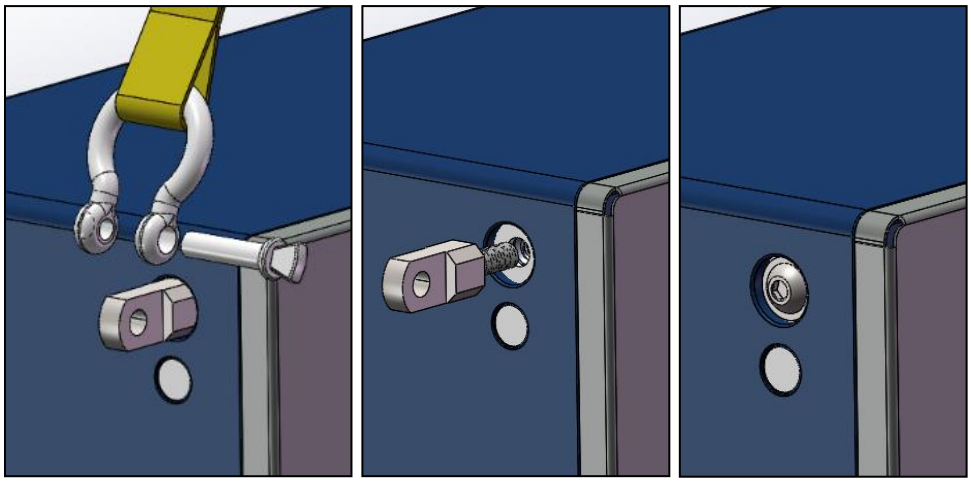
3.1.4. Remove VERSA T and L Leak Detector

1. Remove foam panels from sides of leak detector.
2. Remove protective plastic from leak detector.
3. Given the weight of the product, the TITAN VERSA should only be removed from shipping in the following conditions:
    - Personnel must be qualified and trained in handling heavy materials.
    - Use either a lifting crane or a two-person lift to remove unit from packaging.
    - Use the yellow lifting strap to remove leak detector. Be careful not to tip leak detector more than 20 degrees.



3.1.5. Replace Lifting Hardware (VERSA T and L)

1. Detach yellow lift strap and D-rings from lifting bolts.
2. Unscrew lifting bolts and store with strap in lifting kit bag.
3. Locate two M8 flanged screws inside of lifting kit bag and insert where lifting bolts were located.



3.1.6. Transporting on Mobile Cart

Never move unit while the detector is on. Unit is safe to move once the unit has been off for five minutes and turbo pump has safely spun down.

3.2. Storage

Store the device under the following conditions:

- Ambient temperature
- A cool, dry place
- Ensure the inlet test port is blanked off with a KF-25 blank

4. Description

4.1. Function

The TITAN VERSA Leak Detector can detect helium and hydrogen tracer gases. It is suited for leak testing according to the vacuum and sniffer methods.

- When leak testing according to the sniffer method, the test object is pressurized with a tracer gas. The optional sniffer line can be used to sniff the test object and measure the tracer gas escaping through a leak.
- There are two different options for leak testing according to the vacuum method:
  - The test object can be evacuated, and its outside sprayed with tracer gas. This type of leak test is often referred to as “Outside-In” testing. This procedure has the advantage that leaks can be localized.
  - The test object can be pressurized with tracer gas and tested inside a vacuum chamber. To accomplish this, the TITAN VERSA is connected to a vacuum chamber. The device measures the overall leakage rate of the test object. This type of leak test is often referred to as “Inside-Out” testing.

The device has three sensitivity levels for vacuum method: “GROSS," “FINE,” and “ULTRA." Depending on the pressure in the inlet flange and the user settings, the TITAN VERSA automatically selects the most sensitive level.

4.2. Scope of Delivery

The TITAN VERSA Leak Detector includes the following main components. Check the scope of delivery of the product for completeness after receipt.

- Main leak detector assembly
- Documentation packet
  - *TITAN VERSA Operations and Maintenance Manual*
  - *TITAN VERSA Quick Start Guide*
  - Leak standard certificate
  - Quality certificate
  - USB drive with documentation
- Lifting Packet (not included in VERSA C)
  - *TITAN VERSA Lifting Guide*
  - Two lifting eyes
  - Lifting sling
- Maintenance Kit (see Maintenance Tools and Parts for contents)
  - Maintenance tools
  - Spare parts
  - Oil drain and fill accessories (wet pump versions only)

See Accessories for a complete list of accessories generally needed for leak testing.

The provided USB drive contains files located per the file structure summarized below.

Table 3 *USB Drive Folder Structure*

Root Folder	Sub-Folder
Manuals	TITAN VERSA
	Accessories
	Pumps Manuals
Reference	Brochures
	Catalog
	Certification
	Technical Reference
	Application Notes
Drawings	PDF
	STP
Video	Operation
	Maintenance

4.3. Configurations

The three body style configurations for the TITAN VERSA are summarized in Table 4 below.

Table 4 *VERSA Body Style Configurations*

Body Style Configuration	Height, mm (in)	Width, mm (in)	Depth, mm (in)	Pump Type
VERSA C (“Compact”)	403 (15.8")	562 (22.1")	323 (12.7")	None (customer provides)
VERSA L (“Horizontal”)	403 (15.8")	562 (22.1")	497 (19.6")	Wet or Dry
VERSA T (“Tower”)	607 (23.9")	562 (22.1")	323 (12.7")	Wet or Dry

VERSA C

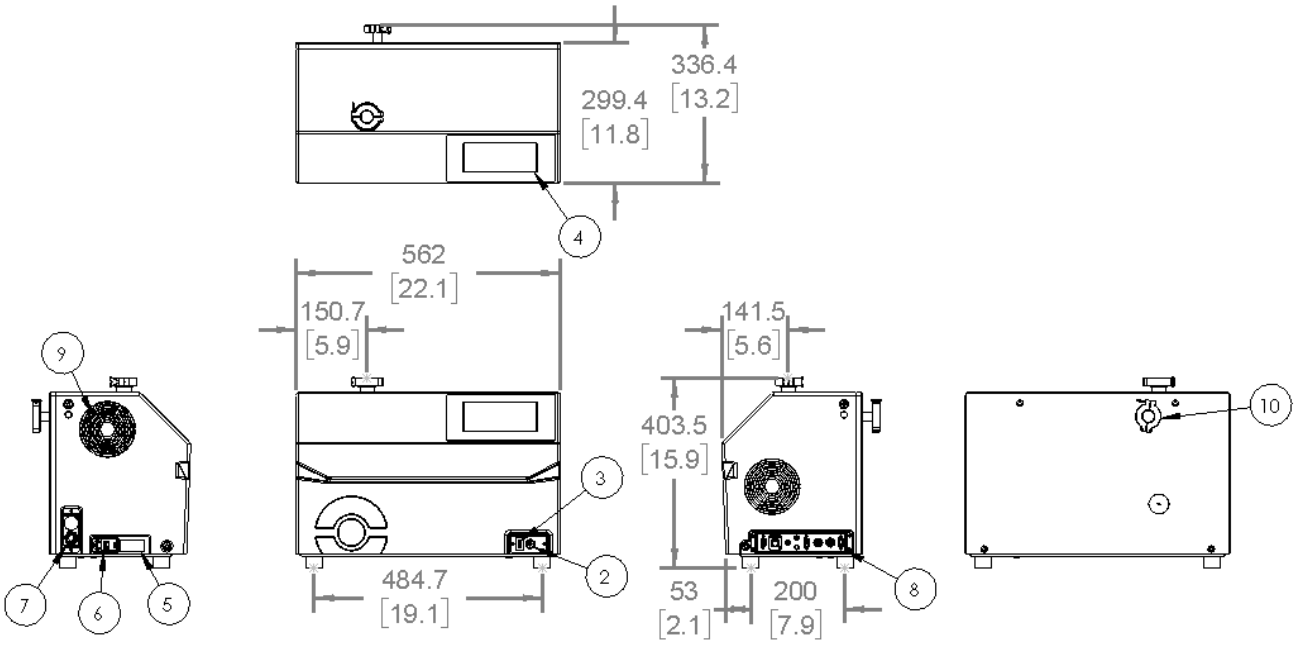
VERSA T

VERSA L

4.3.1. Feature Locations and Dimensions

4.3.1.1. VERSA C Features and Dimensions

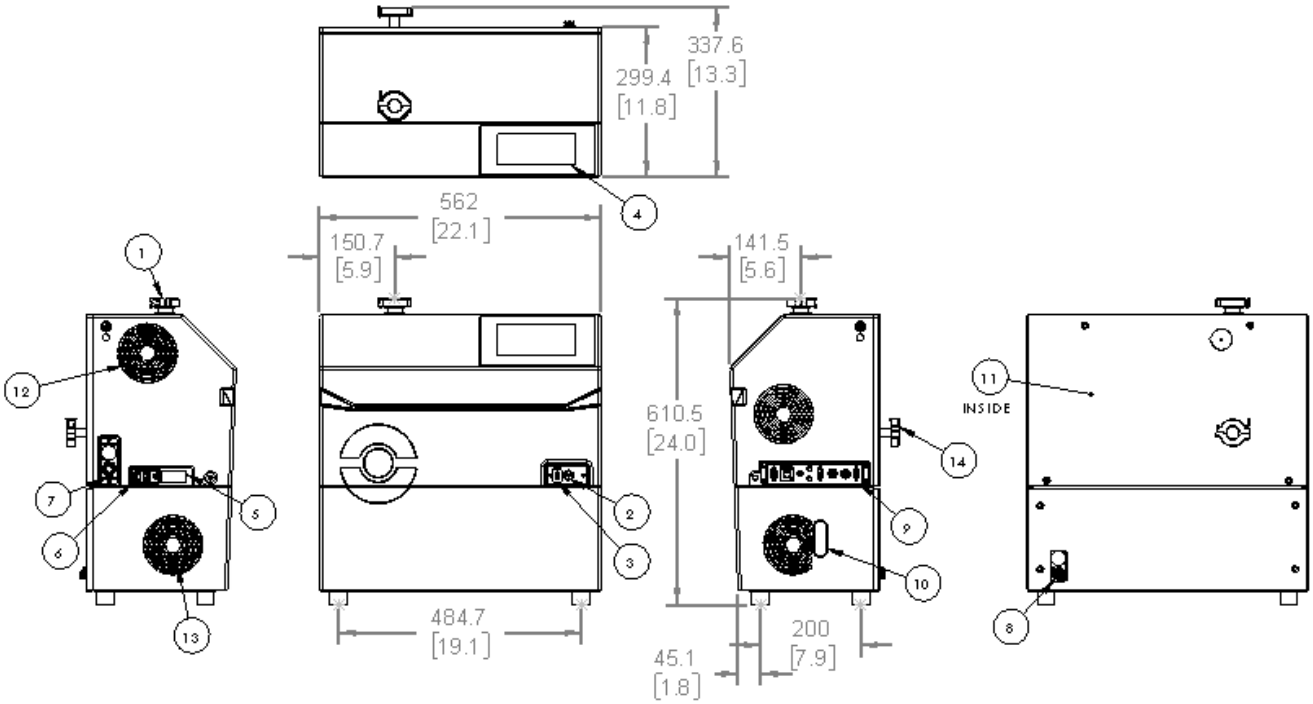
ID	Feature
1	Vacuum test port
2	Sniff test port
3	USB Port
4	Display and Cycle Start button
5	Product label
6	Power entry module
7	Multi-Use ports – Area 1
9	Electrical Interface
12	Fan inlet with filter
14	External pump port
15	Secondary external pump port (for High-Flow)



4.3.1.2. VERSA T Features and Dimensions

Table 5 *VERSA T Features*

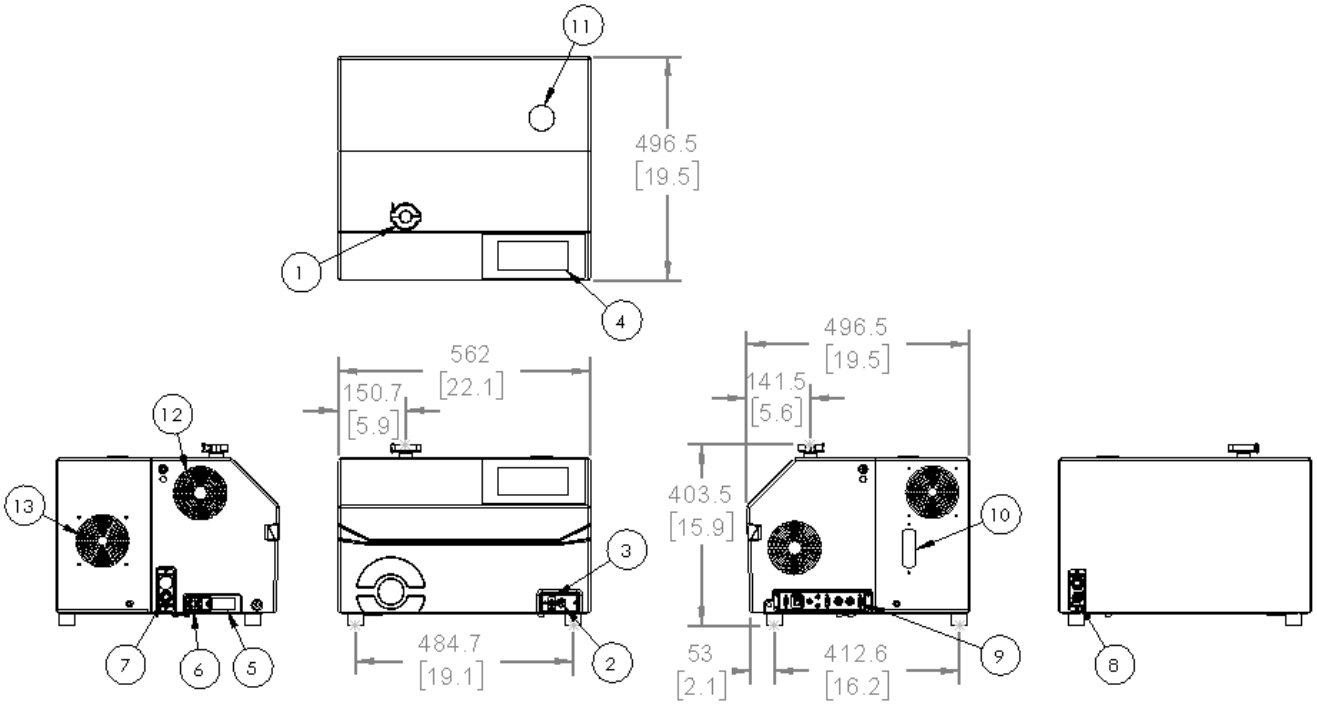
ID	Feature
1	Vacuum test port
2	Sniff test port
3	USB Port
4	Display and Cycle Start button
5	Product label
6	Power entry module
7	Multi-Use ports – Area 1
8	Multi-Use ports – Area 2
9	Electrical Interface
10	Oil sight glass
11	Oil fill area
12	Fan inlet with filter
13	Pump fan with filter
15	Secondary external pump port (for High-Flow)



4.3.1.3. VERSA L Features and Dimensions

Table 6 *VERSA L Features*

ID	Feature
1	Vacuum test port
2	Sniff test port
3	USB port
4	Display and Cycle Start button
5	Product label
6	Power entry module
7	Multi-Use ports – Area 1
8	Multi-Use ports – Area 2
9	Electrical interface
10	Oil sight glass
11	Oil fill area
12	Fan inlet with filter
13	Pump fan with filter



4.4. Technical Data

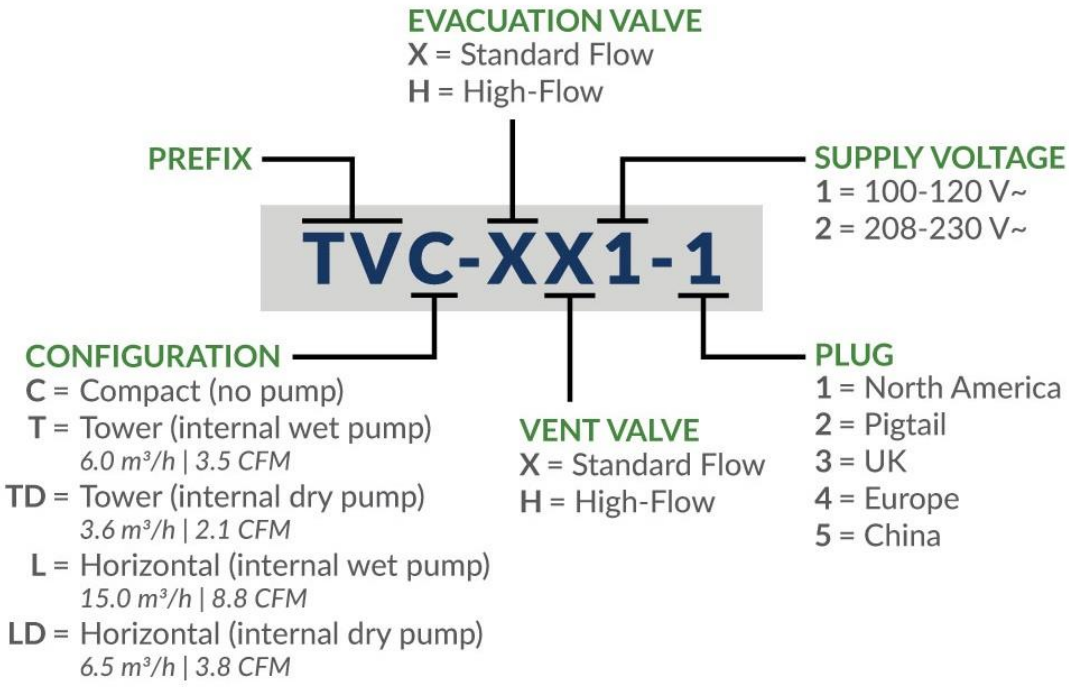
Table 7 *Technical Data*

Parameter	VERSA C	VERSA T	VERSA TD	VERSA L	VERSA LD
Primary pump type	None	Wet	Dry	Wet	Dry
Primary pump speed m^3/h (cfm)	N/A	6.0 (3.5)	3.6 (2.1)	15 (8.8)	6.5 (3.8)
Start-up time	~ 3 min (@ 20 °C)				
Detectable gases	Helium 4, Helium 3, Hydrogen				
Test methods	Vacuum and sniff				
Helium pumping speed (L/s)	2.5				
Minimum detectable leak rate in vacuum, helium (mbar L/sec)	5×10^{-12}				
Minimum detectable leak rate in sniff, helium (mbar L/sec)	5×10^{-9}				
Vacuum test modes with max inlet test pressure	Gross – 25 mbar Fine – 5 mbar Ultra – 0.5 mbar				
Protection category	IP 20				
Inlet flange	DN 25 ISO-KF				
Filament	2 (iridium yttriated)				
Turbo pump flow – SplitFlow 50	53 L/s N_2				
Operating temperature range - Vacuum (°C)	0 - 45	0 - 45	0 - 45	0 - 45	0 - 45
Operating temperature range - sniff (°C)	0 - 45	0 - 40	0 - 40	0 - 45	0 - 45
Noise level (dB A)	N/A	58	56	57	58
Electrical supply – V~, 50/60 Hz	90 - 250	100 - 130 208 - 240	90-250	100 - 130 208 - 240	100 – 130 208 - 240
Electrical power max (W)	350	700	600	850	600
Weight kg (lbs)	25 (55)	44 (97)	42 (93)	58 (128)	47 (104)
Dimensions mm (H x W X D) (in)	403 x 562 x 323 (15.8 x 22.1 x 12.7)	607 x 562 x 323 (23.9 x 22.1 x 12.7)		403 x 562 x 497 (15.8 x 22.1 x 19.6)	

Table 8 *Environmental Conditions*

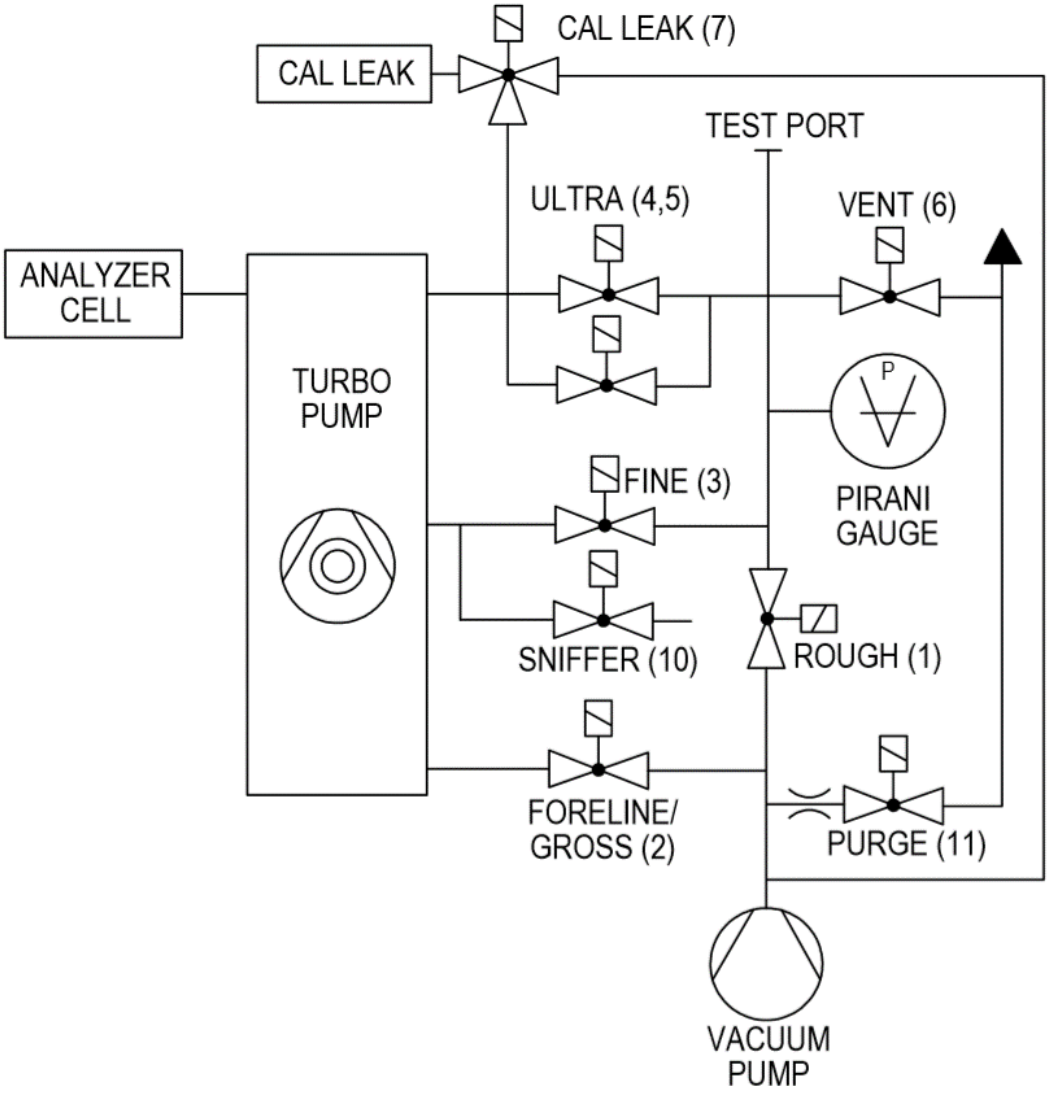
Environmental Conditions	
Storage temperature	-20 °C to + 55 °C
Maximum humidity of air	85% without condensing
Maximum magnetic field	3 mT
Maximum altitude above sea level	2000 m ASL

4.5. TITAN VERSA Part Number Matrix

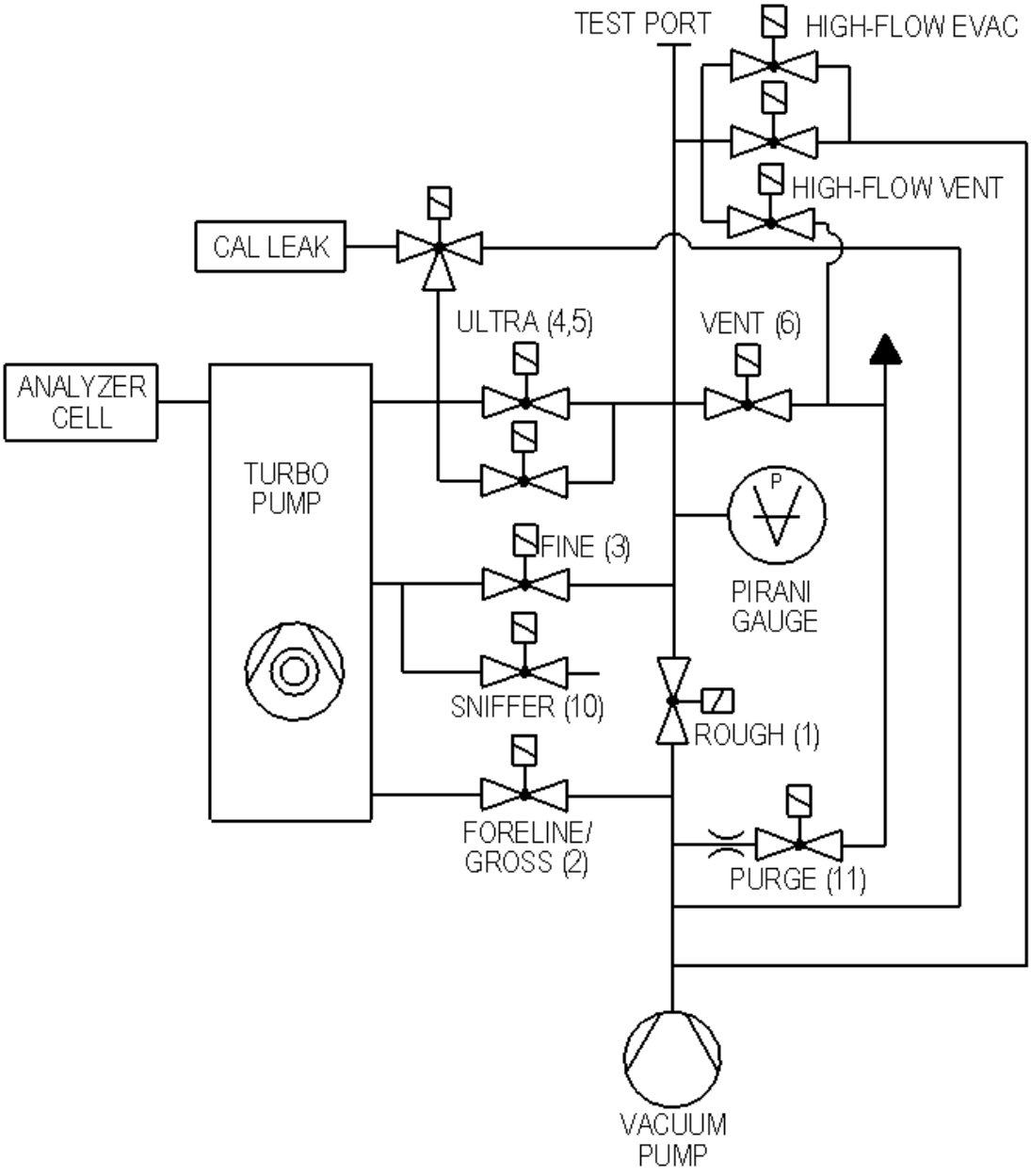


4.6. Vacuum Diagrams

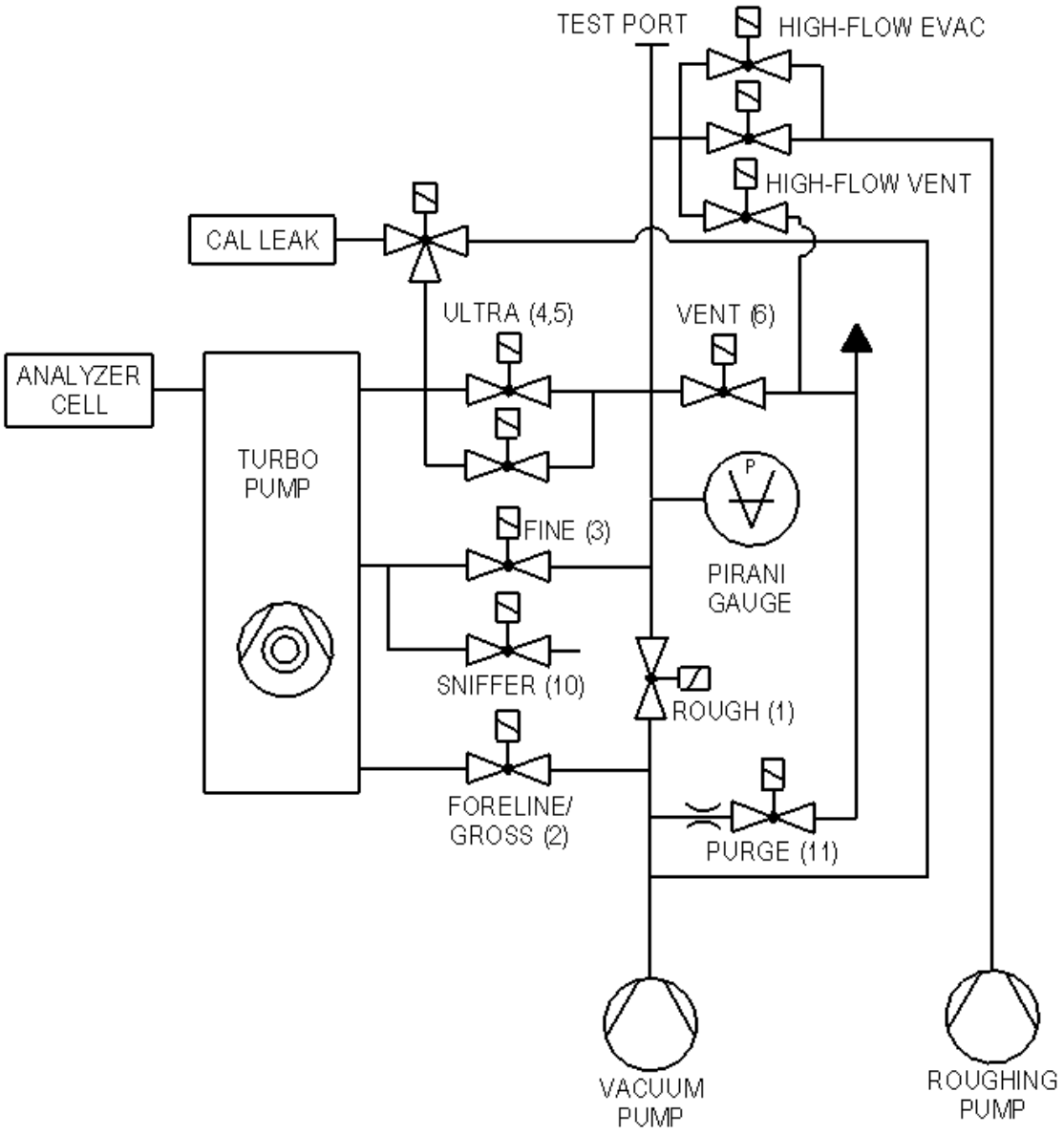
4.6.1. Vacuum Schematic – Main Version



4.6.2. Vacuum Schematic - High-Flow Evac and High-Flow Vent with One Pump



4.6.3. Vacuum Schematic High-Flow Evac and High-Flow Vent with Two Pumps



5. Installation

5.1. Mechanical Setup and Mounting

The leak detector must be installed on a flat, horizontal surface, supported by its feet, with the leak detector's inlet port on the top. Ensure the mounting surface is stable and well-supported. Choose the location for setup according to the specifications of the detector in Technical Data and Feature Locations and Dimensions.

Do not move the TITAN VERSA while in use. Wait five minutes after a full power shutdown to move the unit.

WARNING: Danger from moisture and electricity

Moisture penetrating the device can lead to personal injury from electric shock and to material damage from short circuits.

- Only operate the TITAN VERSA in a dry environment.
- Operate the TITAN VERSA away from sources of liquid and moisture.
- Position the device so that you can always reach the mains plug and disconnect the device from the mains by unplugging the mains plug.

NOTICE: Material damage due to overheating

The device heats up during operation and can overheat without enough ventilation.

- Ensure there is enough space for ventilation. Leave at least 20 cm of free space on the sides of the leak detector, and at least 10 cm in the front and rear.
- Keep heat sources away from the device.
- Do not expose the device to direct sunlight.

NOTICE: VACUUM PUMP OIL

All wet pump units are shipped with vacuum pump oil in the pumps.

5.2. Mechanical Connections

5.2.1. Vacuum Test Port

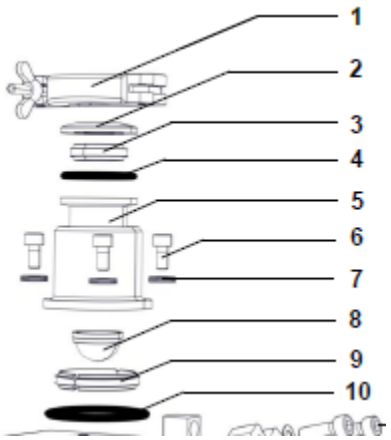
NOTICE: Ensure the parts or test chamber connected to the KF25 inlet of the TITAN VERSA can withstand a negative pressure of 1 bar (15 psi) in relation to atmospheric pressure.

- The maximum permitted weight at the vacuum test port must be no more than 15 kg and the maximum torque must be 10 Nm.
- The inlet pressure of test part or chamber must be no higher than atmospheric pressure, otherwise detector will be damaged.
- Remove the KF-25 blank-off flange on vacuum test port inlet and save it for reuse during storage or transport.

5.2.1.1. Inlet Port Filtration

Each TITAN VERSA unit is proved with two mesh screens filters as outlined in the picture below. These filters should be cleaned yearly, or more frequently in dirty applications.

Figure 1: Inlet Mesh Screen Filters – Items 8 and 9



The sintered bronze filter (P/N: LVF-B-2.5-0.75-40-NW25) is recommended for applications where there are dirty environments or testing of dirty parts. This filter provides 40-micron protection and leads to increased leak detector life.

Place filter into inlet test port with filter towards the inside of the manifold.

Figure 2: Bronze Filter Installation

The filter should be cleaned with clean, dry air every three months and replaced every 18 months.

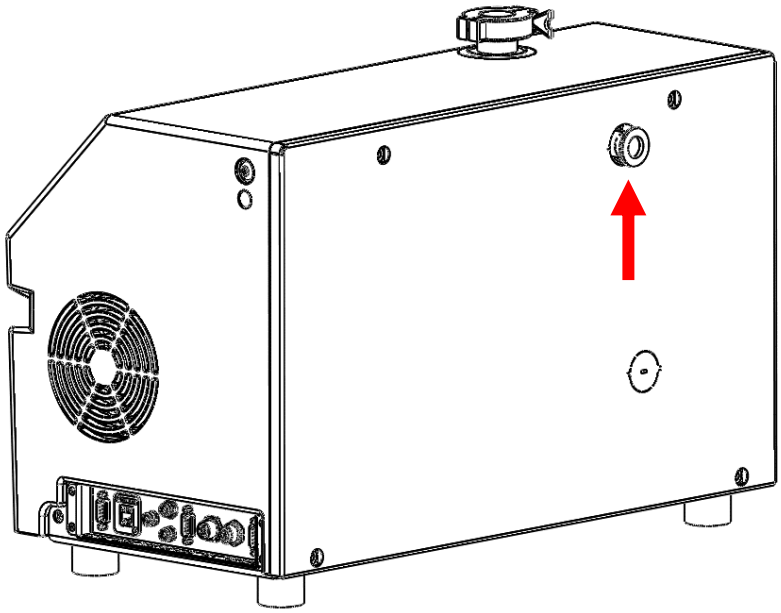
5.2.1.2. Optimized Vacuum Test Performance Recommendations

- Verify test setup has proper hoses, connections, and valves in accordance with good vacuum practice.
- Use pipe with a diameter equal to the diameter of the detector's inlet. The pipes should be as short as possible and completely sealed.
- Do not use plastic hoses such as compressed air pipes.
- Check that the connected part/installation is impermeable to tracer gas.
- Test only clean, dry parts or installations with no trace of water, vapor, paint, detergent, or rinsing products.
- Test that the entire line is completely sealed when the detector is attached to the pumping circuit to ensure the connections (pump, pipe, valves, etc.) are correct.

5.2.2. VERSA C External Pump Connections

The VERSA C (Compact) configuration does not include a primary vacuum pump. The user must supply the following items in this configuration:

- Primary pump meeting the following specifications:
  - Ultimate pressure below 3 mbar
  - Pumping speed greater than 2 m3/h
- Vacuum hose with KF-25 end connection
- Power connection to external primary pump



5.2.3. High-Flow Evac Valve Connections

Table 9 and 10 below outline the required connections for various High-Flow Evac conditions for the different TITAN VERSA models.

Table 9 *High-Flow Evac Internal Configurations*

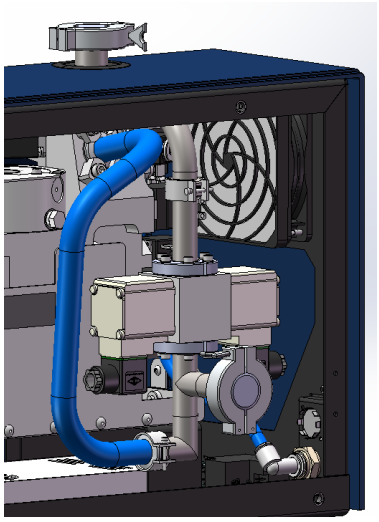
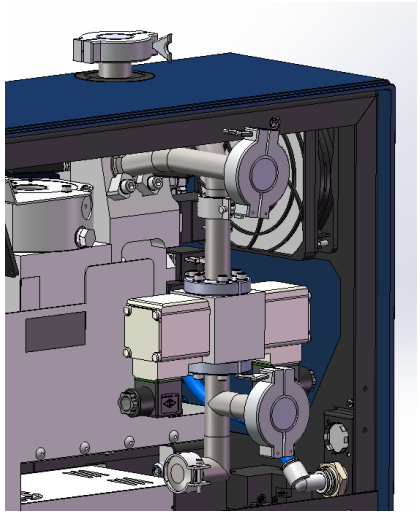
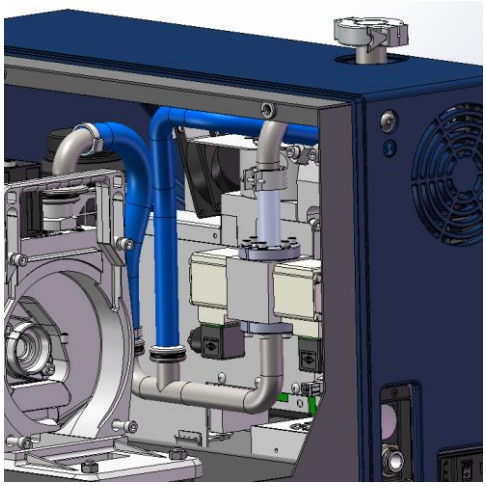
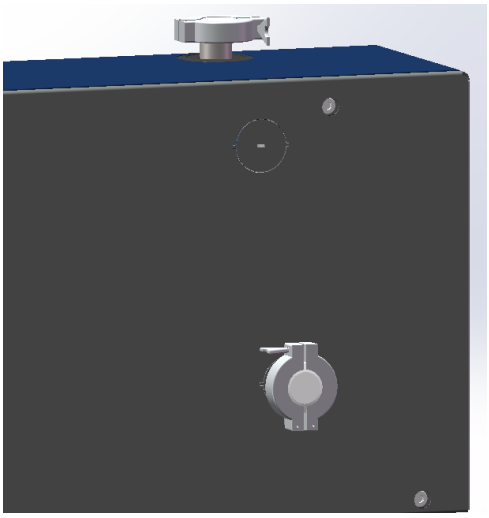
	One Pump High-Flow Evac	Two Pump High-Flow Evac
VERSA C (Compact)		
VERSA T (Tower)	This version not available	
VERSA L (Horizontal)		This version not available

Table 10 *VERSA High-Flow Evac External Configurations*

	One Pump High-Flow Evac	Two Pump High-Flow Evac
VERSA C (Compact)		
VERSA T (Tower)	This version not available	

5.2.3.1. VERSA C (Compact) High-Flow Evac

The default configuration for the VERSA C (Compact) is the single pump configuration (using lower port). If the user desires faster cycle times or is testing a contaminated part, a two-pump configuration may be used. The smaller pump should be connected to the higher port and the larger pump to the lower port.

All Compact High-Flow Evac configurations include a conversion kit. Follow the steps below to convert to a two-pump configuration.

1. Remove back cover.
2. Remove hose assembly.
3. Install KF-16 blank off on bottom elbow assembly.
4. Install bent elbow nipple in vacuum block.
5. Install back cover.
6. Connect smaller pump to upper KF-25 port.
7. Connect larger pump to lower KF-25 port.

5.2.3.2. VERSA T (TOWER) High-Flow Evac

The VERSA T model requires an external pump. Connect the external pump to the KF-25 port on the back cover. Ensure all connections are leak tight.

5.2.3.3. VERSA L (HORIZONTAL) High-Flow Evac

The VERSA L model uses the internal pump only. No external connections are needed.

5.2.4. Sniffer Port

1. Connect the sniffer probe into the sniff port.
2. Connect the sniffer line before you press the “Start / Stop” button when in sniff mode.

If the sniffer line is removed during operation, the device reports an error. The device also reports an error when the sniffer line is not connected and “Sniff” operating mode is active. The sniffer probe can be connected whether in sniff mode or in vacuum mode. A selection of appropriate sniffer probes is listed in the Accessories section.

5.2.5. Multi-Use Ports

Table 11 summarizes the port configurations and locations for all TITAN VERSA configurations. Ports include:

- Vacuum vent
- Pump exhaust
- Oil drain and oil fill

Table 11 *TITAN VERSA Multi-Use Ports and Locations*

Port ID	1	2	3	4	Oil Fill
Model	Left Side, Bottom		Back Side, Bottom		
VERSA C	Vent	Blank	N/A	N/A	N/A
VERSA T - Wet	Vent	Pump exhaust	Oil drain	Spare	Remove Back Cover
VERSA T - Dry	Vent	Spare	Pump exhaust	Spare	N/A
VERSA L - Wet	Vent	Spare	Oil drain	Pump exhaust	Hole in top rear cover
VERSA L - Dry	Vent	Spare	Pump exhaust	Spare	N/A

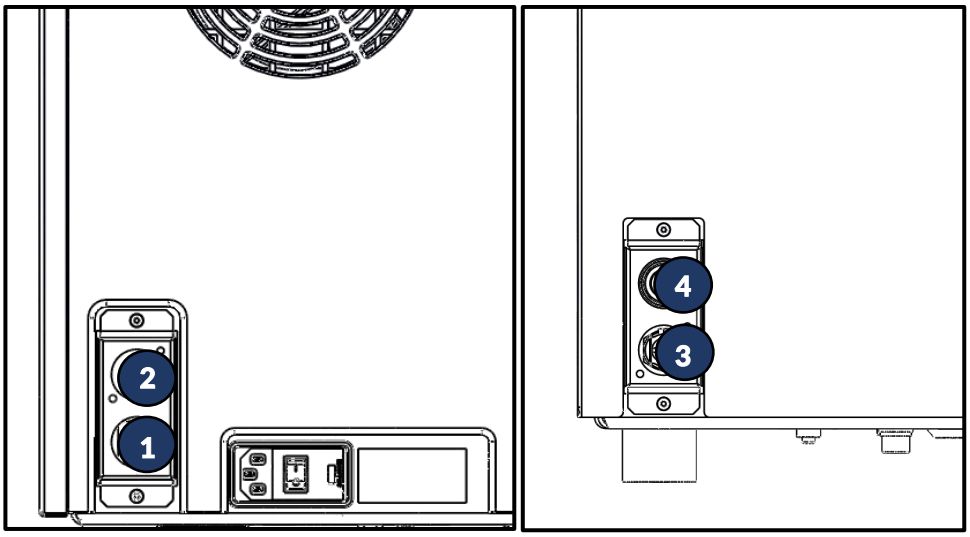
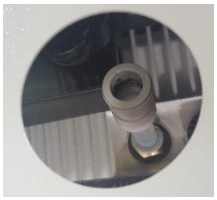


Table 12 *TITAN VERSA Multi-Use Port Details*

Port	Specification	Picture
Vacuum vent	12 mm tube	
Pump exhaust (wet pump)	12 mm tube	

Port	Specification	Picture
Pump exhaust (dry pump)	Silencer	
Oil drain (wet pump)	CPC QD	
Oil fill (quick method)	12 mm tube OD	

5.2.5.1. Vacuum Vent

NOTICE: Vacuum vent connections

- Do not pressure vent connection to over 1.1 bar absolute (16 psia or 1.5 psig).
- If vent gas is used, ensure the gas is clean and filtered, and testing is performed in a well-ventilated test area. Nitrogen or dry air gases are recommended.

The vacuum vent connection consists of 12 mm push tube connection. The port vents the vacuum test line back to atmosphere pressure after a test is completed. It is always labeled with a “VENT” label.

If the testing area air concentration is free from tracer gases, this connection can typically be left open and the test volume will be vented with ambient air. Alternatively, users can install a tubing section to ensure vent air is coming from a cleaner area. Ensure tube section is less than two meters or six feet (see P/N: LMSA5503 for 6-foot tube section).

LACO recommends the Gas Vent Module (P/N: TV118018) for the following applications:

- High humidity
- Test areas with high helium backgrounds
- Production test with fast cycles
- High sensitivity testing (<1 x 10^{-8} mbar*L/sec)

See the *Gas Vent Module Manual* (SMT-07-1047) for more information.

5.2.5.2. Pump Exhaust

WARNING: Danger from exhaust gases and vapors

- Exhaust gases and vapors from oil-sealed pumps may be harmful to health.
- When operating the device in poorly ventilated spaces, mount an exhaust gas line on the TITAN VERSA.

The pump exhaust for VERSA wet pump versions consists of a 12 mm push tube connection. If the VERSA is operated in poorly ventilated spaces, an exhaust gas line is recommended. An exhaust gas line is not included in the scope of delivery. It is the duty of the owner to provide an exhaust gas line and to ensure the discharge of exhaust gases. Do not connect long tube sections to this port; this can adversely affect pump performance. Use short, large-diameter tubing sections (see P/N: LMSA5503 for 6-foot section).

Dry pump versions contain a muffler for the pump exhaust and are to be left alone. Mufflers should be replaced every two years under typical operations.

5.2.5.3. Vacuum Pump Oil Drain

For TITAN VERSA models that use wet pumps, a quick disconnect vacuum pump port is provided. In the TITAN VERSA Tools and Spares Kit there is a drain line connection assembly (P/N: TV118495) that can be used to easily drain the vacuum pump oil. See the following oil change sections for more details.

- VERSA T oil drain
- VERSA L oil drain

5.2.5.4. Vacuum Pump Oil Fill

See the following sections for details on oil change and oil fill.

- VERSA T oil fill
- VERSA L oil fill

5.3. Electrical Power Connection

NOTICE: Equipment damage can occur due to incorrect supply voltage

An incorrect supply voltage may damage the device.

1. Check whether the supply voltage specified on the TITAN VERSA product label matches the supply voltage available on site. Verify the available power source matches product voltage.
2. Connect the device to the electric power supply using the supplied power cable.

5.4. Electrical Interfaces

Electrical interface connections are located on the right side of all TITAN VERSA configurations. Table 13 summarizes all the interfaces, connection specifications, parts, and accessories used with each connection.

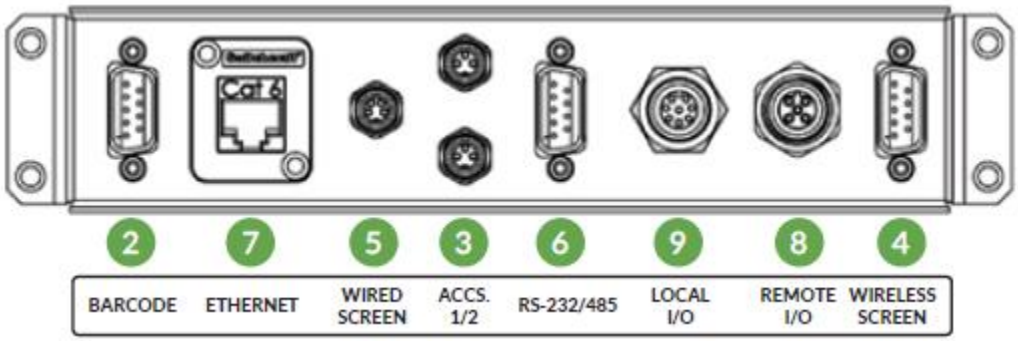


Table 13 *TITAN VERSA Electrical Interface Summary*

ID	Interface	Connection Type	Part Number
1	USB Host	USB Type A (2.0)	• TV5928 (4 GB)
2	Barcode Reader (1D and 2D)	DB9, male	• TV118566
3	Accessory 1 & 2	M8, 3 pin, female	• TV5942 (screw terminal connector) • TV5945 (5M cable) • See Accessory Table – Accessory 1 and 2 items
4	Wireless Pendant	DB9, male	• TV118486
5	Remote Wired Screen	M8, 4 pin, female	• TV115895 (module) • TV5843 (1 m cable) • TV5844 (3 m cable) • TV5845 (5 m cable)
6	Serial (RS232 and RS485)	DB9, female	• TV5946 (3 m M-F cable) • LMSA0360 (USB to serial adapter)
7	Ethernet	RJ45	• LMSA3508 (3 m Cable)
8	Remote I/O (8 digital inputs, 8 digital outputs, 2 analog outputs)	M12, 5 pin, female	• TV115893 (module) • TV5839 (1 m cable) • TV5840 (3 m cable) • TV5841 (5 m cable)
9	Local I/O	M12, 8 pin, female	• TV5944 (screw terminal connector) • TV5943 (5 m cable) • TV118379 (Start / Stop box)

5.4.1. USB Port

A USB host port is provided next the sniffer port on the front of the unit. The user shall only plug in a USB drive to the port. No other USB devices are supported. The USB port is provided for the following features:

- Data Log Settings
- Software Updates

LACO provides a USB drive (P/N: TV5928) with shipment of each unit. This drive contains TITAN VERSA documentation files and can also be used in conjunction with data logging and software updates.

5.4.2. Local I/O

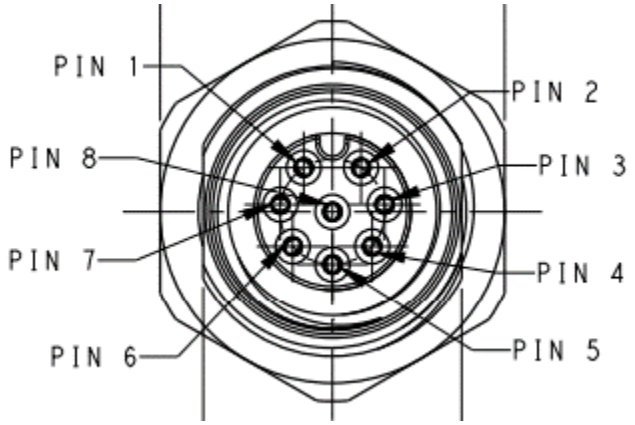
The TITAN VERSA is equipped with a local I/O on the M8 pin per table below. The local I/O is provided primarily for the analog output features. See Local I/O for configuring local analog inputs.

For traditional leak detector I/O, see Remote I/O.

Table 14 *Local I/O Pinout*

PIN	Function	I/O Group	Comments
1	+5 V	Digital Output Power	Use with digital outputs
2	Start / Stop Test	Digital Input	Connect pin to GND to start or stop test
3	Ground	Ground	For analog outputs and digital input
5	Analog Output 1	Analog Output (0-10 VDC)	Default to Leak Rate Mantissa
4	Analog Output 2	Analog Output (0-10 VDC)	Default to Leak Rate Logarithmic
6	Analog Output 3	Analog Output (0-10 VDC)	Default to Leak Rate Exponent
7	Selected Test Mode Reached	Digital Output	Open Collector. Connect 5V pin and output pin.
8	Leak Rate greater than Reject Point	Digital Output	Open Collector. Connect 5V pin and output pin.

Figure 3: Local I/O Pin Locations



The local I/O is provided primarily for the analog output features. See Local I/O operation section for details on configuring local analog inputs.

NOTICE: Digital outputs utilize 5-volt open collector logic with very low current. LACO recommends using a solid-state relay with a 5-volt coil (P/N: LMSA5981) to drive other voltages (i.e. 24 VDC) or larger current loads.

Figure 4: LMSA5981 Solid Relay for use with Local I/O digital outputs

The remote Start/Stop module can be connected to the Local I/O port to provide a remote connection with the following feaures:

- Standby Mode – Press button to start test cycle.
- In Mode – Press button to end cycle.

Figure 5: Start/Stop Box (TV118379)

5.4.3. Serial Port

The serial communication serial port (female DB-9) has both RS232 and RS485 protocols available. Table 15 below outlines the pinout for the DB-9 connector. The following baud rates are available in Communication settings: 9600, 19,200, 57,600 and 115,2000. These can be set at Menu > System > Communications. All communication follows these additional serial settings:

- Bits: 8
- Parity: None
- Stop Bit: 1

The RS485 protocol is integrated without a Node ID address.

➔ Serial communication should not have message rates faster than 100 msec per message.

See the *TITAN VERSA Communication Interface Manual* (SMT-07-1038) for information on the protocols and syntax to access information from the leak detector.

A null modem crossover cable is required to communicate from a PC to the leak detector (see P/N:TV5946 for 3-meter M-F cable). If a user's computer does not have DB9 serial port, use a USB to serial adapter (P/N: LMSA0360).

Table 15 *Serial DB9 Pinout*

PIN	Function
1	RS485 A+
2	RS232 TxD
3	RS232 RxD
4	NC
5	Gnd, RS232
6	NC
7	NC
8	NC
9	RS485 B-

5.4.4. Ethernet Port

The RJ45 Ethernet port is currently not functional. Functionality will be added in a future software release.

5.4.5. Barcode Reader

To access the barcode reader features, the LACO barcode reader (P/N: TV118566) must be used. Both 1D and 2D barcodes may be used with this reader.

Connect the barcode reader to the male DB-9 Barcode reader port. When powered correctly the unit will beep shortly. Scan any barcode on the Test ID screen.

Barcode reader entry allows for quick entry of critical test ID data. See Test ID for more details.

5.4.6. Remote I/O

The Remote I/O module (P/N: TV115893) can be connected to the Remote I/O port with three different cable lengths.

- TV5839 (1 m cable)
- TV5840 (3 m cable)
- TV5841 (5m cable)

The module is powered by 24 VDC power from the TITAN VERSA and is fused at 2.0 amps. In case of short circuit, replace fuse F2 (see Fuses for instructions on fuse replacement). The module is DIN rail mountable.

The module provides the I/O functions listed in Table 16. See the *TITAN VERSA Remote I/O Manual* (SMT-07-1040) for more details on the module.

Table 16 *Remote I/O Functions Summary*

I/O Function	Total	Detail	Electrical Spec.
Digital Input	8	8 Bi-directional (PNP or NPN)	15-30 VDC On Voltage, Optical Isolation,10 msec response
Digital Output	8	6 Relay 2 PNP transistor	Relay: DC or AC load Transistor: 24 VDC, 250 mA max
Analog Output	2	Voltage (0-10 VDC) or Current (4-20 mA)	12-bit A-D, 0.2% of full scale Current - max load 500 Ohm Voltage – max load 1000 Ohm

The TITAN VERSA I/O module offers the following benefits over a traditional leak detector I/O on DB25 or DB37 connector:

- Ability to put I/O module where needed (critical in production leak testing applications)
- Easy I/O wiring with no soldering needed; just a screwdriver is required
- 24 VDC logic inputs and outputs
- Flexible digital inputs – PNP or NPN
- 4-20 mA analog outputs provide less noise and longer runs

5.4.7. Accessory Features

Two accessory ports allow the following functionality to be added to the TITAN VERSA:

- High-Flow Evac valve
- High-Flow Vent valve
- Pass / Fail light

24 VDC power is provided (fused at 2.0 amps—see fuse F1) to all accessory functions. Table 17 below identifies the function of each pin on accessory connectors.

Table 17 *Accessory Pin Functions*

PIN	Function
1 - BRN	Normally closed connection (24 VDC in off position)
3 – BLU	0 VDC
4 - BLK	Normally open connection

Figure 6: Accessory Pin Locations

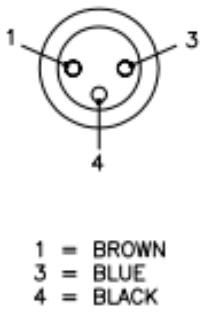


Table 18 below contains a list of current accessories and how to connect them. After connecting an accessory, go to Menu > System > Accessories to configure the accessory.

Table 18 *Accessory List, Connections, and Reference*

Accessory	Connection	Reference
High-Flow Evac	Always Accs. 1 (internally)	SMT-07-1046
High-Flow Vent	Accs. 1 or Accs. 2 (internally)	
Pass / Fail Light	Accs. 1 and Accs. 2 (externally)	This section

The pass / fail light assembly illuminates a pass or fail depending the final leak rate value vs. the reject limit.

Figure 7: Pass / Fail Light Assembly (P/N: TV118378)

5.4.8. Remote Wired Screen

The remote screen accessory allows users to mount a remote screen when the main screen is not accessible. Connect the M8 cable from remote screen port to male M8 port on the remote screen. Configure remote screen to Menu > System > Accessories.

See the *Remote Screen Manual* (SMT-07-1041) for more information on the screen and various mounting options.

Figure 8: Remote Wired Screen

5.4.1. Wireless Handheld Pendant

When configuring the Wireless Handheld Pendant, use only the wireless connection option and hardware. To connect the Wireless Handheld Pendant:

1. Power on the leak detector
2. Connect the serial to Bluetooth adapter into wireless remote male DB9 port and power on the adapter. Note the MAC address.

3. Power on the remote.
4. From the list, select the correct MAC address. Unit is connected wirelessly and directs to home page.

Refer to the *RC10 Manual* (P/N: 124628) for more information.

Figure 9: Wireless Handheld Pendant

5.5. Disposal of the TITAN VERSA

The device can be disposed of by the user or sent to LACO Technologies for disposal. The device is made of recyclable materials. Use this option to avoid waste and to protect the environment.

➔ Please comply with the environmental and safety regulations of your country when disposing of the device.

5.6. Service for the TITAN VERSA

LACO Technologies offers first-class service of your TITAN VERSA, including:

- On-site maintenance for TITAN VERSA and other products
- Overhaul and repair at the Salt Lake City Service Center
- Fast device replacement with refurbished exchange products in exceptional condition
- Expert advice on cost-efficient and quick solutions to your service needs.
- Available rentals when a TITAN VERSA is sent for repair or preventive maintenance.
- On-site and LACO facility trainings for TITAN VERSA and many other LACO products.
- Original parts on all repairs and preventive maintenance

For more information on our services, see: LACO Service Solutions, or contact LACO Technologies directly:

- **Phone:** 801-486-1004 | Toll Free: 800-465-1004 (Service Department)
- **Email:** Service and Repairs: repairs@LACOtech.com

WARNING: Danger due to harmful substances

Products sent to LACO Technologies must be free of harmful substances. Products that are contaminated with radiation, toxins, caustic, or microbiological substances cannot be sent to LACO. When sending products to LACO, a Hazardous Material Declaration must be filled out and included with the leak detector.

6. Operation

6.1. Prerequisites for Use

Refer to Factory Default Settings for information on initial settings. It is likely the operator will change the default settings to support their unique application.

NOTICE: Risk of seizing

Never move the detector while the unit is powered on, even if it is placed on a moveable cart.

NOTICE: Filling with oil

For VERSA models using wet pumps, oil level must be between min and max level prior to being switched on.

NOTICE: Connecting the primary pump

For VERSA C models, the external primary pump must be connected and powered up before the detector is switched on.

Each time before powering on the TITAN VERSA:

1. Become familiar with the safety instructions (see
2. Safety).
3. Check that all the connections are correct (see Installation).
4. Ensure that leak detector will be operating in an environment free of tracer gas.
5. Check the electrical network is properly attached to the connector using the power cable.

6.2. Power-On Process

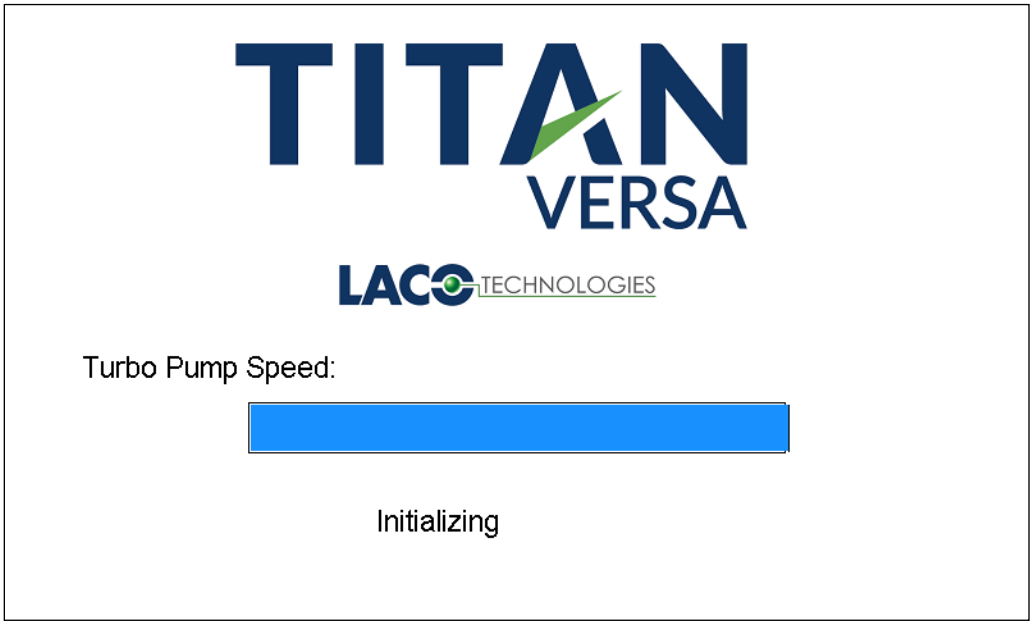
1. Connect the necessary accessories or equipment before powering on the device.

Operating Mode	Connect to device
Sniff mode	Sniffer probe on vacuum chamber flange
Vacuum mode	Test object
Any test mode	Accessories needed per test

2. To power on the VERSA C, the user must power on their external pump prior to switching on the leak detector.

3. Verify proper operation voltage per the product label and switch on the device with the power entry module. The TITAN VERSA will energize and go into startup phase.

4. During startup, the turbo pump will spin up to full speed (1500 Hz). The startup time for the turbo pump ranges from two to five minutes. After the turbo pump reaches full speed, the Mass Spectrometer (Mass Spec) will verify filament function and proper emission.



➔ If the leak detector has not been used for 15 days, the unit will undergo a storage delay setup.

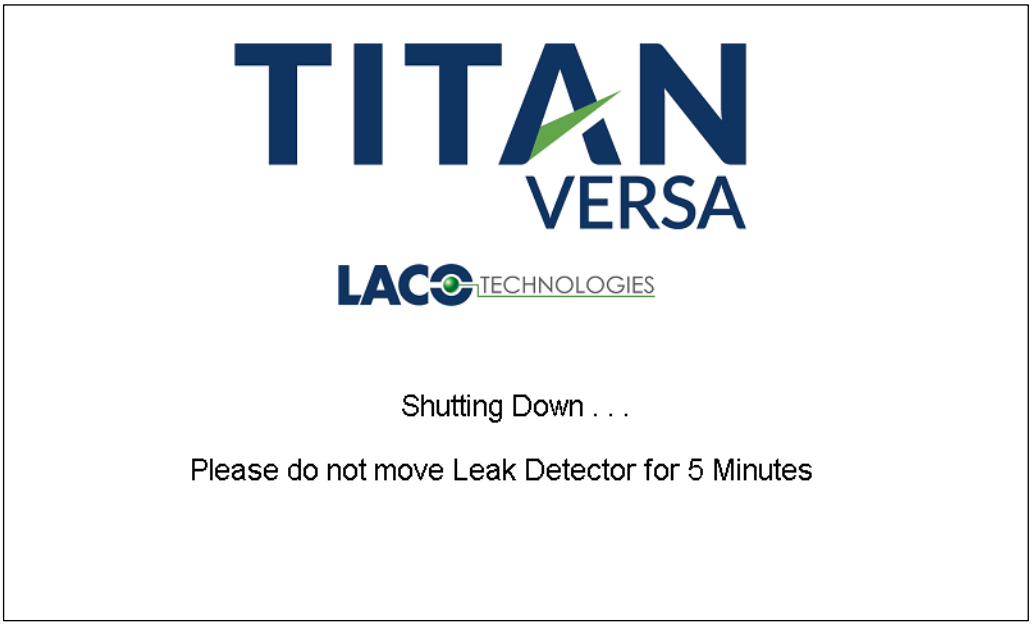
5. After startup is complete, the test screen appears, and the leak detector status will read “Standby”.

NOTICE: Allow the device to warm up for 20 minutes before making exact measurements or executing a calibration.

6.3. Power-Off Process

The TITAN VERSA can be powered off at any time by turning off the switch on the power entry module.

During shutdown, the main controller and screen remain powered for an additional 90 seconds, using stored energy from the turbo pump controller. Note that during this state, only the control system is power on; the vacuum pumps and detector and powered off.



During shutdown, the purge valve (valve 11) opens to vent the pump foreline. This feature prevents oil migration in the cell block in the case of anti-suck back valve failure on a wet pump.

NOTICE: Safe to move detector

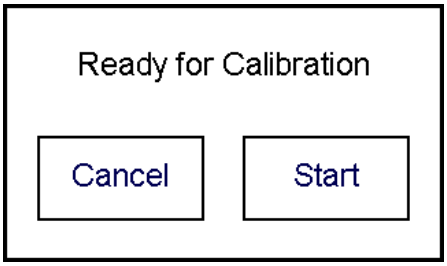
Only after the leak detector has been powered off for five minutes is it safe to move the unit.

6.4. General Use Guidelines

6.4.1. Calibration

NOTICE: Calibration Frequency

After the leak detector has been powered on for 20 minutes, the calibration warning screens appears. It is recommended operators calibrate the unit 20 minutes after each time the unit is powered on.



NOTICE: Calibration Settings

Verify all calibrated leak settings are correct before performing a calibration. Refer to Calibration Settings.

NOTICE: Leak Standard Calibration Frequency

LACO recommends the internal calibrated leak standard be calibrated at least every two years.

Sniff calibrated leaks and higher leak rate external leaks (> 1.0 e-6 mbar*L/sec) should be calibrated yearly, or more frequently if the depletion rates are large.

The TITAN VERSA Leak Detector offers both internal and external calibrations as outlined in the table below.

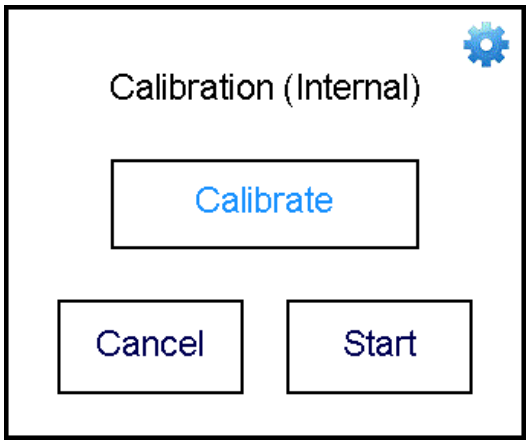
Table 19 *Calibration Types per Mode and Mass*

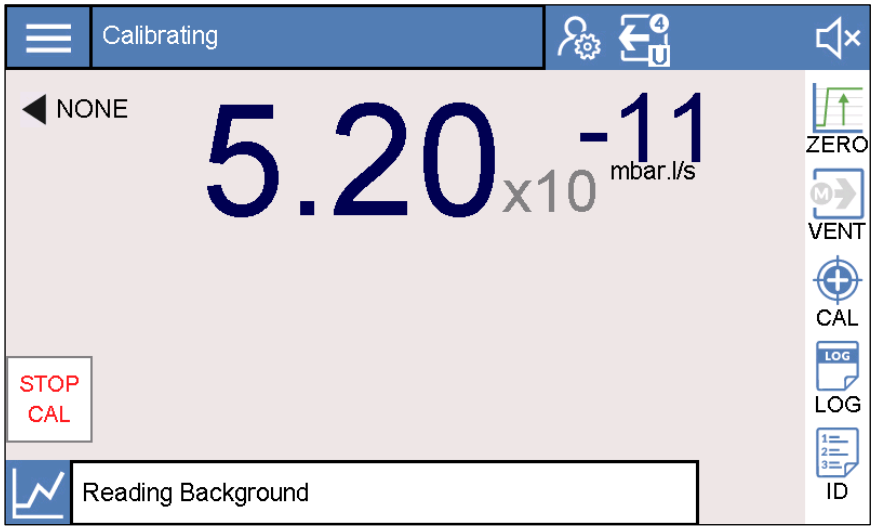
ID	Test Mode	Test Gas Mass	Calibration Type
1	Vacuum	Helium 4	Internal
2	Vacuum		External
3	Sniff		
4	Vacuum	Helium 3	
5	Sniff		
6	Vacuum	Hydrogen	
7	Sniff		

6.4.1.1. Internal calibration

1. Press the Calibrate Icon.

2. In this screen the user can select the gear icon to review calibrated leak settings (see Calibration Settings). In the Cal Type box, there are two options: Calibrate or Cal Check. Calibrate will always be default. Press Start button to start calibration.





3. The unit will proceed through an automated calibration sequence. The user can press the Stop Cal button if they wish to abort the calibration. The calibration sequence has the following main states: peak find, peak measure, and background check. During a calibration, the acceleration voltage and the calibration factor are changed. During background check, the detector verifies acceptable background readings. This background reading is used for the background suppression feature.
4. If the unit fails a calibration the user will be notified. See Calibration History for more information on reviewing calibration results.

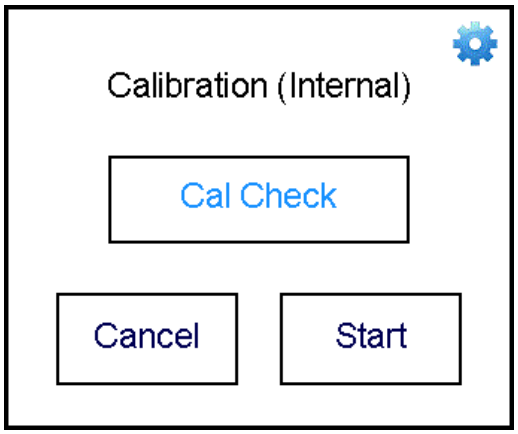
6.4.1.2. Calibration Check (Cal Check)

NOTICE: Cal Check Availability

Note: Cal Check is only available for helium (mass 4) testing in vacuum method with the internal calibrated leak selected.

1. Press the Calibrate Icon.

2. In the Cal Type box, there are two options: Calibrate or Cal Check. Toggle the Cal Type button to select Cal Check and press the Start button.



3. The unit will proceed through the peak measure and background check sections of a calibration cycle. The detector verifies the calibration reading is within 20% of adjusted leak rate value.
4. If the unit fails a Cal Check the user will be notified via a warning. See Calibration History for results on both Cal Checks and calibration cycles.

6.4.1.3. External Calibration – Vacuum Method

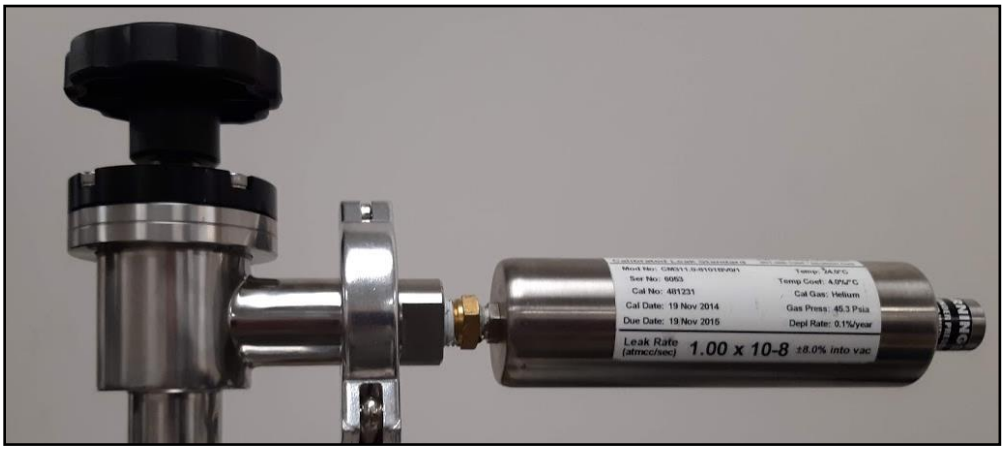
NOTICE: External Vacuum Calibration Availability

The external vacuum calibration method is available for all test gas masses.

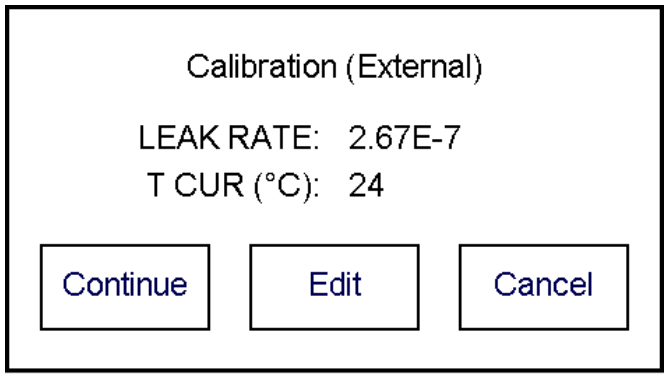
NOTICE: External Calibrated Leak Settings

Verify the calibrated leak is within calibration and the correct calibrated leak settings are entered. External leaks require the user to enter an estimated calibrated leak temperature. LACO manufactured leak standards are very temperature independent, so entering an average temperature of around 25 °C will work for most applications.

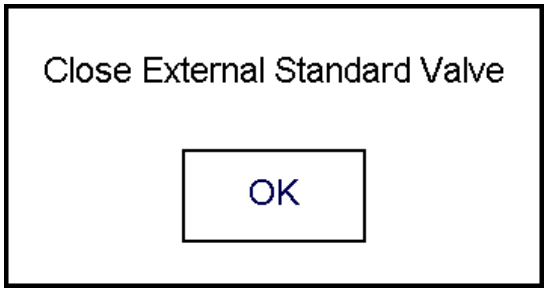
1. Set Calibrated leak type to External (see Calibration Settings).
2. Place the calibrated leak standard, with integrated isolation valve, onto the KF-25 inlet test port with the calibrated valve open.



3. Press the Calibrate icon.
4. Verify the Calibrate option and press Start.
5. Verify External Calibrated leak setting configurations. Press Continue to start the calibration or Edit to change the calibrated leak valve settings.



6. Confirm calibrated leak valve is open.
7. Calibration proceeds through peak find and peak measure.
8. Dialog prompts user to close calibrated leak valve. After valve is closed, press Continue.



9. If the unit fails a calibration, the user will be notified. See Calibration Settings for more information on reviewing calibration results.
10. Remove calibrated leak valve from test inlet port.

6.4.1.4. External Calibration – Sniff Method

NOTICE: External Sniff Calibration Availability

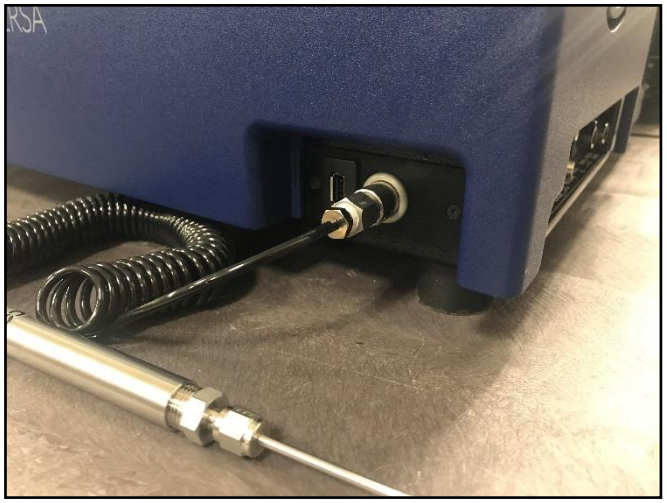
The external sniff calibration method is available for all test gas masses.

NOTICE: External Sniff Calibration Availability

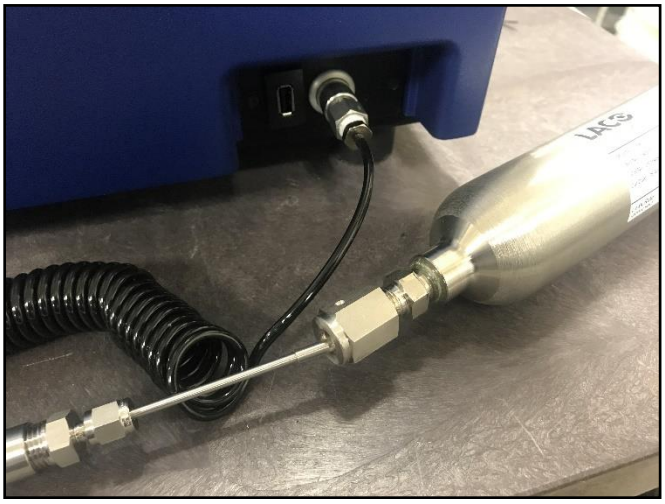
Verify the calibrated leak is within calibration and that the correct calibrated leak settings are entered. External leaks require an estimated calibrated leak temperature. LACO manufactured leak standards are very temperature independent, so entering an average temperature of around 25 °C will work for most applications.

Sniff calibrations do not require a valve on the calibrated leaks standard. Contact LACO for the industry's largest selection of calibrated leak standard options.

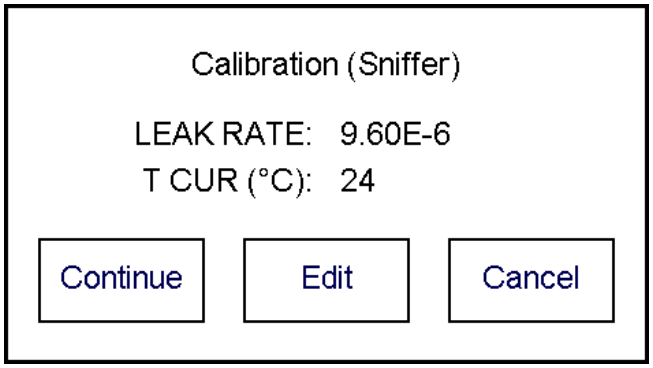
1. Set Calibrated leak type to External.
2. Insert sniffer probe into sniff test port inlet.



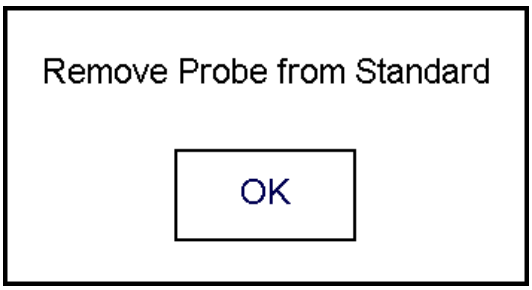
3. Use a sniff calibrated leak standard. This type of leak standard is different than other vacuum-style calibrated leaks in that the leak element is built directly on the end the calibrated leak element.
4. Place the sniffer probe into the calibrated leak inlet port.



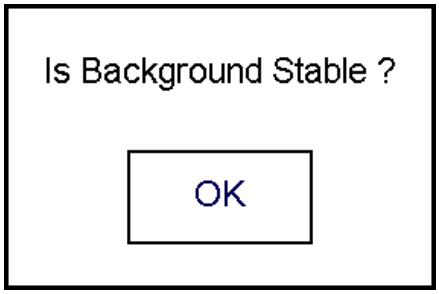
5. Press the Calibrate icon.
6. Press Start.
7. Verify External Calibrated leak setting configurations. Press Continue to start the calibration or Edit to change the calibrated leak valve settings.



8. Confirm sniffer probe is connected and leak rate is stable. Keep sniffer probe inserted.
9. Calibration proceeds through peak find and peak measure.
10. Dialog prompts user to remove sniffer probe. After probe is removed, press Continue.



11. Verify the leak rate is stable. Calibration verifies background reading.

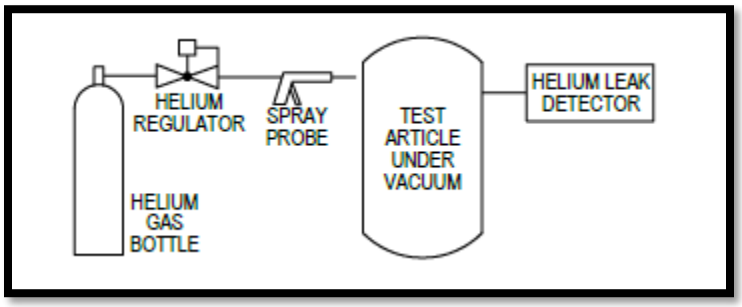


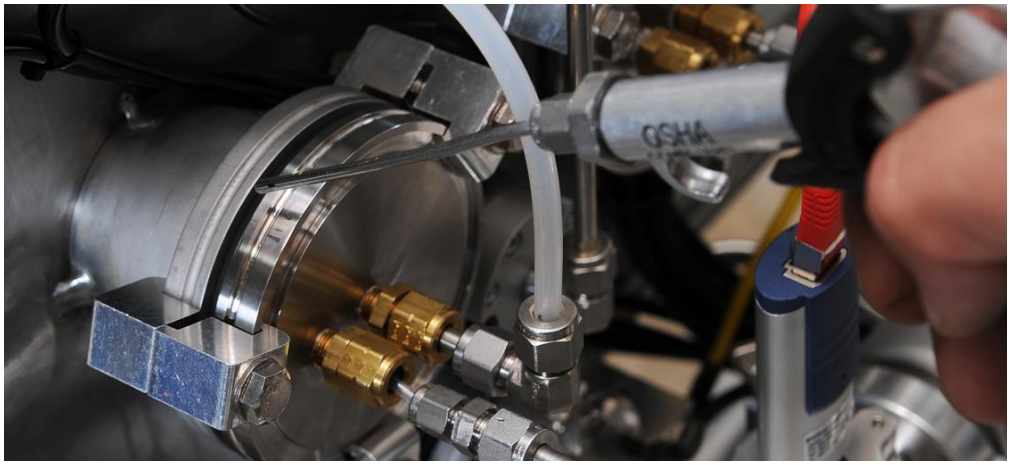
12. If the unit fails a calibration the user will be notified. See Calibration History for more information on reviewing calibration results.

6.4.2. Vacuum Method Leak Testing

6.4.2.1. Outside-In Leak Testing

In this method, the test object is evacuated (direct connection to vacuum inlet test port KF-25) and the user sprays helium to verify test leak integrity. This method allows for leak location.





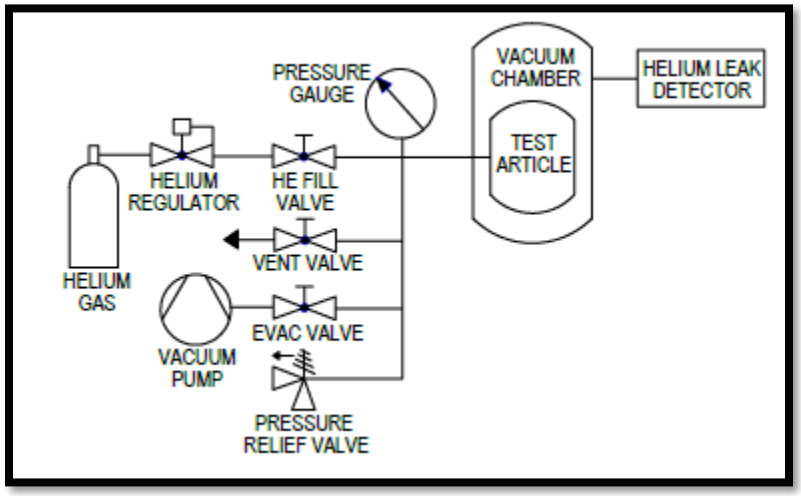
If test objects are small enough, a plastic bag can be placed over the test object and helium sprayed into bag. This method ensures helium application is global around the entire part

The following accessories can aid in test this method. See Accessories for more details.

- Helium Spray Gun (P/N: LHSP04 and LHSP07)
- LHREG-01, 0-100 psi bottle regulator for helium gas bottle (P/N: CGA580)

6.4.2.2. Inside–Out Leak Testing

For Inside–Out Vacuum leak testing, the test object is leak-tested inside a vacuum chamber. The test part can be filled with helium either before or after being placed in the vacuum chamber. The schematic below shows the test part being filled inside the vacuum chamber. This method is ideal for a high sensitivity global leak test.

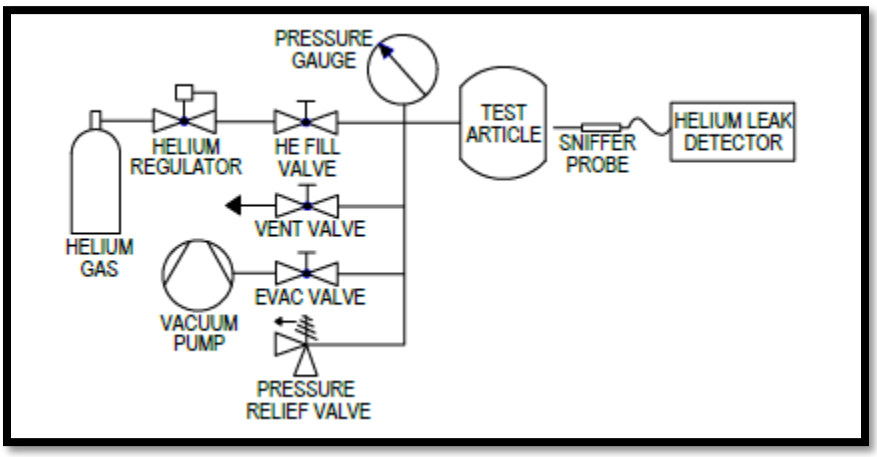


The following accessories can aid in testing using this method. See Accessories for more details.

- Gas Charge Manifold
- LHREG-01, 0-100 psi bottle regulator for helium gases (P/N: CGA580)

6.4.3. Sniff Method Leak Testing

Sniff leak testing is an atmospheric leak test method. As such, the test ultimate test sensitivity is 5e-7 mbar*L/sec. The test object is filled with helium gas (or another tracer gas) and leaks are detected with a sniffer probe. Exact leak locations can be detected. However, sometimes leaks can be missed if test operators move the probe too quickly.



The following accessories can aid in sniff leak testing. See Accessories or visit http://www.lacotech.com for more details.

- Sniffer Probe
- LHREG-01, 0-100 psi bottle regulator for helium gas (P/N: CGA580)
- Gas Charge Manifolds

6.4.3.1. Sniff Leak Testing Tips

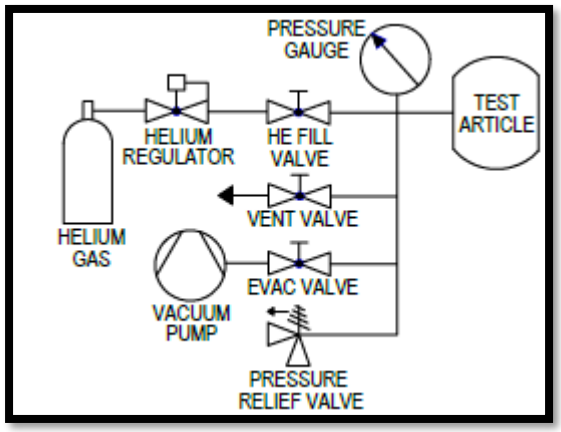
- When using a helium sniffer probe to test pressurized components or systems, ensure there are no gross leaks in the system prior to pressurizing. Gross leaks will allow the surrounding air (or background) to become contaminated with helium, which lowers the sensitivity of the leak test.
- When venting helium from a pressurized test part, do not vent in the same area where the testing is performed; this will contaminate the surrounding air with helium.
- When the ambient air is contaminated with helium, a large fan can be used to exhaust the test area and provide clean air.
- When sniffing a part with multiple potential leak locations, always begin sniffing near the bottom of the part and work towards the top. It may be necessary to repair leaks that are found before proceeding. Helium escaping from the part will rise and can give a misleading leak location.

6.4.4. Gas Charging Process

Both the Inside-Out and sniffer test methods require the test device to be filled with a tracer gas. This process should be controlled and repeatable for best leak testing results. LACO recommends the following general process:

1. Configure charge manifold as outlined in schematic below. Set helium regulator to desired test pressure.
2. Connect test part to charge manifold and turn on evac vacuum pump.
3. For gross leak check, fill test part with air and close air fill valve. Ensure test part pressure is stable.
4. Vent air and close air fill valve.

5. Open evac valve and evacuate inside of part. Close evac valve.
6. Open helium fill valve and fill part to desired pressure range. Close helium fill valve.
7. Perform leak test by sniffer method or Inside-Out vacuum method.
8. When leak test is complete, open vent valve to remove test gas. Vent tracer gas away from test area to reduce helium background in the testing area.



6.5. User Interface Features

6.5.1. Touchscreen Display and Buttons

The detector has a color touchscreen display, Start / Stop cycle button, and a user-programmable option button for the main user interface items. Table 20 below describes how each device is used to control the detector.

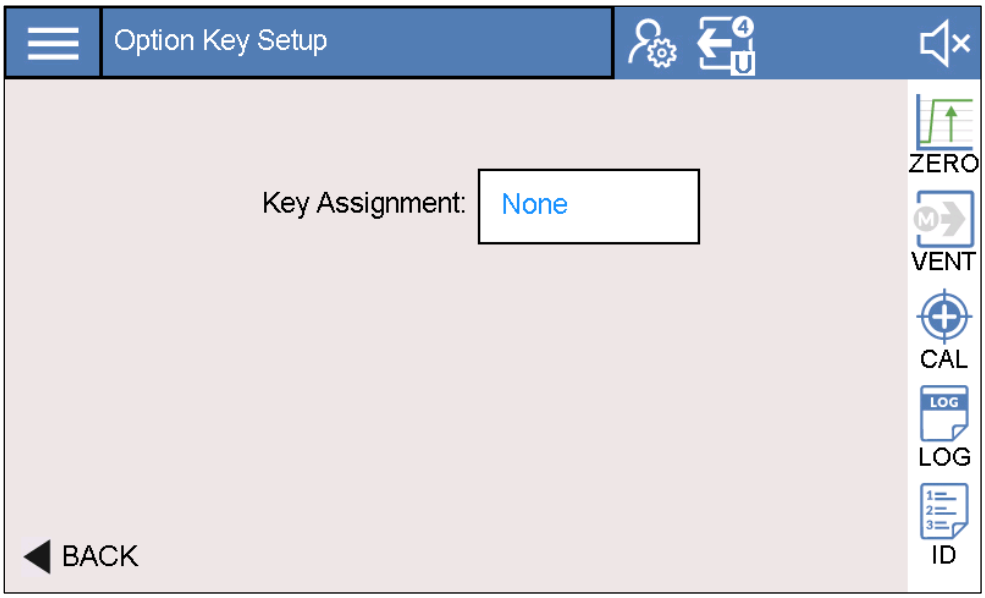
Table 20 *Control Unit Buttons*

ID	Name	Function
1	Touchscreen Display	Press on the relevant area to perform the needed functions. The settings for many functions can be accessed quickly by pushing down on an icon for more than 1 second.
2	Start / Stop	When in standby mode, press button to start a cycle. When in test mode, press the button again to stop the test cycle.
3	Option button	User can configure button to perform these commonly-used functions: None, Zero, Vent, Data Log On, Alarm. The default setting is None.

6.5.2. Option Button

The Option button allows the user to have quick access to a custom programmed, physical button for a commonly-used feature. The selection of the Option button is located to the right of the physical button on the touchscreen.

➔ To edit the current configuration, press and hold the screen area for one second. The following screen appears. The user can toggle through the various options as outlined in Table 21.



The Option button can also be edited from Settings > System > Display.

Table 21 *Option Button Selections*

Option Function	Comments
None	
Zero	Only works in Manual zero method
Vent	Only works in Manual Vent options
Data Log	Only works from stream method. Test Summary and Cycle Combo methods will automatically data log.
Mute	Press button to quickly mute the audio

6.5.3. Screen Type Navigation

There are two main types of screens: Test or Settings. Test screens allow the user perform leak tests, while the settings screen allow the user to change device settings. In the upper-left of the touchscreen there are two main icons that allow for access to either a settings screen or test screen.

Table 22 *Basic Screen Type Navigation*

Screen	Icon	Description
Test		Press Home icon to get to test screens.
Settings		Press Settings icon to show settings main menu.

6.5.4. Touchscreen Layout

The common areas of the touch screen are outlined below.

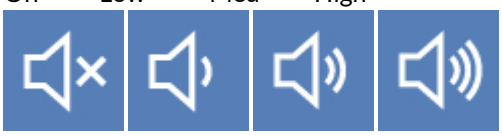
1. Upper-left – Setting or test screen navigation icons.
2. Upper-middle – Status text or screen name. Note that status text is also displayed on the bottom of the screen.
3. Upper-right – Status icons.
4. Right-side menu on test screens for Quick-Access features .

6.5.5. Status Icons

In the upper-right section of all screens five status icons are available. These icons give the user current status information (see Table 23 below).

Table 23 *Status Icon Summary*

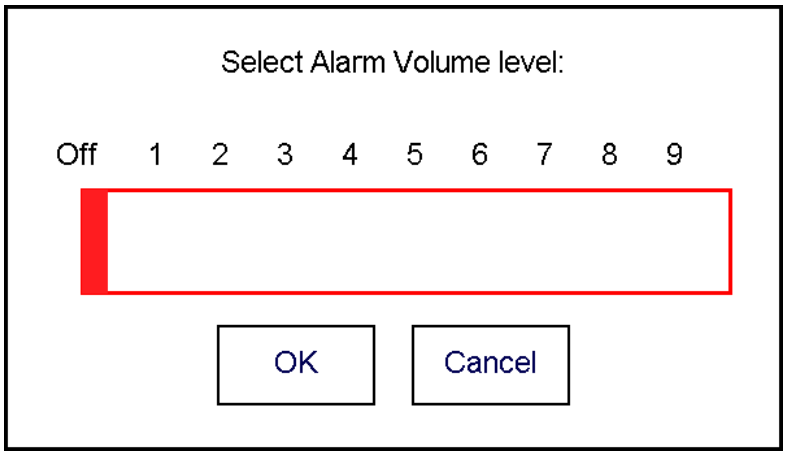
Function	Icon	Description
Login Level		Operator Login – Not set up by default. If configured, the base user has very limited access to change parameters.
		Technician Login – Access all features except advanced.
		Advanced Login – Login for service centers or advanced users.
Method / Mode / Mass		Dynamic Icon indicate main unit settings. • Main Symbol – Vacuum or Sniff Subscript - Test Mode • G = Gross test mode • F = Fine test mode • U = Ultra Test mode Superscript – Mass • 2 = Hydrogen • 3 = Helium 3 • 4 = Helium

Function	Icon	Description
Maintenance Items		Maintenance items due shortly. Press button for more detail.
		Maintenance items due. Press button for more detail.
Faults / Warnings		Warning active (A warning allows for the unit to continue in operation, but the user should be aware of the condition(s)). Press button to see popup dialog of warning details.
		Fault active – Press button to see popup dialog of fault details.
Volume Settings		Off Low Med High 

6.5.6. Volume Settings

The TITAN VERSA has an audio output signal that correlates with the current leak rate vs the reject limit. The larger to difference between current leak rate and reject limit the higher the pitch. If the audio is on and the leak rate is lower than the reject limit than the audio signal will be off. Audio signals are ideal for sniff leak testing.

To adjust the audio settings, press the volume icon for more than one second and the following sub screen will appear. Pressing near the zero level will turn off the audio signal. Setting nine is the loudest signal.



If the audio is on and the user quickly presses on the audio icon, the signal will automatically turn off.

6.5.7. User Access Levels

The TITAN VERSA employs three user access levels: Operator, Technician, and Advanced. User levels are enabled by pressing the User icon in the upper-right status section, then entering the correct password. Table 24 below summarizes the main features of each user level.

Table 24 *User Access Level Summary*

User Level	Icon	Description	Password
Operator		Allows user to start and stop cycles and run calibrations. Settings can only be viewed.	None
Technician (default)		All functionality except Advanced functions	Determined by user
Advanced		All functions	5226

Technician Level

By default, the technician level is enabled without any password. This level allows the user to have easy access to all settings except the Service Menu settings.

Operator Level

To protect settings from accidental changes and restrict operators to start and stop cycles and calibrations only, the user must enable the Operator level (see Parameters section).

To set up the Operator level, the user must first enter a new technician password. Once enabled, the system default boots to the Operator level. This level is disabled by pressing the Login level icon and entering either the Advanced or Technician password. The operator level has the following restrictions and permissions:

- Permissions
  - Run a cycle form HMI or use Cycle Start and Option button
  - Run a Calibration or Cal Check
  - Use Vent or Test
  - Edit Test ID data
  - Start or Stop data logging
- Restrictions
  - Can view (but not edit) all parameters in Test, Calibration, System and Maintenance Menus.

Advanced Level

The Advanced level has access to all functions. Users should only use these functions if properly trained. When the advanced menu button is pressed, the user will be prompted to enter the advanced password.

6.5.8. Screen Menu Structure

Table 25 *Screen Menu Structure*

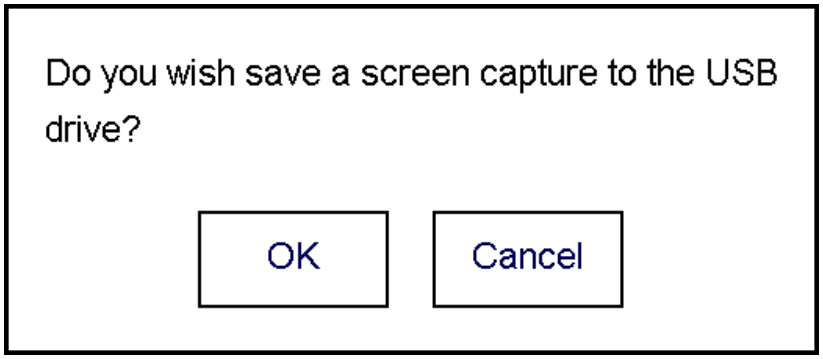
Start Up			
Shut Down			
Test			
Test Graph			
Test ID	Test ID Setup		
Settings	Test	Method	
		Reject Limits	Additional Reject Limits
		Vent	
		AutoTest	
		Zero	
		Data Logging	
		Graph	
	Calibration	Calibrated Leak	
		Calibration Start	
		Calibration History	Cal History Detail
	System	Mass Spec	
		Units	
		Display	
		Accessories	
		Communication	Terminal Testing
		Remote I/O	Digital Input
			Digital Output
			Analog Input
		Local I/O	
	Maintenance	Maintenance Tasks	Maint. Task Details
		Counters	
		Manual Control	
		Event History	Event History Detail
		Detector Info	Software Versions
		Turbo Pump Info	
		Parameters	Software Update
		Pirani Cal	
	Advanced	Cell Info	
		Advanced Settings	
		Method Correction	
		Cell Tuning	
		Terminal Testing	

6.5.9. Screenshot to USB Drive

With a USB drive device attached to the USB port, the user can take a screenshot of any HMI screen. To take a screenshot:

1. Insert USB drive into USB port.
2. On the desired screenshot screen, the user will press in the bottom-right area for two seconds. See the area indicated by a red square in the screen shot below.

3. The following dialog appears. Press the OK button to capture the current screen. Note that the HMI will become unresponsive for about 20 seconds after the screenshot event occurs.



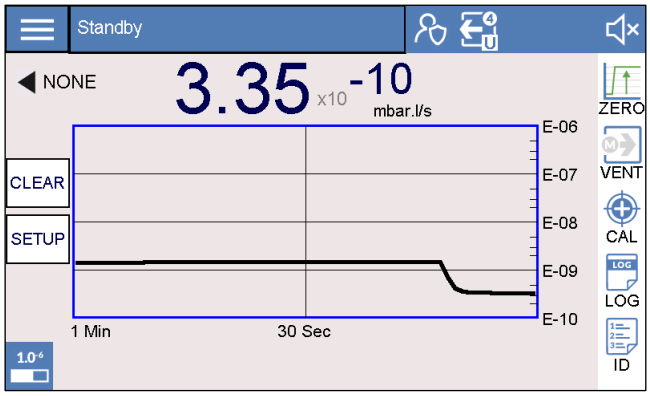
6.6. Test and Settings Main Screens

Test Screens

The VERSA provides two test screens. The lower-left icon right icon allows the user to toggle between the two test screens as outlined in the table below.

Table 26 *Test Screen Options*

Test screen	Toggle Icon	Description
Test		View basic settings with a bar graph.
Test Graph		Large 2D leak rate plot with many options / settings.



6.6.1. Test Screen Quick Access Features

Table 27 outlines five commonly-used test features in the test screens. These features may be accessed through either the Test screens or Settings menu.

Table 27 *Test Screen Added Functions Summary*

Function	Icon	Description
Calibration		Press the Cal icon to perform either calibration or calibration check process.
Vent		Vent options: • A: Auto Vent mode • M: Manual vent mode Icon vent arrows are green when venting is active. Icons are blue or grey when incactive.

Function	Icon	Description
Zero		Zero options: • No letter – Zero function is off • M = Manual Zero • A = Auto Zero
Data Log		Test Summary method: Log single row of data at the end of cycle.
		Stream method: Log live data, per log interval, anytime at user discretion.
		Cycle Combo method. While in cycle in log all data per log interval and log single summary row at end of cycle.
Test ID		Test ID functions allow user to attach Test ID attributes to a specific test.

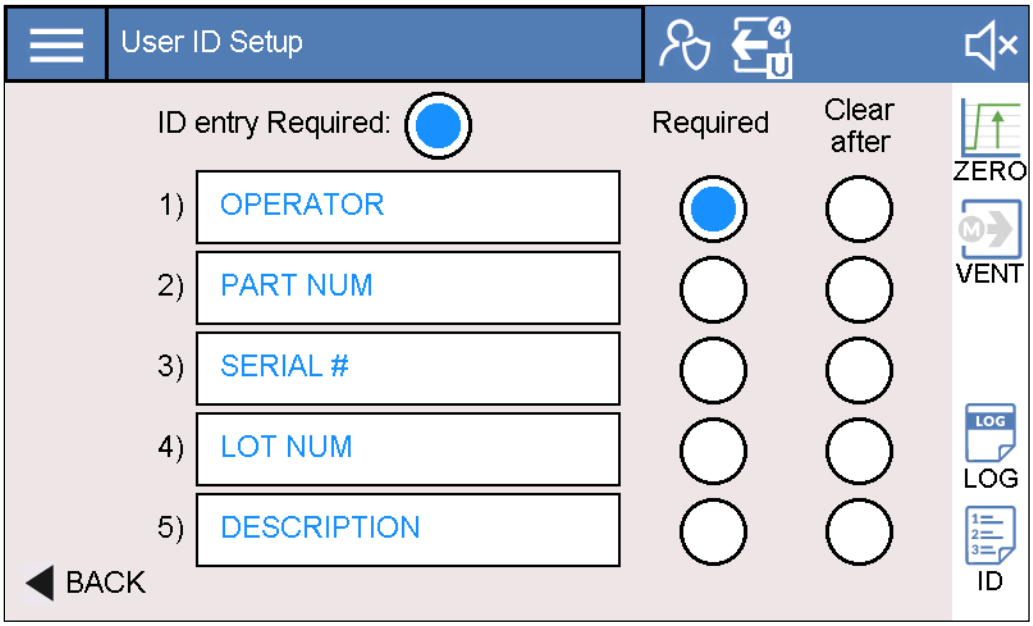
6.6.2. Test ID Function

Test ID functions allow user to attach Test ID attributes to a specific leak test.

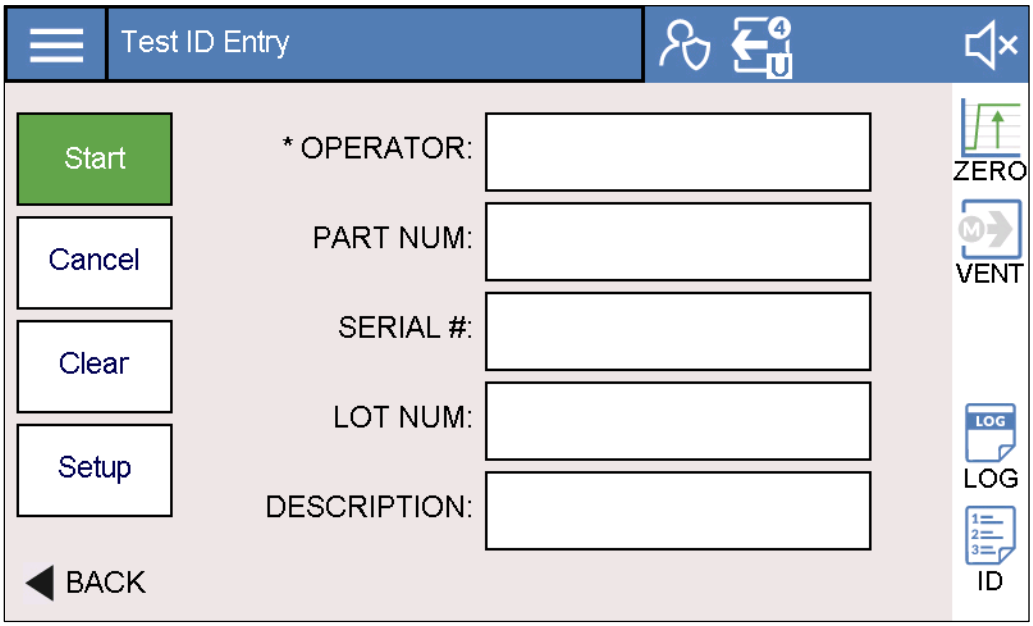
To access the Test ID settings, the user must select the Test ID icon from the test screen.

➔ Enter data via the bar code reader or the touchscreen keyboard.

➔ Barcode entry will cycle through all the configured commands.



To access the Test ID settings, the user must first select the Test ID icon from the test screen and then select the Setup option. The screen below appears.



Test ID Fields

The user can define up to five user defined Test ID parameters. These parameters are typically used in data logging. Examples include:

- Operator
- Part Number
- Serial Number
- Lot number
- Test Description

ID Review on Start — When the user presses the Cycle Start button and this option is active, the user must review all the test ID the variables before starting the test. After review, the user presses the start button on the Test ID screen and the cycle starts.

Required — If a field is defined as Required and the field data is empty, the Test ID screen will automatically appear on cycle start command.

Clear After — If a field is defined as Clear After, the field contents will be deleted when a full test is completed. This field is helpful for unique field options such as serial number.

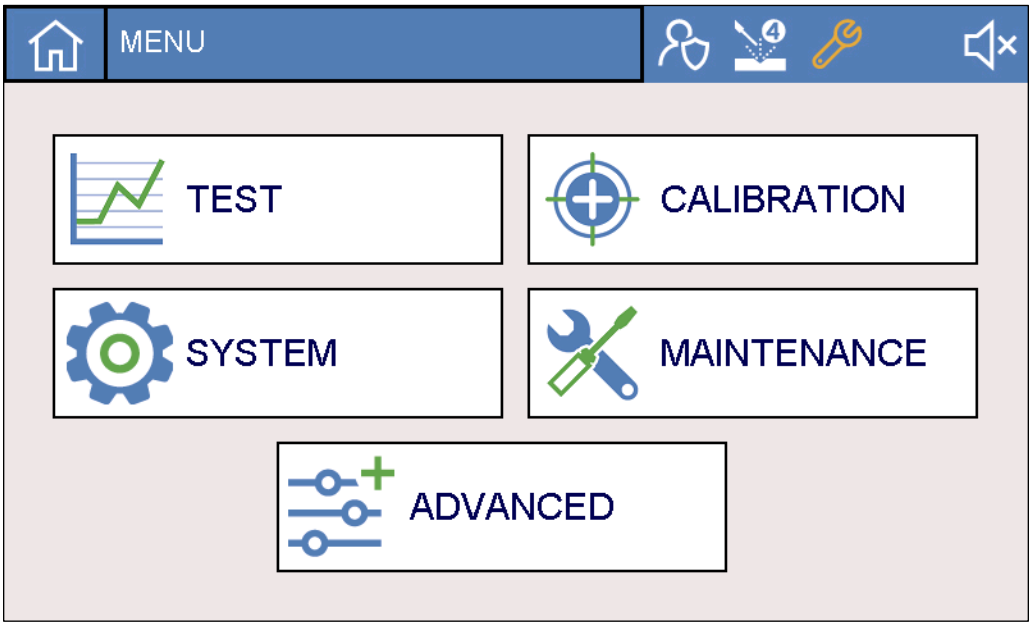
6.6.3. Settings Main Menu

To access the main Settings menu from the test screens, press the menu icon (three bars).

In the Settings main menu, the following setting categories are available.

Table 28 *Settings Menu Structure*

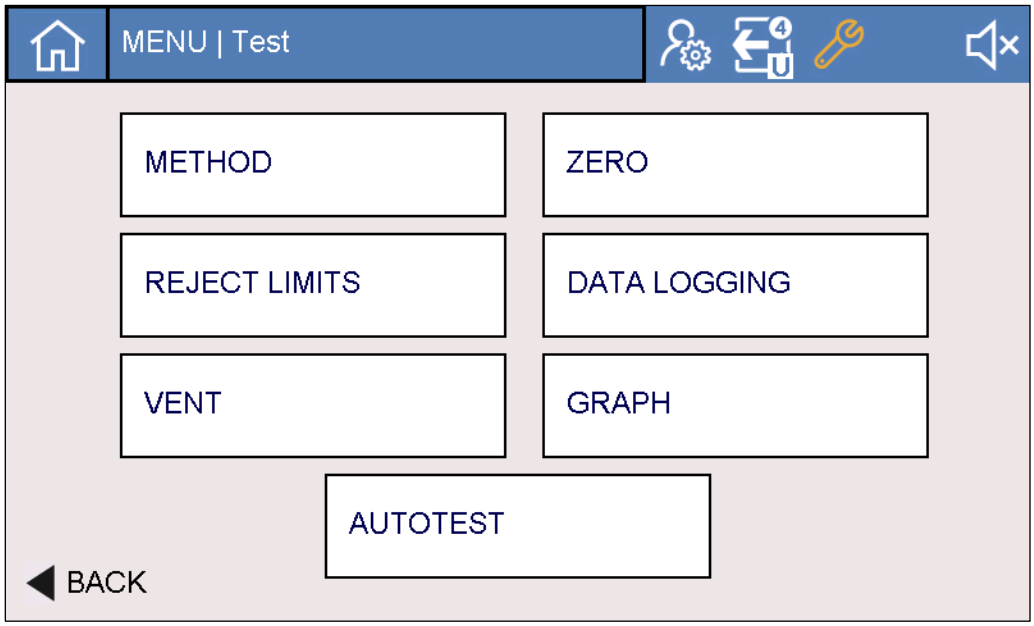
Menu	Icon
Test	
Calibration	
System	
Maintenance	
Advanced	



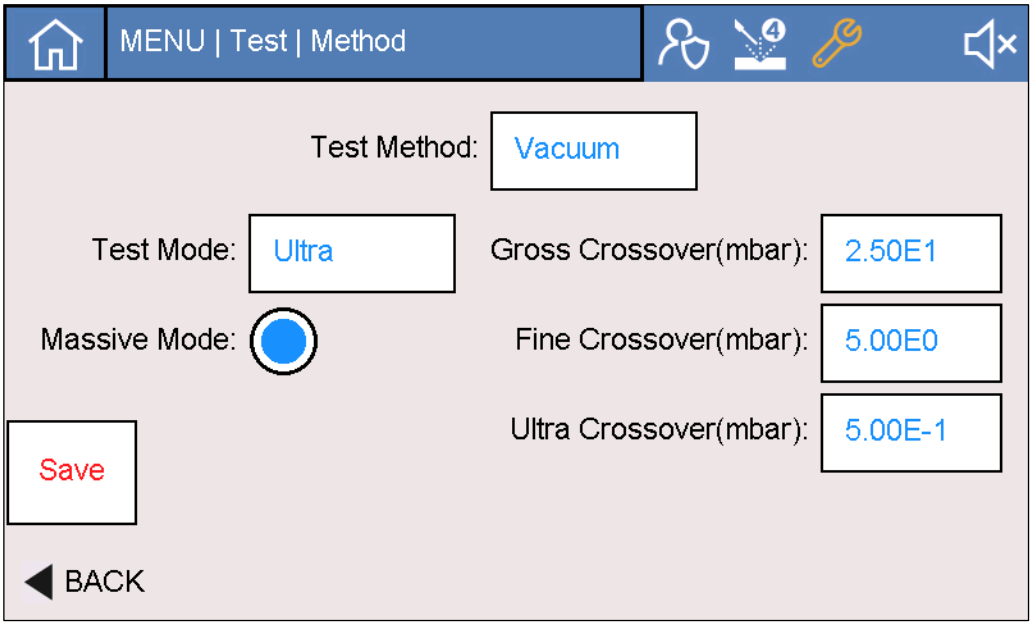
6.7. Test Settings

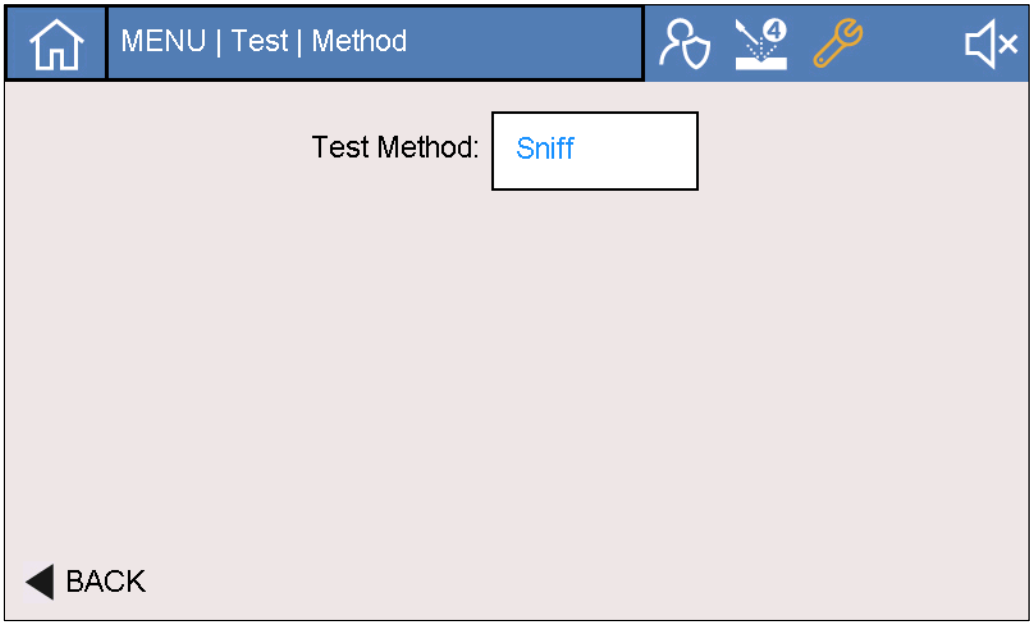
The test settings section has the following sub-menus:

- Test Settings
- Reject Levels
- Vent
- AutoTest
- Zero
- Data Log



6.7.1. Method Settings





Test Method

The two test methods for the TITAN VERSA are vacuum and sniff. Press the method icon to toggle between the two desired settings and the press the Save button to save the settings.

➔ See General Use Guidelines for application and theory on both Vacuum and Sniff leak testing methods.

➔ Switching from Vacuum to Sniff test

After modifying the settings, a transition duration of <3 minutes occurs, during which the test can be performed but calibration is not possible.

➔ Switching from Sniff to Vacuum test

After modifying the settings, a transition duration of 30 seconds occurs, during which neither the test nor the calibration can be performed.

Vacuum Test Mode

Table 29 outlines the three vacuum test modes and their various functions. Press the Test Mode button to toggle between the three options. In most applications, Ultra mode should be used as the final test mode.

➔ Note: When in sniff mode this parameter will be hidden.

Table 29 *Vacuum Test Mode Summary*

Vacuum Test Mode	Maximum Pressure (mbar)	Helium Pumping Speed (L/s)	Where used
Gross	25	Depends on Primary pump speed	Larger leak rates or applications where deeper vacuum levels are difficult to achieve.
Fine	5	1.0	Medium leak rate signal response and sensitivity
Ultra	0.5	2.5	Best signal response and sensitivity

Crossover Pressures

As defined in Table 29 above, each vacuum test mode has a maximum pressure crossover setpoint. In most applications the default crossover pressures should not be adjusted.

➔ Note: These parameters are hidden when in Sniff mode.

➔ Skip Test modes. In certain applications it may be desired to skip certain test modes. To enable skipping of test modes, enter crossover pressures smaller than final desired test mode (see table below).

Table 30 *Test Mode Skip Example*

Vacuum Test Mode	Scenario 1 – Crossover Pressures to Pump Directly to Ultra mode	Scenario 2 – Crossover Pressures to skip Gross Mode only
Gross	0.4	4
Fine	0.3	5

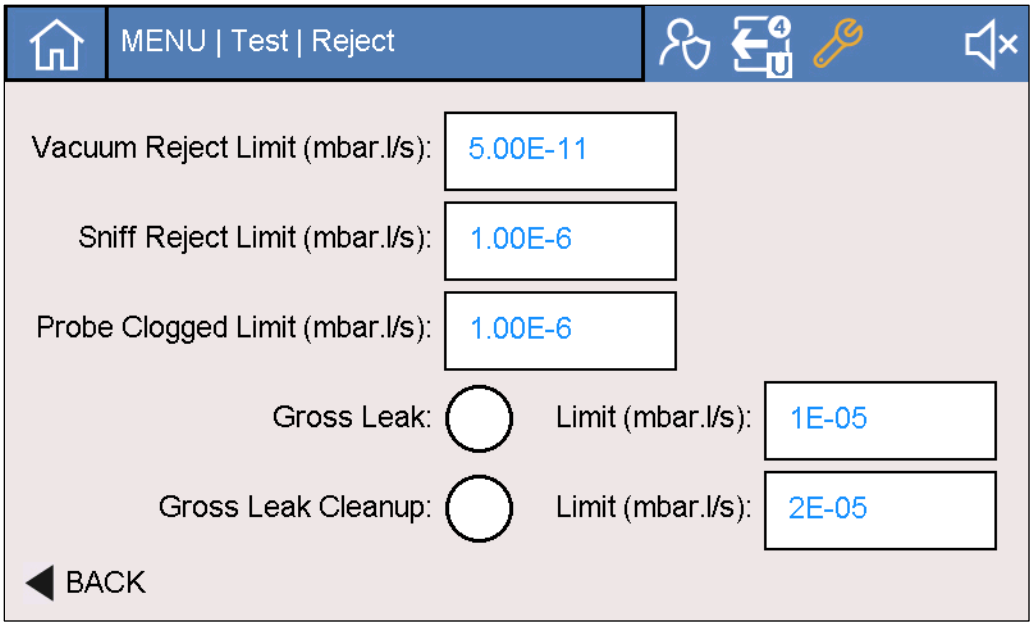
Ultra	0.5	0.5

Massive Mode

When Massive mode is enabled, it allows for gross leak testing in vacuum method (typically Outside-In leak testing) using the Pirani vacuum gauge. If during pump down the vacuum pressure settles between 25 – 100 mbar for greater than 10 seconds, the unit will go into massive mode.

The test screen display will show Massive mode and display a non-quantitative bar graph. The user can spray helium to help locate large leaks. Once the leak is fixed, the pressure can go below 25 mbar and the test will go into full cycle.

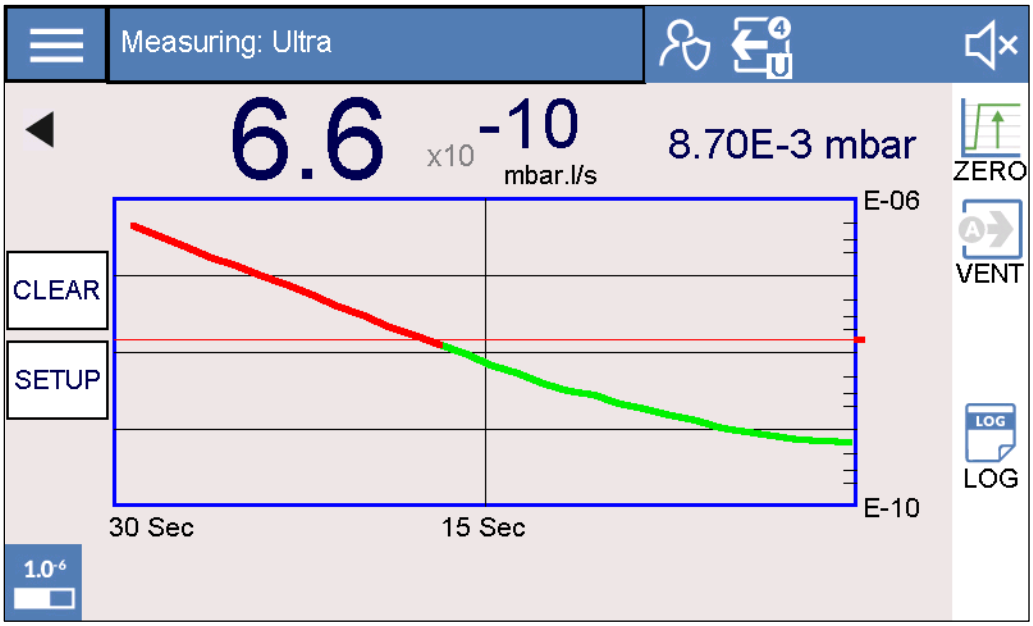
6.7.2. Reject Limits



Reject Limits

Reject limits can be entered for either vacuum or sniff test methods. Rejects limit are used throughout the unit in the following ways.

- ➔ On Test screens indicating Pass / Fail conditions (green indicates Pass, red indicates Fail).
- ➔ Reject limits determine the audio signal level (if turned on) in relation to the current leak rate.
- ➔ On the Test graph screen, the reject point is identified with a red line. When the leak rate is above the reject limit, the graph line is red; the line is green when the leak rate is below the reject limit.



➔ If AutoTest mode is set to Automatic, and Save Result is on, the finished test will read Pass or Fail at the end of the test. When a new test is started, the text will refresh to the current value.

➔ For data logging in either Test Summary or Test Stream and Summary methods, the test result will read Pass or Fail depending on the final leak rate and the Reject Limit setting.

Sniffer Probe Clogged

When the leak rate exceeds the Probe Clogged Limit in Sniff Mode, the unit will issue a warning to indicate clogged sniffer probe. Inspect sniffer probe when this occurs.

Gross Leak Setpoint

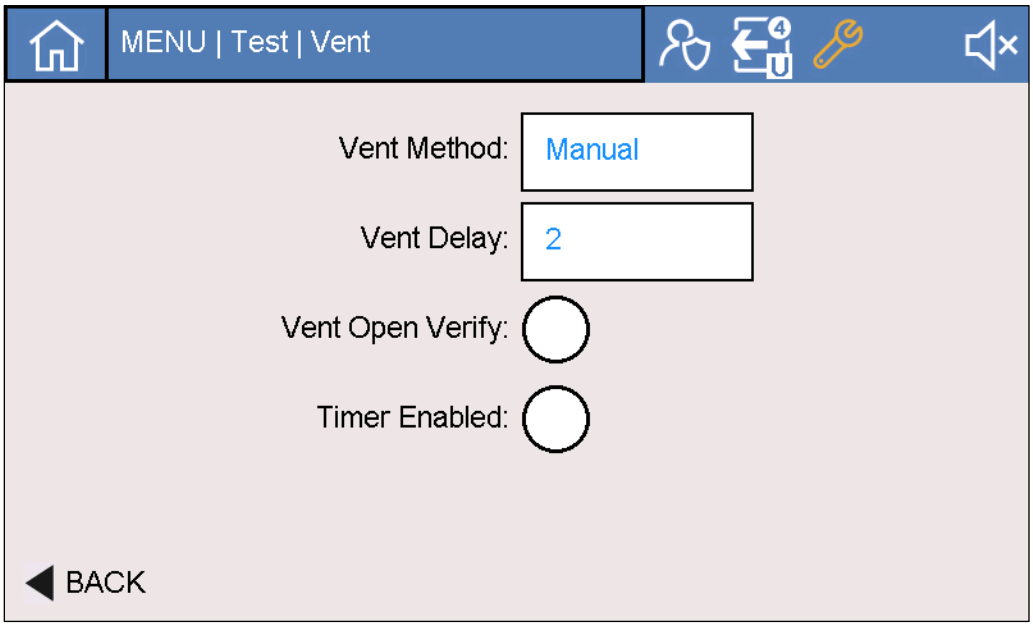
The Gross Leak Setpoint parameter prevents excess tracer gas from contaminating the detector. When this setting is enabled, and the leak rate exceeds the gross leak setpoint, the test cycle stops automatically and returns to standby mode.

It is recommended to set the gross leak setpoint to a maximum of 4 decades above the reject set point. This is setting is ideal for Inside-Out Vacuum applications where gross leaks can be common.

Gross Leak Cleanup

If a gross leak appears the above the setpoint, the unit will switch to Gross Mode and pump to remove gross leak condition. In this condition, the detector can switch between gross and ultra modes to help eliminate the high leak rate condition.

6.7.3. Vent Settings

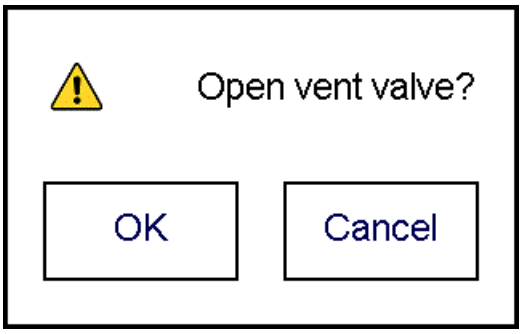


Method - Manual Vent

In Manual Vent mode the system does not automatically vent at the end of the test cycle. The user must press the vent icon to open the vent valve. The vent valve opens for the vent delay and timer settings.

Manual Vent Verify

If the user desires additional verification of manual vent, select the Manual Vent Verify option. The screenshot below will appear in this condition.



Method - Auto Vent

In Auto Vent mode the system automatically vents the test volume at the end of the cycle, per the vent settings timers (see Vent Timer below).

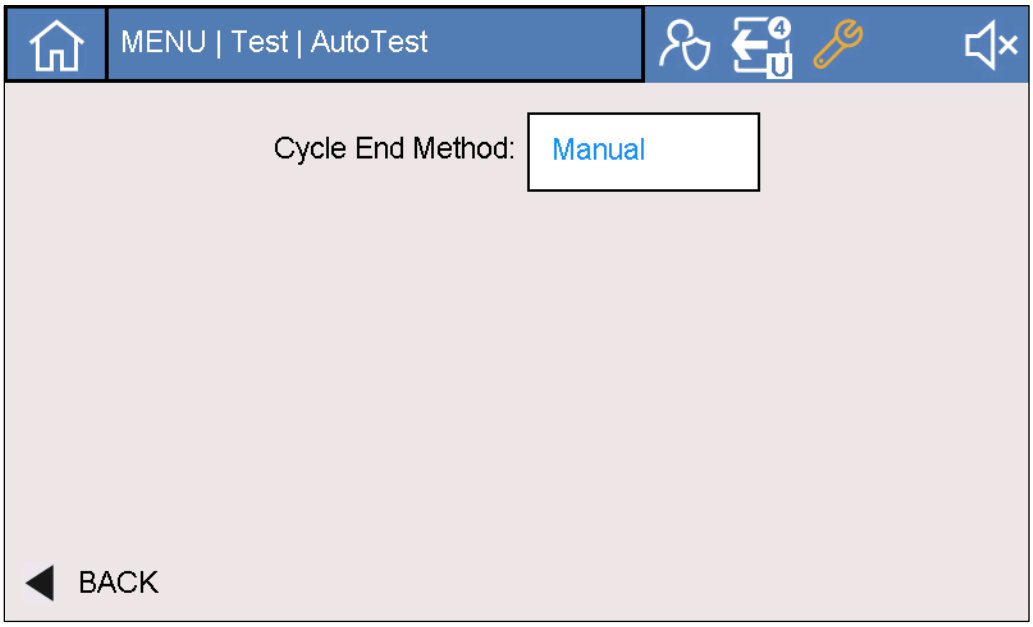
Vent Delay

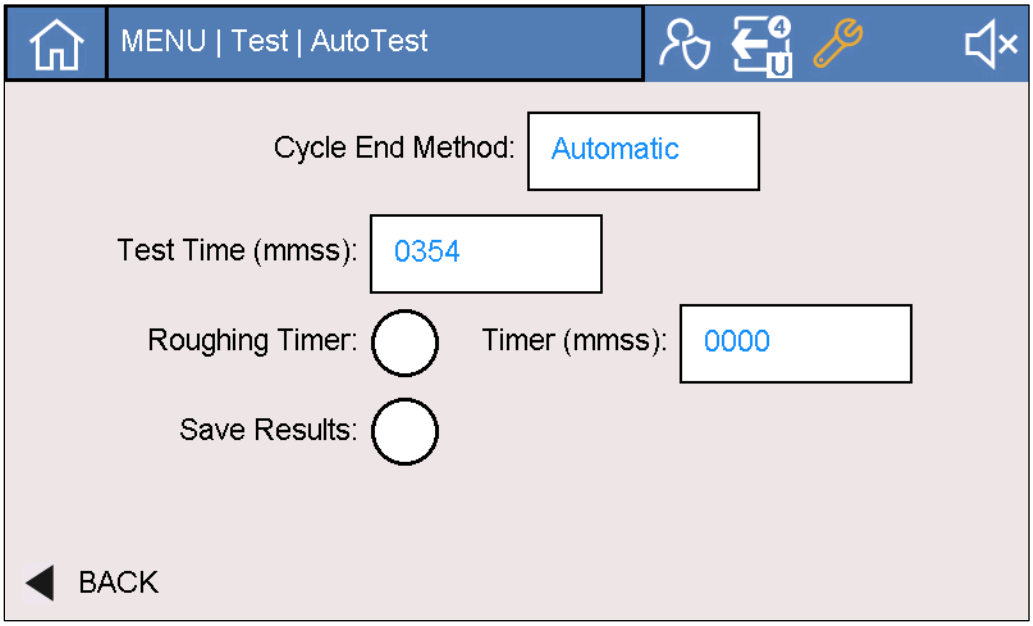
Vent Delays of 0, 1, or 2 seconds are allowed after cycle ends before the vent valve opens. Vent Delays can occur in both Manual and Auto Vent modes.

Vent Timer

The vent timer can be enabled or disabled. If disabled, the vent valve stays open until a further test cycle is started. If enabled, the vent valve stays open per the vent timer and then closes. The vent timer can be useful for applications where nitrogen venting the of the test volume will enable low background readings.

6.7.4. AutoTest Settings



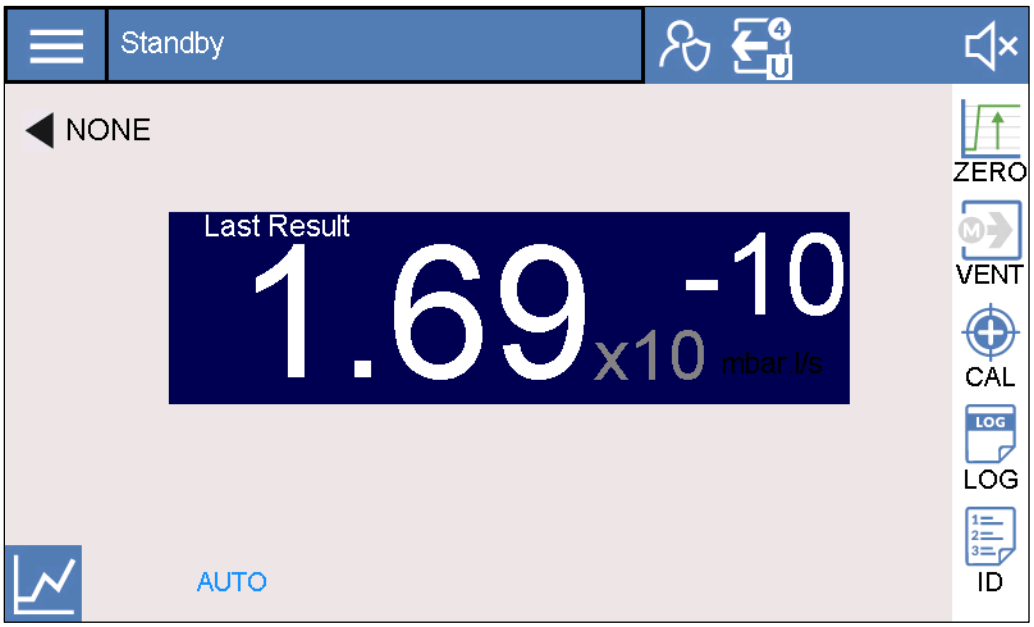


Cycle End Method The Cycle End Method may be set to either Manual or Automatic. See the following options for Automatic settings.

Rough Timer A rough timer option can be used to verify if the pump down state is too long. If the timer expires before the rough step is complete the test cycle will end automatically

Total Test Timer The timer option is full test time from start cycle initiation. When the timer expires the cycle will end.

Show Last Test Result This option keeps the final leak rate from the test on the test screen. The text "Last Result" is displayed. See image below for example.



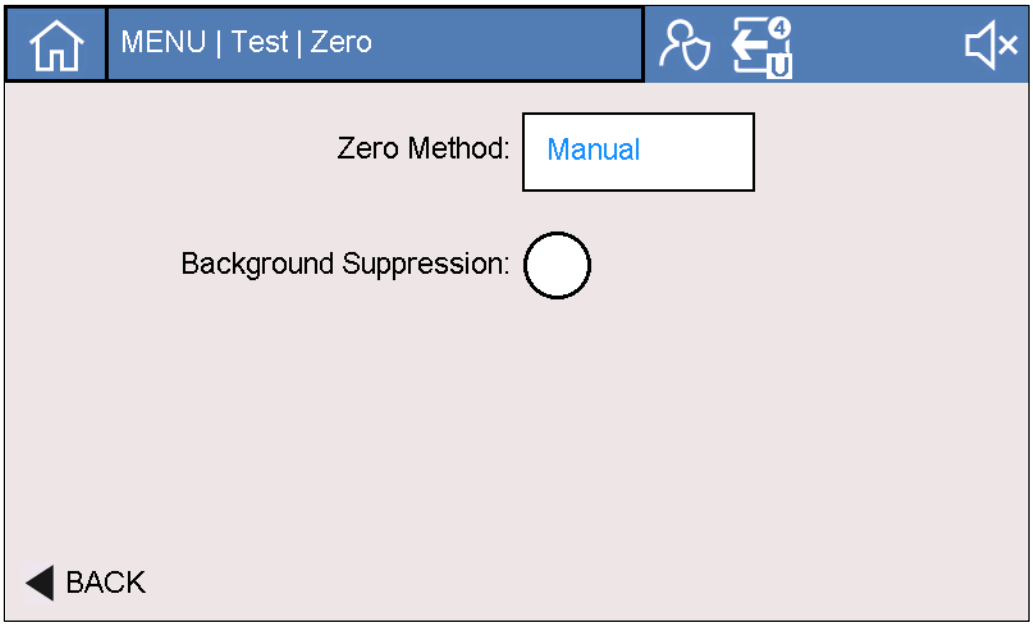
6.7.5. Zero Settings

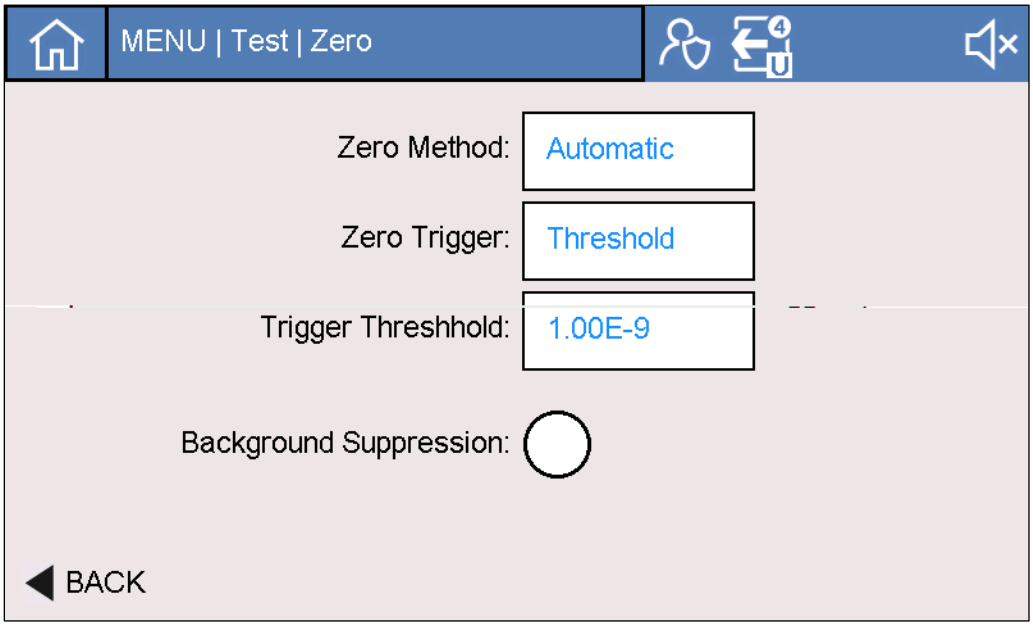
NOTICE: Use of Zero function

The use of the Zero function is recommended when the background signal is stable and significant.

The Zero function can assist the operator in finding smaller leak rate variations. Zero function features include:

- Recording signal background when the zero function is activated. This value is subtracted from the current signal.
- Signal limit of either 100 or 1000 times lower than the background.
- If signal increases while zero is on, the Zero function stays on but is not functional. To re-zero, the user must deactivate Zero function and then reactivate.
- When the signal decreases while zero is on a new reference, background is automatically calculated.





Zero Method The Zero function can be controlled either manually (by button press) or automatically. For manual operation, the default setting of a quick button press enables zero mode.

Manual Zero Start / Stop To start or stop the Manual Zero method, the button press can be either a quick press or long press (> 2 seconds).

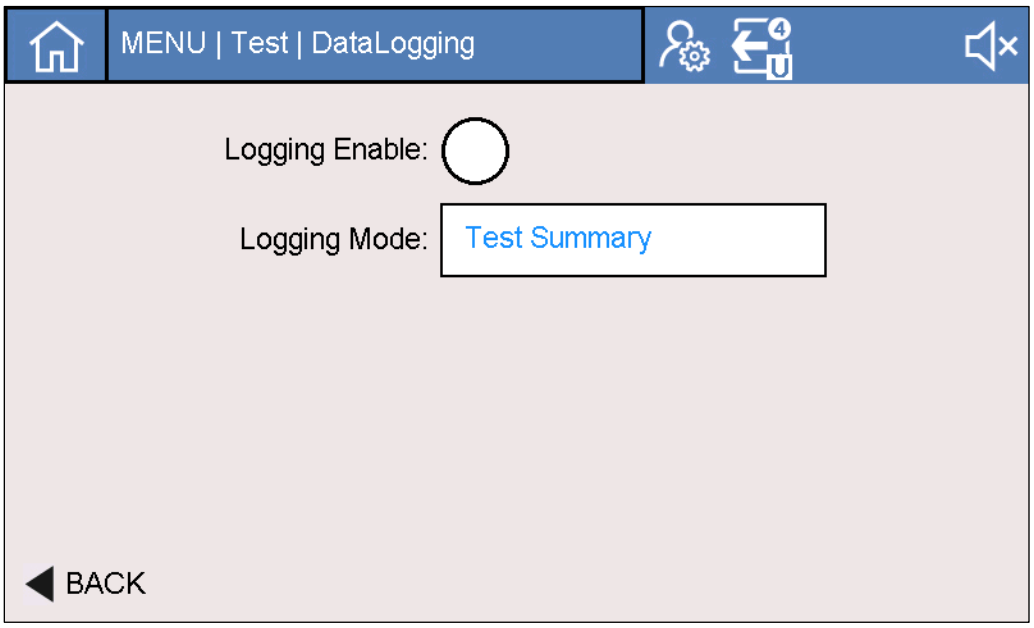
Zero Auto Trigger The Zero Auto Trigger can be set to either the threshold (leak rate) or timer.

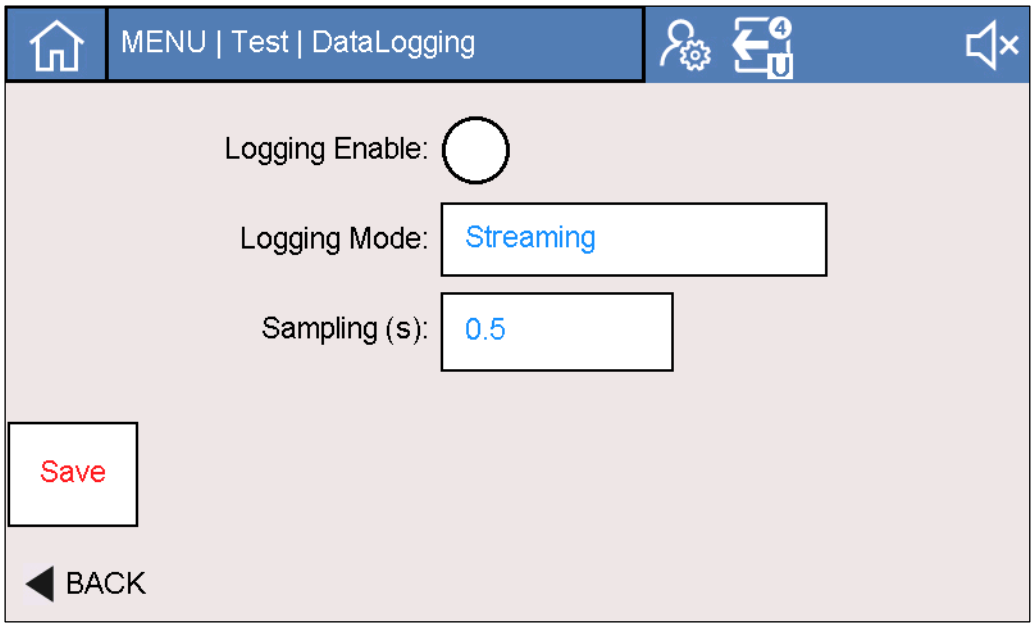
Zero Threshold To set Zero Threshold, enter the leak rate at which you need Zero function to start.

Zero Timer Enter the desired Zero time, at which the Zero function will automatically start.

Background Suppression The background suppression feature subtracts the background reading using the value from the end of the last successful calibration. This function works both in Standby and Test modes. This feature is enabled by default and can be used to measure a leak rate two decades lower than the detector's background.

6.7.6. Data Log Settings





NOTICE: USB drive

For data logging features to function, a USB drive must be inserted in the USB port. A USB is provided in shipment in documentation packet. Spare drives can be ordered (P/N: TV5928).

➔ To access Data Log settings, go to either Test Settings or Test Quick-Access.

The three data logging methods are:

- Test Summary
- Stream
- Cycle Combo (Test Summary and Stream during test cycle)

Test Summary Method

The Test Summary Method logs a row of test summary data at the end of a test cycle or aborted test cycle.

➔ The first time a Test summary log occurs, a new TestSummary.csv file is created and appears on the USB drive. Subsequent test cycles add additional rows to the existing csv file.

➔ Enter any Test ID data that is desired before running the leak test (see Test ID). Entered data will be logged.

➔ The Test Summary Method is ideal for users requiring traceability for their leak test application.

To enable the Test Summary Method:

4. Select Test Summary from the log method and press the Data Log Enable button.
5. When in a test cycle is in process, the Data Log icon will flash with a T symbol. Additionally, the bottom the test screen will read “Data Logging Active”.
6. The data is logged at the end of the test cycle.

Table 31 *Test Summary Field Description*

Data Field	Comments
Date	
Time	
Leak Rate	Final Leak rate
Pressure	Final Pressure reading
Method	Vacuum or Sniff
Vac Mode	Ultra, Fine, or Gross
Result	Pass, Fail or Incomplete

Figure 10: Example of Test Summary csv File from Excel

Operator	Part Number	Serial Number	LOT #	TB	Date	Time	Leak Rate	Pressure	Method	Mode	Pass
Operator	Part Num	Serial #	Lot Num	Operator	1/1/2019	15:45:40	2.17E-06	0.174	Vacuum	Ultra	Fail
Operator	Part Num	Serial #	Lot Num	Operator	1/1/2019	15:55:59	2.78E-11	0.001	Vacuum	Ultra	Pass

Stream Method

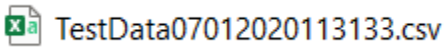
The Stream Method of data logging allows for logging of live leak rate data at any time.

7. To configure the Stream Method, select Stream option from the Log Method and press the Data Log Enable button.

1. Select the desired data log interval in seconds (0.5, 1, 2, 5, 10, 30, 60).
2. To begin logging, press the Data Log icon on the Quick Access toolbar. Or, user can use the option button, if programmed for data logging. The data log icon will flash with an "S" symbol when logging is active. The bottom of the test screen will read "Data Logging Active".
3. Alternatively, press the Option button to start a Stream data log. To stop data logging, press the Data Log icon (or Option button) again and the logging will stop. The icon will stop flashing.

➔ If a stream log is not stopped after 1 hour it will be automatically shut off.

➔ After a stream data log concludes, a CSV file appears on the USB drive. The file nomenclature is TestData (Date) (Time).csv. For example:



➔ Stream data is ideal for in-depth analysis of leak testing data.

Stream files contain pre-filled headers followed by the generated file data. The headers include the following fields: Date, Time, Test Method, Vac Mode, Log Interval, Leak Rate Units, Pressure Units, Vent valve Status, and Zero Status. Table 32 shows the data fields that are logged per the data log interval.

Table 32 *Stream Data Log Field Summary*

Data Field	Function
Time	(per user selection)
Leak Rate	In current units
Vacuum	In current units
Status	Standby, Roughing, Gross, Fine, Ultra

Figure 11: Example of Test Summary CSV File from Excel

Date	Time	Test Method	Log Interval	Leak Rate Units	Pressure Units	Vent Valve Status	Zero Status
1/1/2019	16:16:56	Vacuum	0.5	mbar l/s	mbar		
Time	LeakRate	Vacuum	Status				
0	1.00E-12	26.4	Roughing				
0.5	1.00E-12	24.3	Roughing				
1	2.81E-07	23	Roughing				
1.5	2.05E-03	20.4	Gross				

2	1.58E-03	19.4	Gross
2.5	9.68E-04	18.5	Gross
3	7.28E-04	16.8	Gross

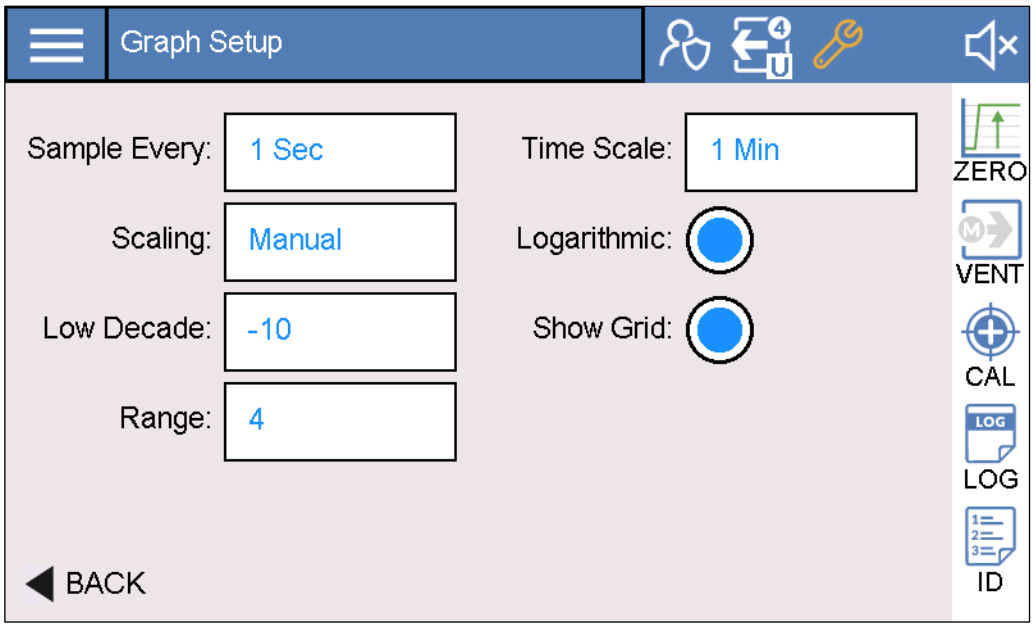
Cycle Combo Method

The Cycle Combo log method combines features of both stream and test summary methods. This method logs automatically only during a test cycle and has all the features of Stream and Test Summary methods as described above.

➔ Enter any test ID data that is desired before running the leak test (see Test ID). Entered data will be logged.

➔ This data log method is ideal for customer requiring traceability for their leak test application.

6.7.7. Graph Settings

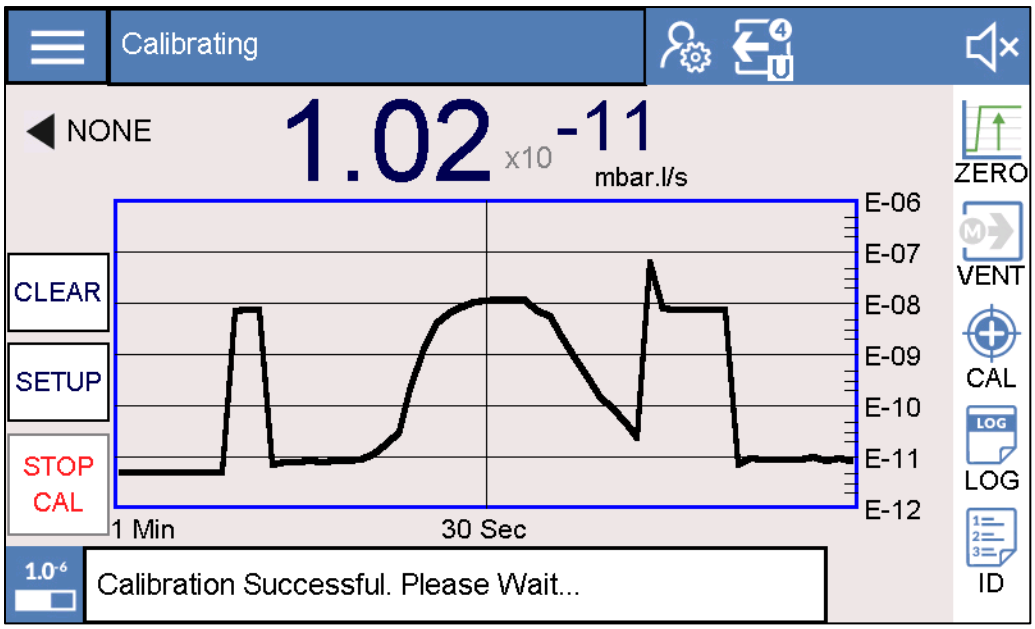


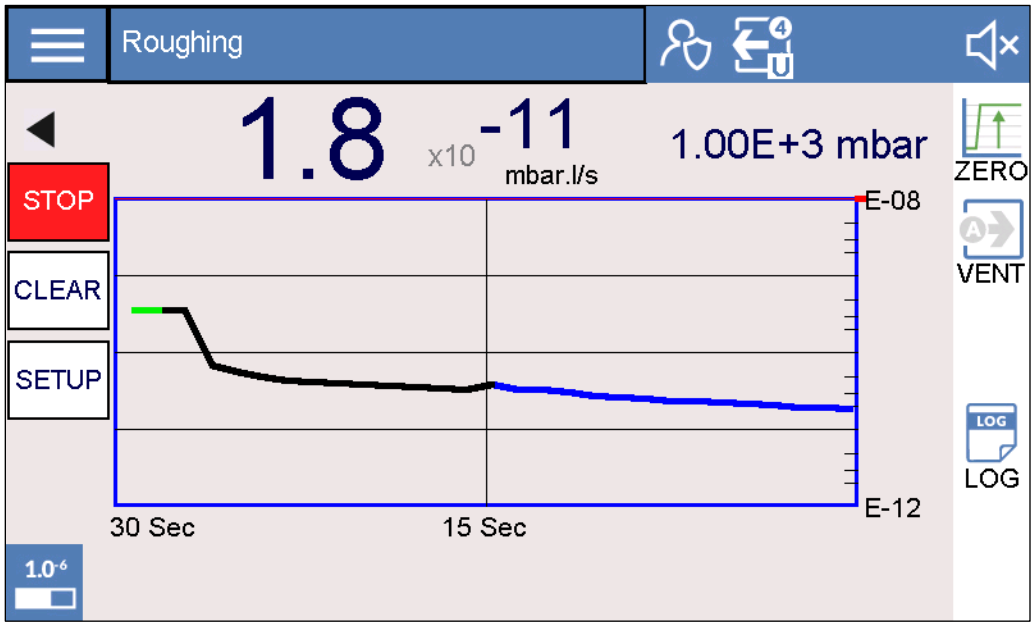
On the Test Graph screen, the user can select the desired graphing options per the parameters below. To edit graph settings, press the Setup button on the graph screen or go to Settings > Test > Graph.

The following graph line colors are used.

- Black – Standby
- Blue – Rough
- Green – In cycle and below reject limit
- Red – In cycle and above reject limit

Sample Interval	Select options of 0.5 seconds, one second, or two seconds.
Scaling	Select Automatic or Manual. Automatic scaling adjusts the graph as the leak rate changes.
Scaling Reference	Select either Reject Limit or Current Value for the scaling reference. This setting only applies to Automatic Scaling.
Low Decade	Select the low decade range between -12 and -5.
Decade Range	User can display from one to six decades in graph.
Overall Graph Range	Select options of 1 minute, 2 minutes, 4 minutes, or 30 seconds.
Logarithmic	Select to graph values to log scale; default graph logs in linear scale.
Show Grid	Select to show grid on graph.

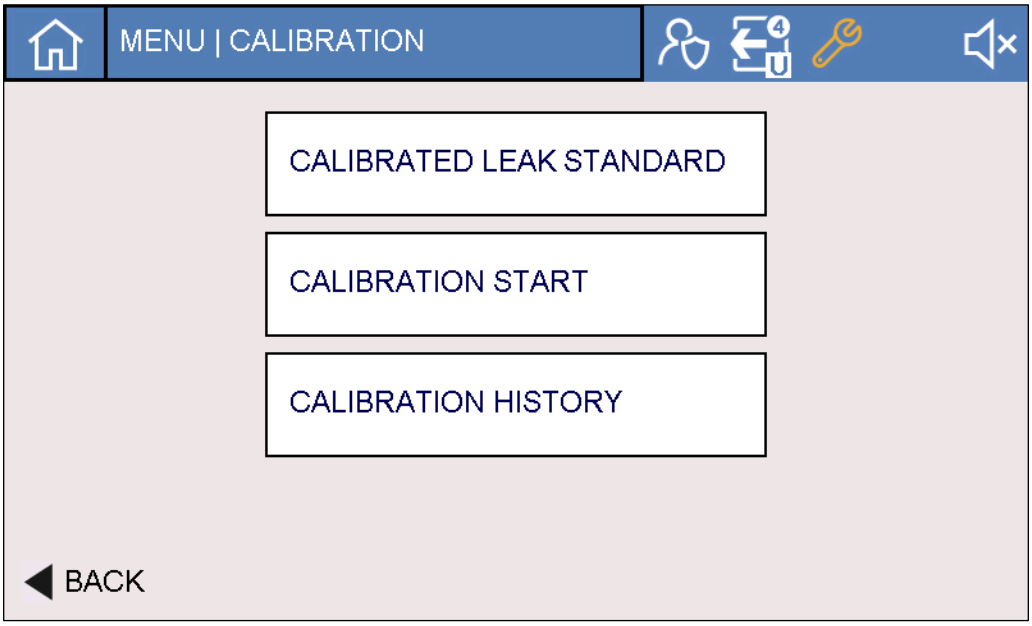




6.8. Calibration Settings

The calibration settings menu has the following sub-menus:

- Calibrated Leak Standard
- Calibration Start
- Calibration History

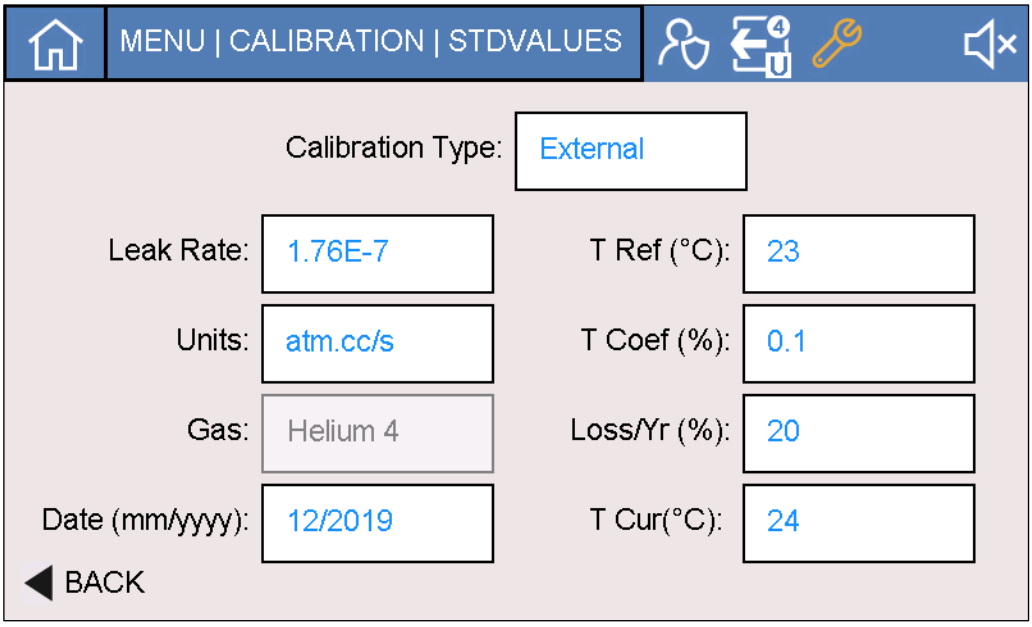


6.8.1. Calibrated Leak Standard

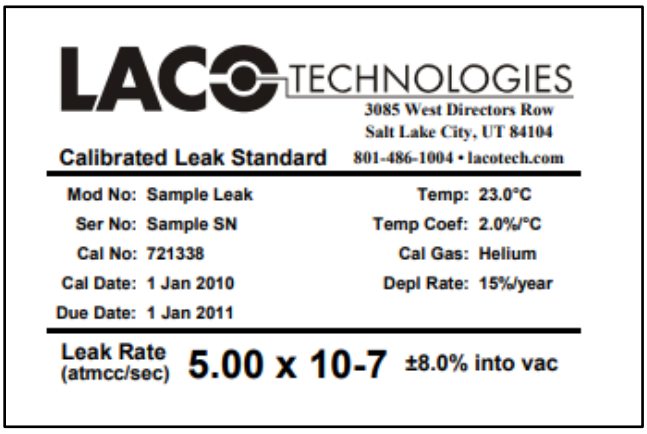
Table 33 below outlines the seven sets of parameters for calibrated leak settings per Mass and Test Mode selected by the user. See Calibration for information on performing the different types of calibrations.

Table 33 *Calibration Method per Mode and Mass*

Calibration Method	Mass	Test Mode
Internal	Helium 4	Vacuum
External	Helium 4	Vacuum
		Sniff
	Helium 3	Vacuum
		Sniff
	Hydrogen	Vacuum
		Sniff



Internal calibration cycles are fully automated using the internal leak standard. For external calibrations, the user must follow the on-screen prompts to introduce and remove the leak standard at certain time. See Section 6.4.1 for more information on performing the different types of calibrations. Reference the leak standard label to enter the parameters below.



Calibration Method Select option of either Internal (Vacuum, Mass 4 only) or External calibration per Table 33.

Leak Rate Enter the leak standard leak rate.

Units Select the leak standard units.

Date Enter the month and year of the leak standard calibration in the MMYYYY format.

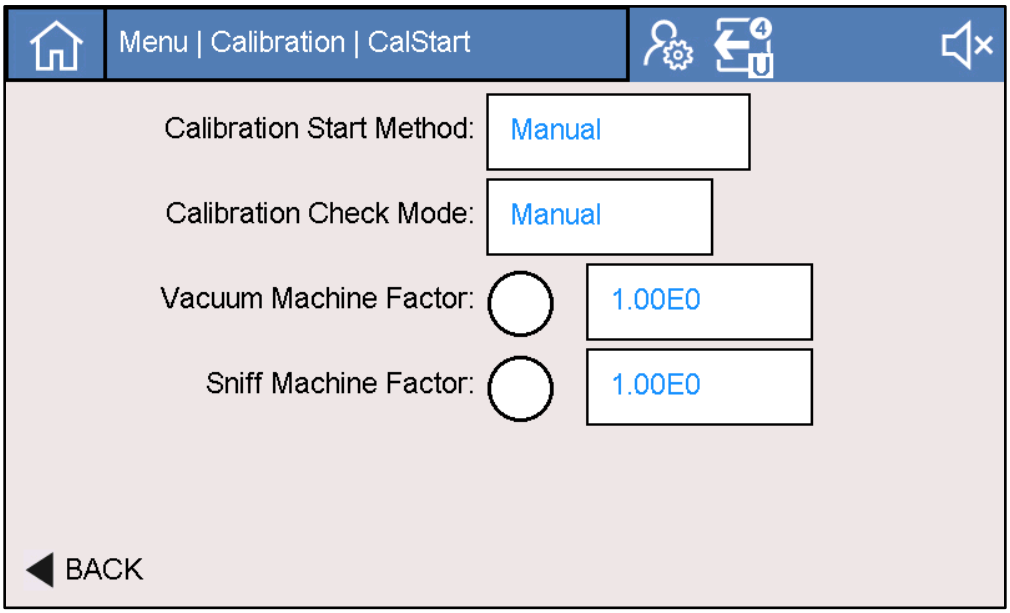
Cal Temp Enter the leak standard calibration temperature in Celsius.

Temp Coefficient Enter the temperature coefficient in 0.1 % precision.

Depletion Rate Enter the depletion rate. Round to nearest whole percentage number.

Current Temperature Enter the estimated current leak standard temperature in degrees Celsius (only for External leaks).

6.8.2. Calibration Start



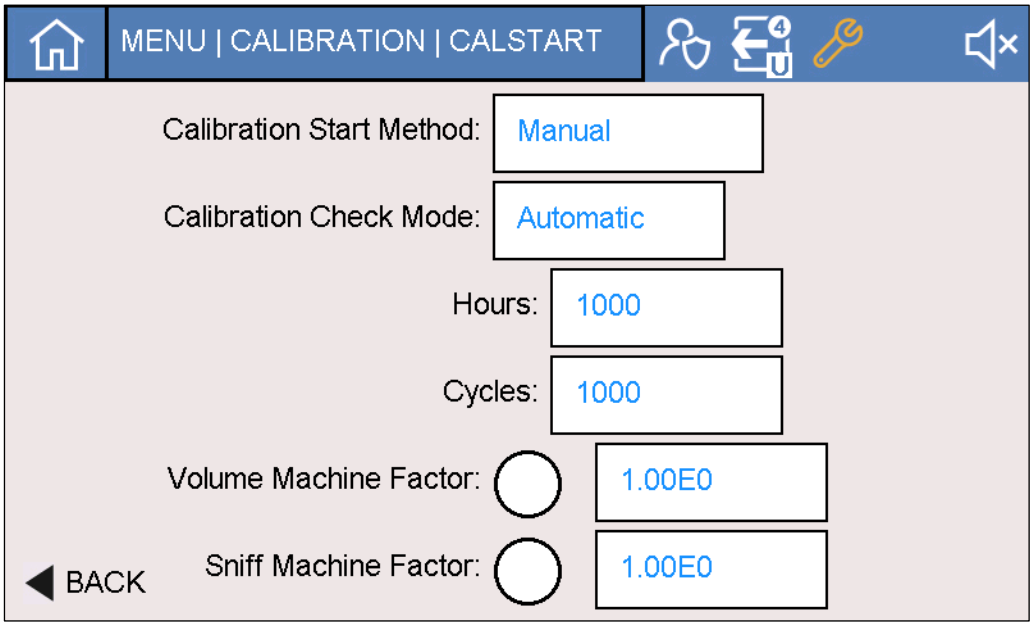
Cal Start Method There are three options for calibration start.

- Cal at Start (not recommended but available)
- Cal Check at Start (This runs both a cal check and an autocalibration)

- Manual (after 20 minutes of warm-up)

Cal Check Start Method Refer to Calibration Check (Cal Check) for more information on this function. The default manual method allows the user to run a cal check whenever desired. Automatic method will automatically run a cal check when either the Hours or cycles have been reached.

Cal Check Auto Hours Enter desired hours before performing cal check.



Cal Check Auto Cycle Enter desired cycles before performing cal check.

NOTICE: Use caution when using the Machine factors as they can give incorrect readings if used improperly. The factors will adjust all leak test readings. Only use machine factors when external calibrations have been used to verify correct readings.

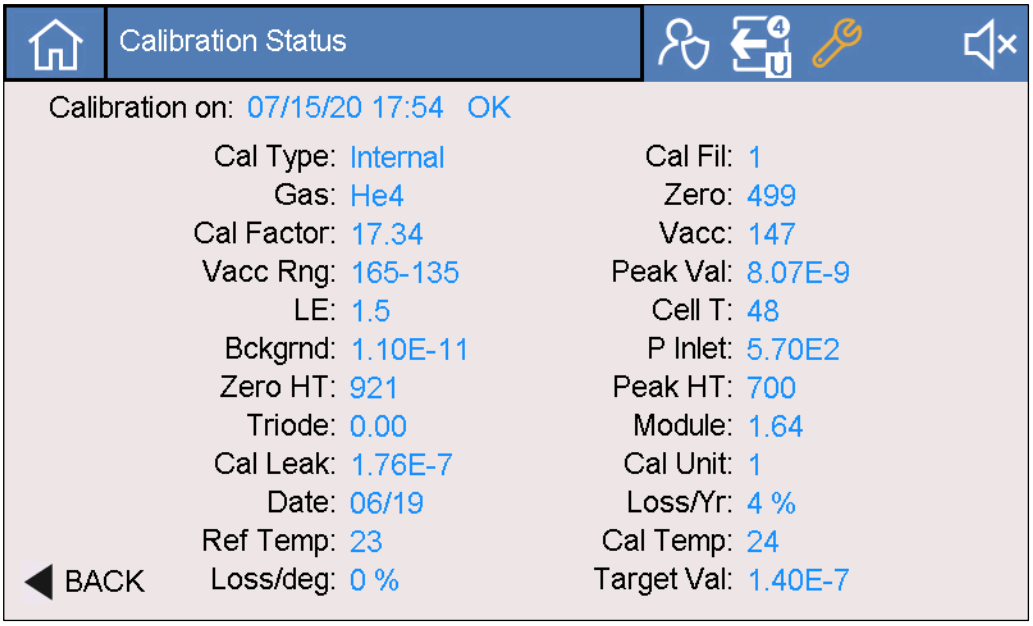
Machine Factor-Vacuum The machine factor is only used in split flow applications.

Machine Factor-Sniff Enter desired machine factor for sniff mode.

6.8.3. Calibration History

The Calibration History screen provides a review of the last 20 calibrations or cal checks. Six calibrations can be viewed per screen; use the scroll button to toggle through the history.

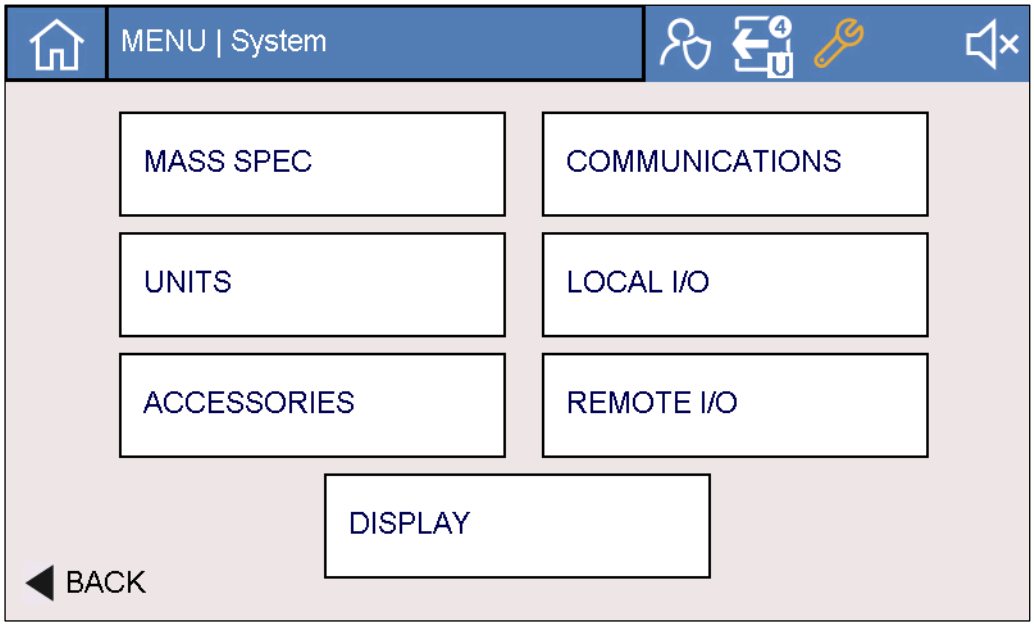
Select the desired the event to review and the following screen will appear where the user can review the calibration history. In a calibration, both the cal factor and acceleration voltage (Vacc) are adjusted.



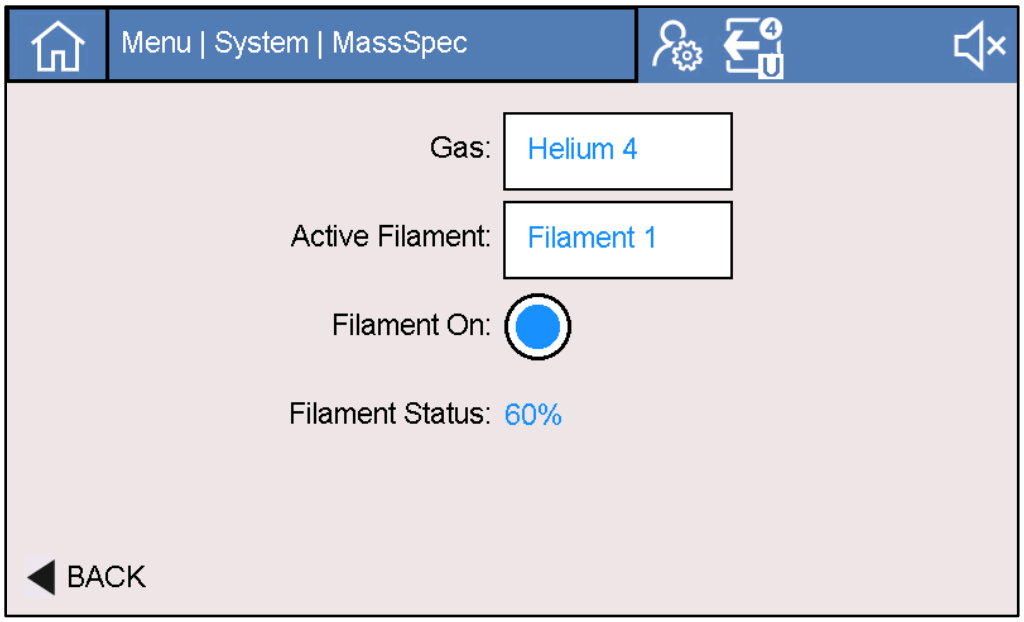
6.9. System Settings

The calibration settings section has the following sub-menus:

- Mass Spec
- Units
- Accessories
- Communication
- Local I/O
- Remote I/O
- Display



6.9.1. Mass Spec Settings



Test Gas

Enter either Helium 4, Helium 3, or Hydrogen for desired test. Helium 4 is default.

➔ Whenever a test gas is changed, the user must calibrate the detector with a leak standard of the same gas species.

Active Filament

The detector has two filaments. The user can switch to filament 2 when filament 1 has higher cal factors (>20).

➔ When the filament is changed, the user must recalibrate the system.

Filament On / Off

The filament should only be turned off in cases of required maintenance or troubleshooting.

Filament Status

This parameter indicates the relative life of the filament. When below 20% the user should schedule maintenance for a filament change.

6.9.2. Unit Settings

Leak Rate Units

Toggle through the available units as listed in the table below. Note that pressure units cannot be selected but are dependent on the leak unit selected

Table 34 *Leak Rate Unit Options*

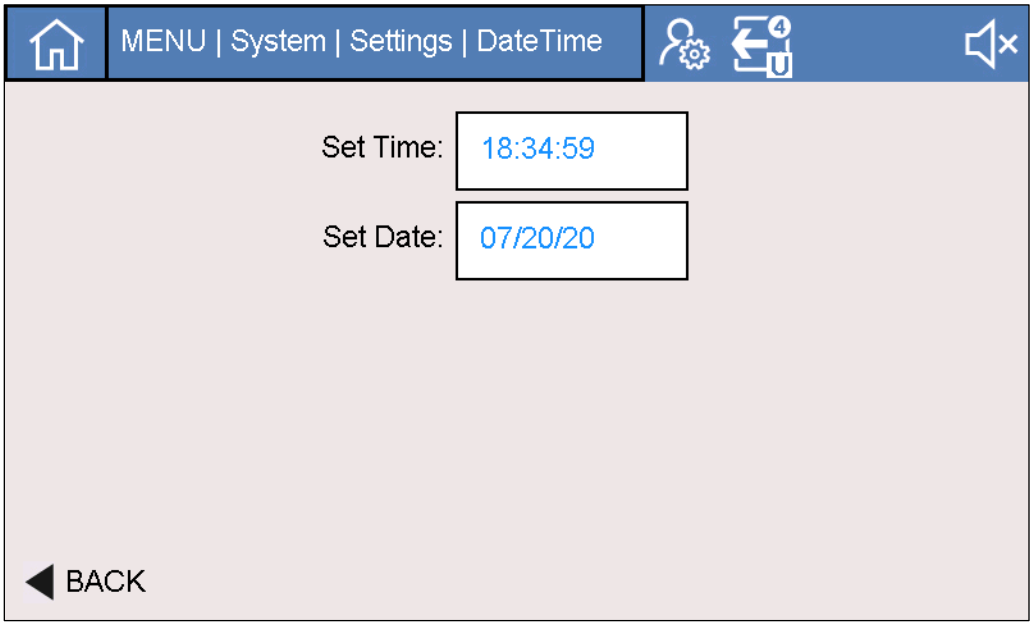
Leak Rate Units	Pressure Units
mbar L/s	mbar
Pa m3/s	Pa
Torr L/s	Torr
Atm cc/s	mbar
ppm	mbar
sccm	mbar
sccs	mbar
mTorr L/s	mTorr

Date and Time

Press the Date and Time box and the screen below appears. Set the desired date and time and press the Back button to save.

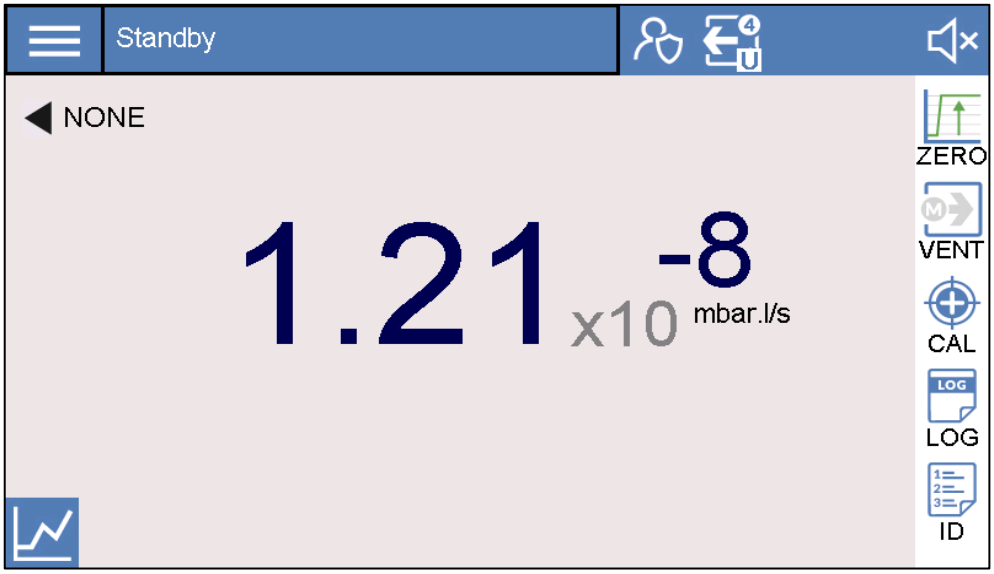
➔ Date format: MMDDYY

➔ Time Format: HHMMSS in 24 hour (military)

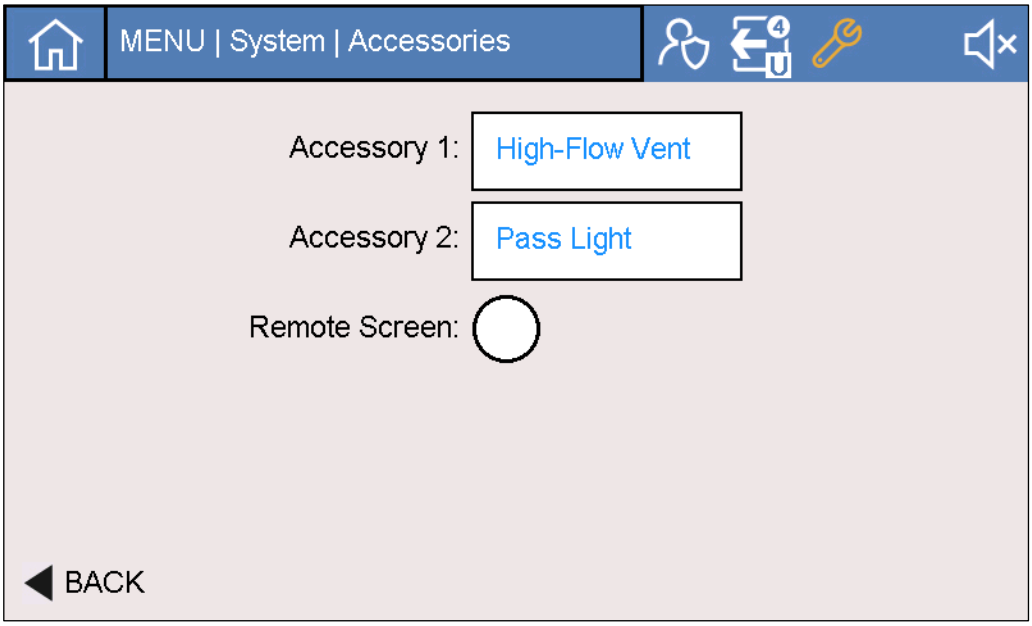


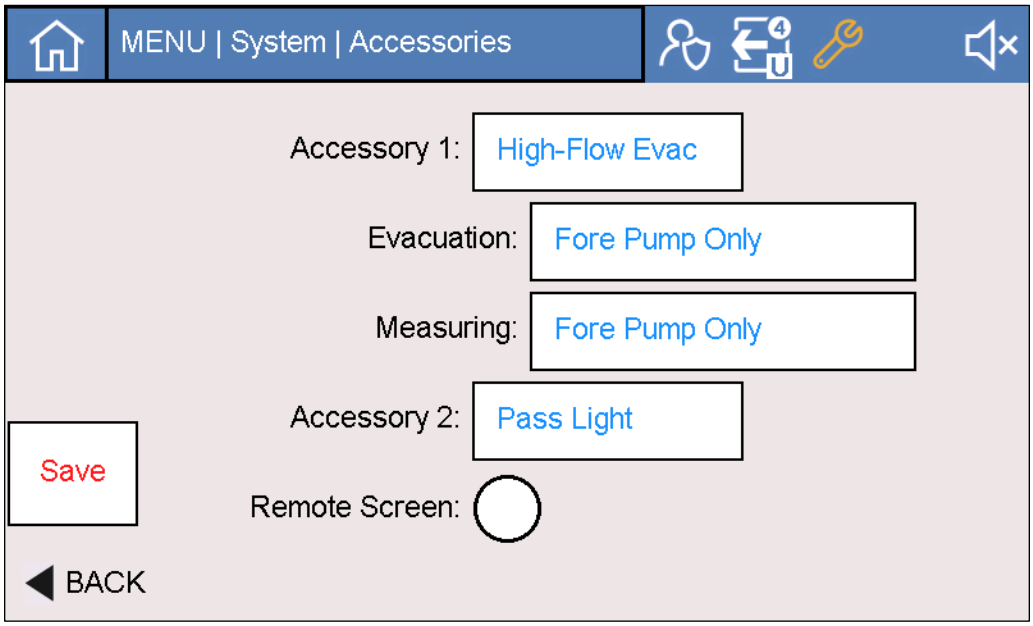
Audio Settings

The audio setting is turned off by default. Select toggle to turn on Audio levels range from 0 (off) to 9 (loudest). Audio levels can also be adjusted by pressing the audio status icons (upper right). Additionally, the option button can be programmed to mute audio signal.



6.9.3. Accessory Settings





Accessory 1 & 2

If an authorized accessory is connected, configure the settings per the following available accessories: High-Flow Evac, High-Flow Vent and Pass / Fail light. If no accessory is configured, select the None option.

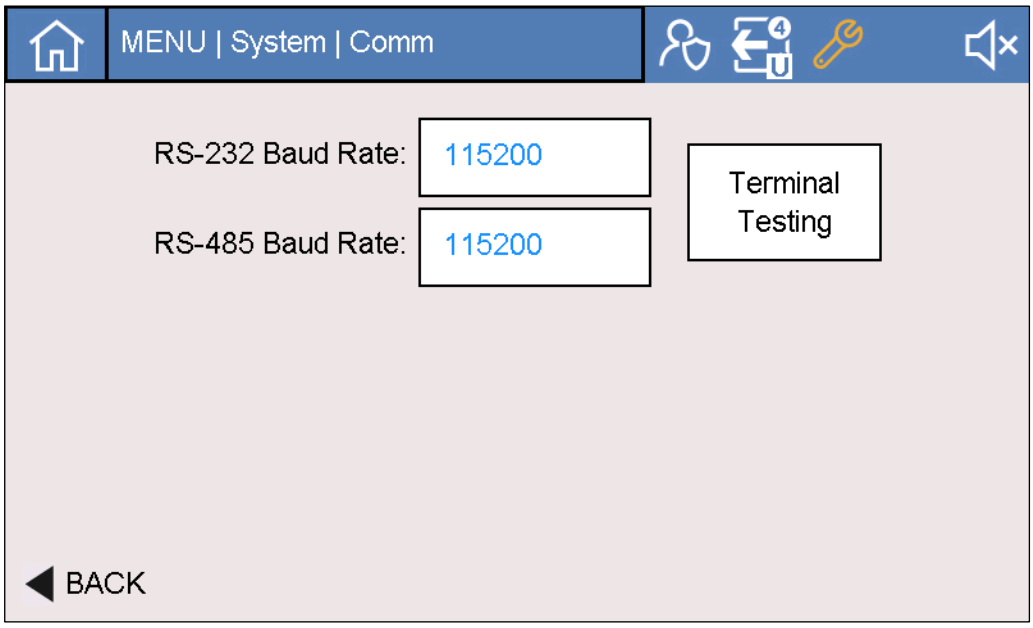
When the High-Flow Evac valve is configured, the user must select from the options summarized in the following table.

Table 35 *High-Flow Evac Options*

Step	Option	Comments
Rough	High-Flow Evac and LD Rough	
	High-Flow Evac only	Better for processes that may contaminate the leak detector.
Test	LD Test only	
	LD Test and High-Flow Evac	This condition is referred to split flow. User should use Machine Factor adjustment.

Remote Screen Enter if the Remote Screen accessory is attached.

6.9.4. Communication Settings

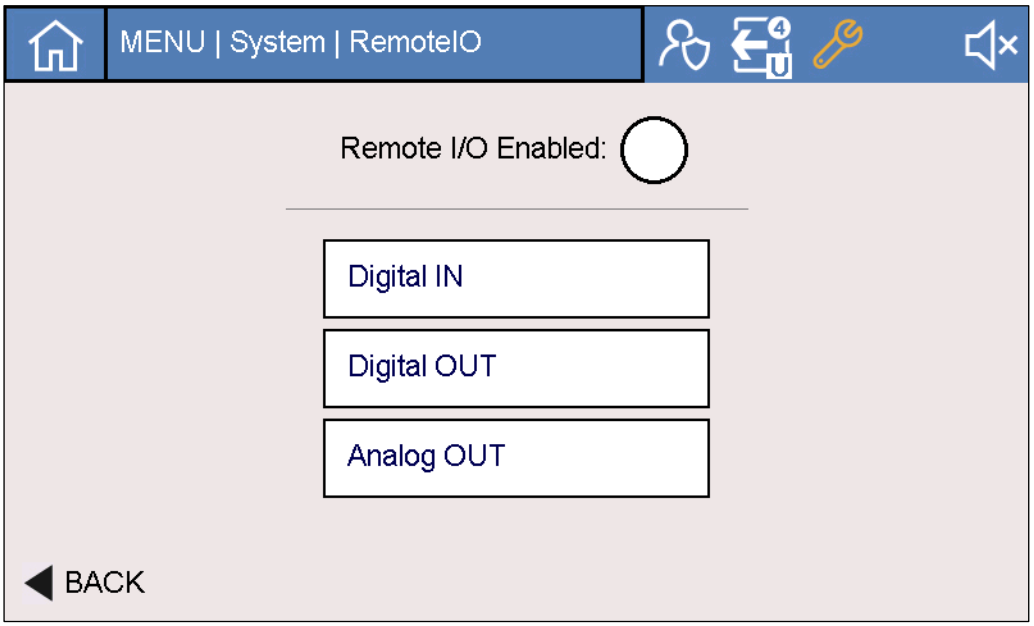


Serial Baud Rate Enter the desired baud rate for both the RS232 and RS485 communication methods. Available baud rates are 9600 (default), 19200, 57600, and 115200.
All communication adheres to the following additional serial settings:

- Bits: 8
- Parity: None
- Stop Bit: 1

See the Terminal Testing section for more information on this feature.

6.9.5. Remote I/O



Remote I/O

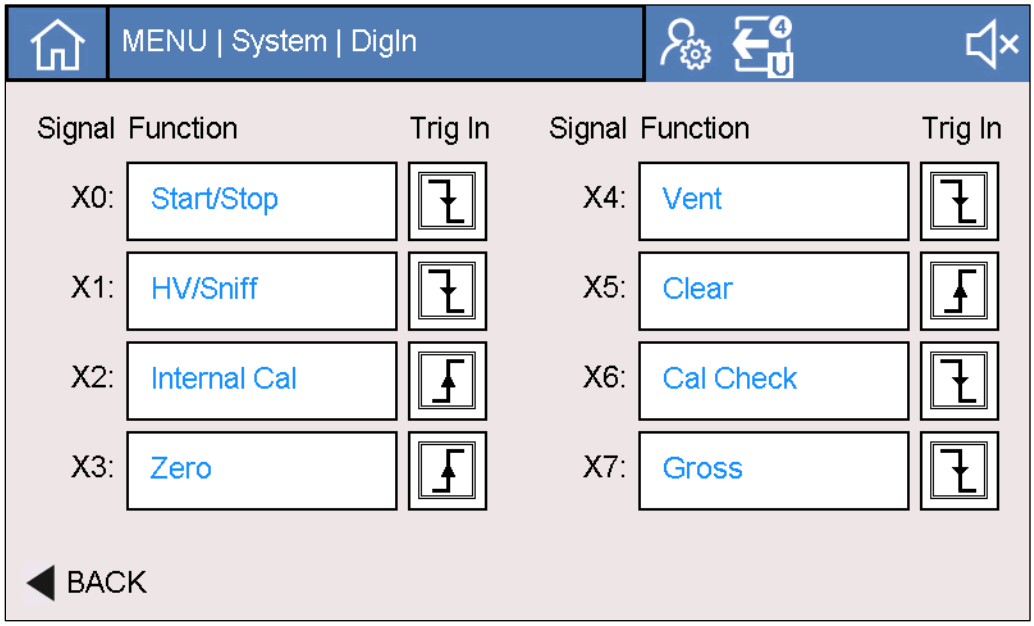
If the Remote I/O module accessory is attached, select the Remote I/O option. Next, press the various I/O option type buttons to configure the required I/O.

Below is a summary of the default I/O configurations.

Table 36 *Remote I/O Default Options*

ID	Digital Inputs	Digital Outputs	Analog Outputs
0	Start / Stop	Reject 1	Mantissa
1	Sniff / Vac	Ready to Start	Exponent
2	Internal Cal	LD error	
3	Zero	In final test mode	
4	Inlet Vent	Calibrate Ack	
5	Clear Error	Reject 2	
6	Int Cal Check	Reject 3	
7	Go to Ultra mode	Calibration active	

6.9.5.1. Digital Inputs



Configure Digital Inputs as needed per application. Digital input triggers can be defined as either a rising edge or a falling edge.

 Falling Edge

 Rising Edge

The table below lists all available Digital Inputs.

Table 37 *Digital Input Options*

Digital Input	Comments
Start / Stop	Not in-cycle and receive input then start. If in-cycle and received input, then stop cycle.
Sniff / Vac	Default is vacuum.
Internal Cal	Set to internal calibration mode; then, initiate a calibration.
Zero	Toggle Zero function to On / Off.
Inlet Vent	Toggle Vent valve Open / Closed.
Clear	Reset error or warning message.
Int Cal Check	Set to internal calibration mode, then start Cal Check.
Gross	Set test mode to Gross.
Fine	Set test mode to Fine.
Ultra	Set test mode to Ultra.
None	No function.

6.9.5.2. Digital Outputs

Configure Digital Outputs as needed per application. Digital outputs can be classified as either Normally Open (NO) or Normally Closed (NC).

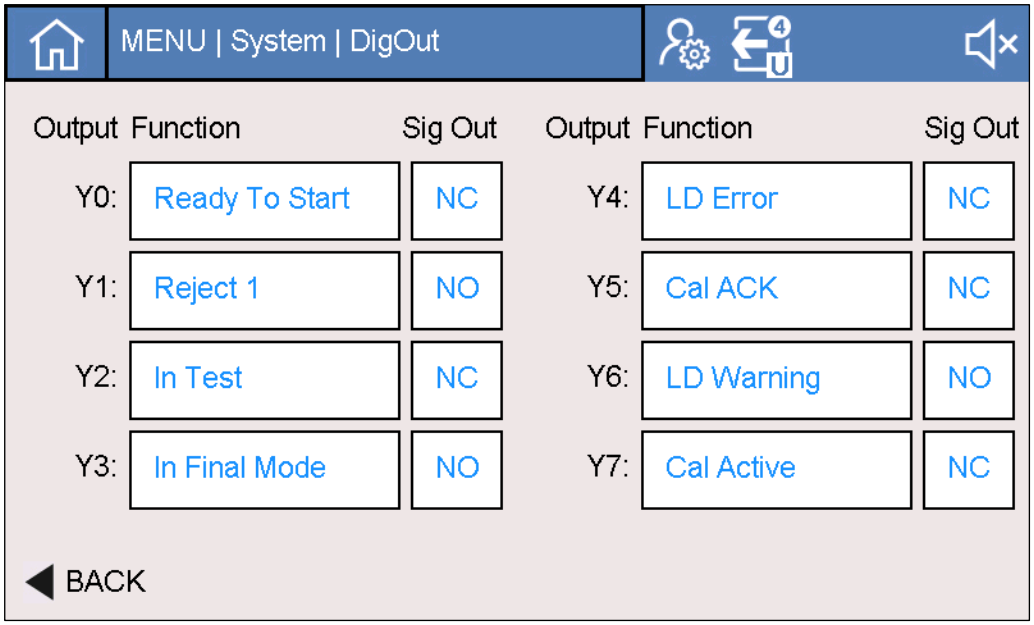
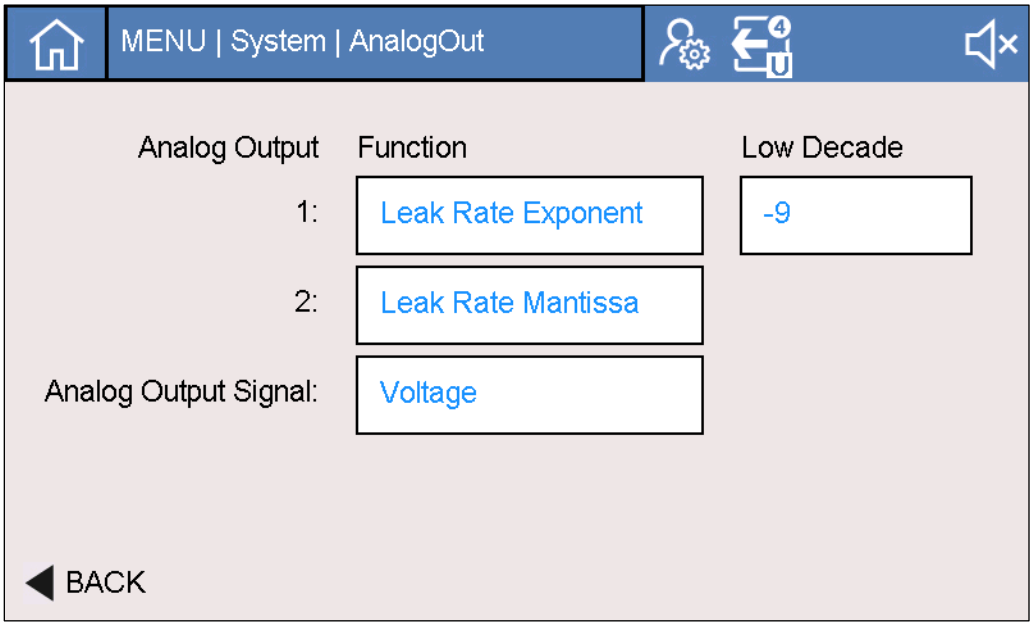


Table 38 *Digital Output Options*

Digital Output	Comments
Reject 1	Turn on when leak rate is below user defined limit, level 1
Reject 2	Turn on when leak rate is below user defined limit, level 2
Reject 3	Turn on when leak rate is below user defined limit, level 3
Ready to Start	Status is standby.
In test	Status is in-cycle.
In final test mode	Mode is in test mode as set.
LD error	Leak detector has reported an error.
Calibrate ACK	Calibration ACK received. User must respond.
LD error or warning	Leak detector has reported a warning.
Calibration Active	Calibration in progress.
Sniff Active	Leak Detector is in sniff method.
HV active	Leak Detector is in vacuum method.
Fil 1 active	Filament 1 is active.
Fil 2 active	Filament 2 is active.
Start Up	System is in Startup Initialization.
Shutdown	System is in Shutdown / Power down.
None	

6.9.5.3. Analog Outputs



Configure the two Analog Outputs as needed per application. These Analog Outputs have the same options listed in the Local I/O section below.

Analog Output Signal

Select between either Voltage or Current Analog outputs.

- Voltage Conditions: 0-10 VDC, max load 1000 ohm
- Current Conditions: 4-20 mA, max load 500 ohms

6.9.6. Local I/O

Three analog outputs can be configured on the Local I/O connector per the following options:

- Leak Rate Mantissa
- Leak Rate Exponent
- Leak Rate Logarithmic
- Leak Rate Compound
- Inlet Pressure

Configure the analog outputs referencing the following information. For the Exponent and Logarithmic selections, the user must also enter the low decade information.

Mantissa

The "Mantissa" output corresponds with the leak rate mantissa:

Formula

U = Voltage measured (V) on analog output

Mantissa = U

Examples

- U = 3.5 V -> Mantissa = 3.5

- U = 6.9 V -> Mantissa = 6.9

Exponent

The "Exponent" output corresponds with the leak rate exponent:

- it increases by 1 V per decade,
- the starting decade corresponds with 10 V.

Formula

U = Voltage measured (V) on analog output D_0 = Low decade for 0 V

$$\text{Exponent} = 10 - U + D_0$$

Example 1

Low decade at 10-12 (10 V = -12) -> D_0 = -12

- U = 7 V -> Exponent = 10 - 7 - 12 -> Exponent = -9
- U = 2 V -> Exponent = 10 - 2 - 12 -> Exponent = -4

Example 2

Low decade at 10-10 (10 V = -10) -> D0 = -10

- U = 7 V -> Exponent = 10 - 7 - 10 -> Exponent = -7
- U = 2 V -> Exponent = 10 - 2 - 10 -> Exponent = -2

Logarithmic

The "Logarithmic" output corresponds with the leak rate value:

- it increases by 1 V per decade,
- the starting decade corresponds with 0 V.

Formulas

U = Voltage measured (V) on analog output D0 = Low decade for 0 V

$$\text{Mantissa} = 10^{(U - \text{Integer value (U)})}$$

$$\text{Exponent} = \text{Integer value (U)} + D_0$$

$$\text{Leak rate} = \text{Mantissa} \times 10^{\text{Exponent}}$$

Example 1

Low decade at 10-12 (0 V = 1 10-12) -> D0 = -12

- V = 3 91 V -> Leak rate = $10^{(3\,91-3)} \times 10^{(3-12)} = 8\,13\,10^{-9}$
- V = 8 25 V -> Leak rate = $10^{(8\,25-8)} \times 10^{(8-12)} = 1\,78\,10^{-4}$

Example 2

Low decade at 10-10 (0 V = 1 10-10) -> D0 = -10

- V = 3 91 V -> Leak rate = 10(3 91-3) x $10^{(3-10)} = 8\,13\,10^{-7}$
- V = 8 25 V -> Leak rate = 10(8 25-8) x $10^{(8-10)} = 1\,78\,10^{-2}$

Compound

The "He Compound" output is a combination of mantissa and exponent:

- the integer part represents the exponent
- the decimal part represents the mantissa.

Formulas

U = Voltage measured (V) on analog output

$$\text{Mantissa} = 10 \times (U - \text{Integer value (U)})$$

Exponent = Integer value (U) - 12

He Compound = Mantissa x $10^{Exponent}$

Examples

- U = 3.91 V -> He Compound = 10 x (3.91-3)) x $10^{(3-12)}$ = 9 10 10^{-9}
- U = 8.25 V -> He Compound = 10 x (8.25-8)) x $10^{(8-12)}$ = 2.50 10^{-4}

Inlet Pressure

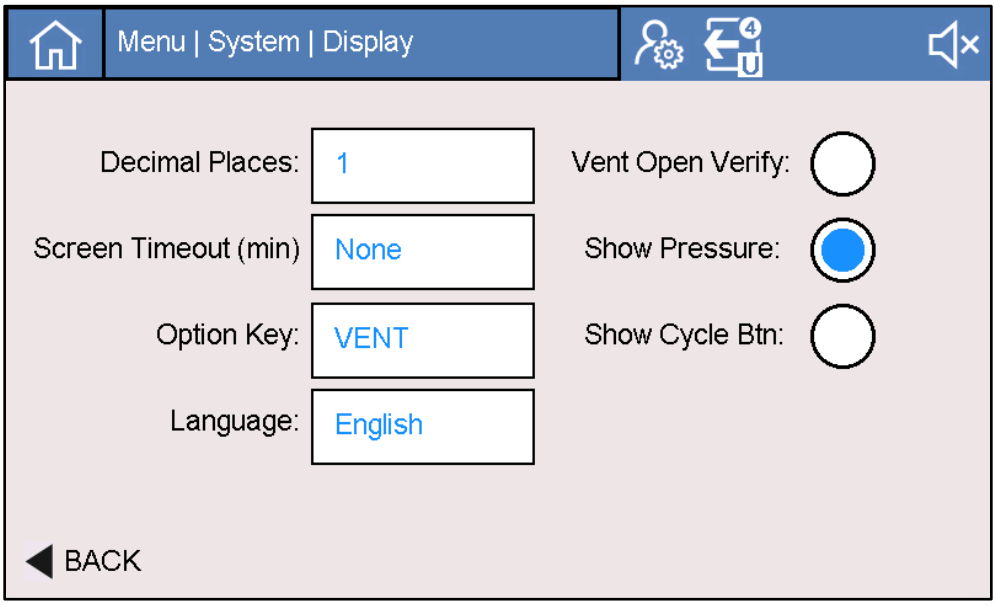
The "Inlet Pressure" output corresponds with the inlet pressure source:

Formula

U = Voltage measured (V) on analog output

Inlet pressure = $10^{(U-5.5)}$ hPa

6.9.7. Display



LR Decimal Places Select between either 1 or 2 for the leak rate decimal display.

Show Vacuum Pressure This parameter is on by default. Unselect to not show the vacuum pressure on the test screens.

Show Cycle Button This parameter allows user to have an HMI controlled start / stop button in addition to the physical button.

Screen Dim Select this option to dim the screen by 50% from the following inactivity timepoints: None, 5 min, 10 min, 20 min, and 30 minutes. By default, the screen is set to no dim time.

Option Button Select the desired Option key function from the table below.

Table 39 *Option Button Selections*

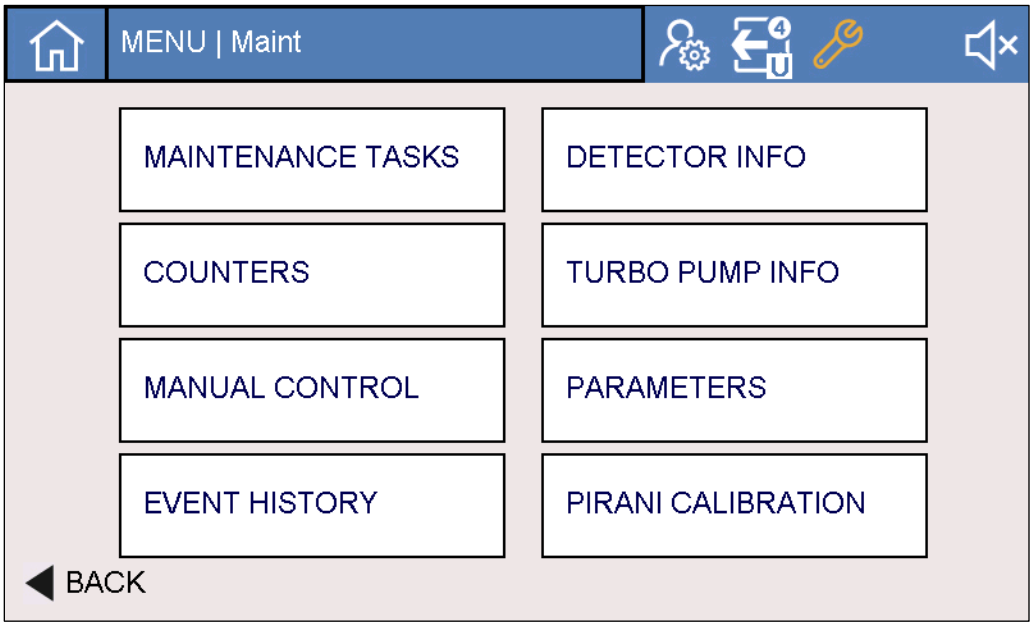
Option Function	Comments
None	
Zero	Only works in Manual zero method.
Vent	Only works in Manual Vent options.
Data Log	Only works from stream method. Test Summary and Test Summary and Stream will automatically data log.
Mute	Press button quickly to mute the audio.

Language Select from the following screen language display options: English, Spanish, German, French, Chinese.

6.10. Maintenance Settings

The maintenance settings section has the following sub-menus:

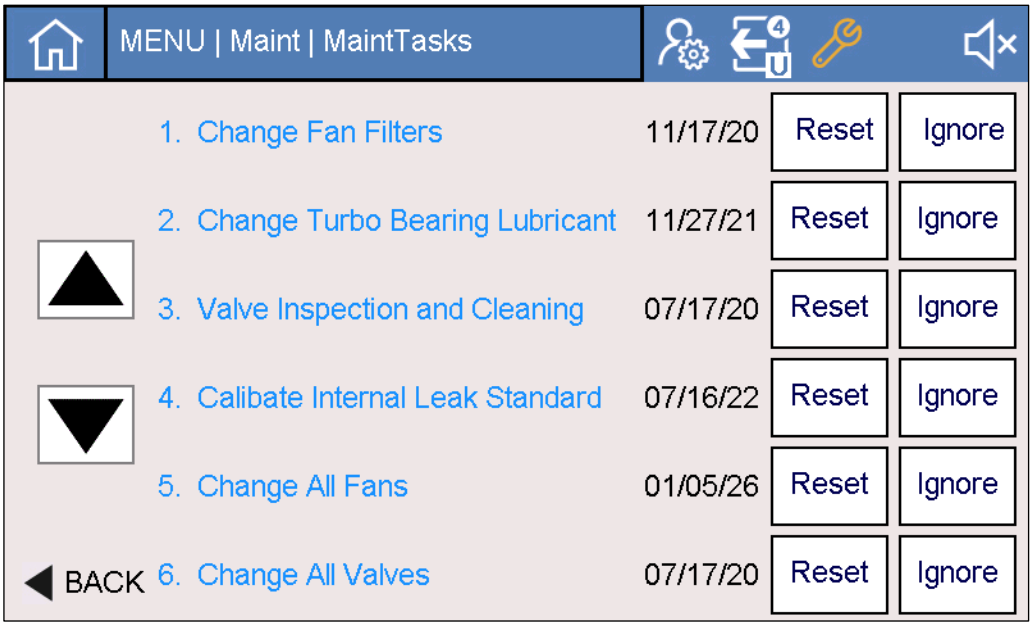
- Maintenance Tasks
- Counters
- Manual Control
- Event History
- Detector Info
- Turbo Pump
- Parameters
- Pirani Calibration



6.10.1. Maintenance Tasks

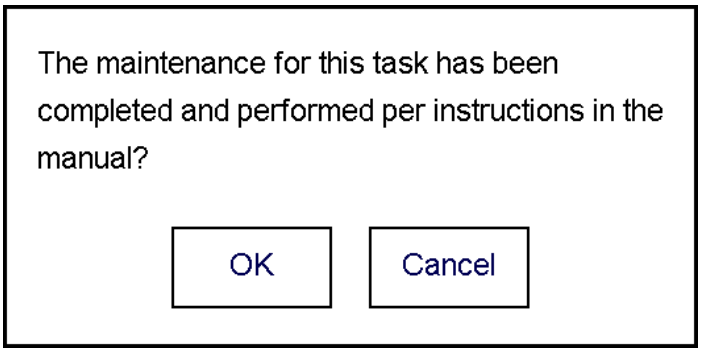
This screen sorts the needed maintenance tasks with due dates from closest to furthest. Maintenance due dates are determined from the maintenance tasks and intervals table (see Maintenance Tasks and Intervals), product configuration, and when maintenance was last performed.

When maintenance items are close to being due, the maintenance icon wrench on the test screen (status icon area) will appear orange. When items are due, the icon will become red.



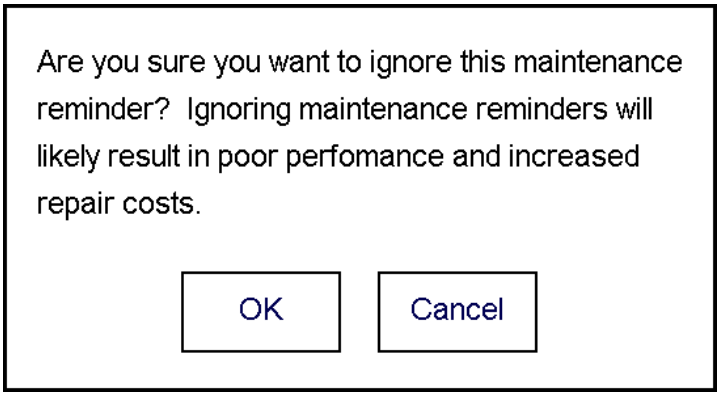
Reset Maintenance

After the user performs the required maintenance, the user will press the Reset button and the following dialog will appear. Press the OK Button.

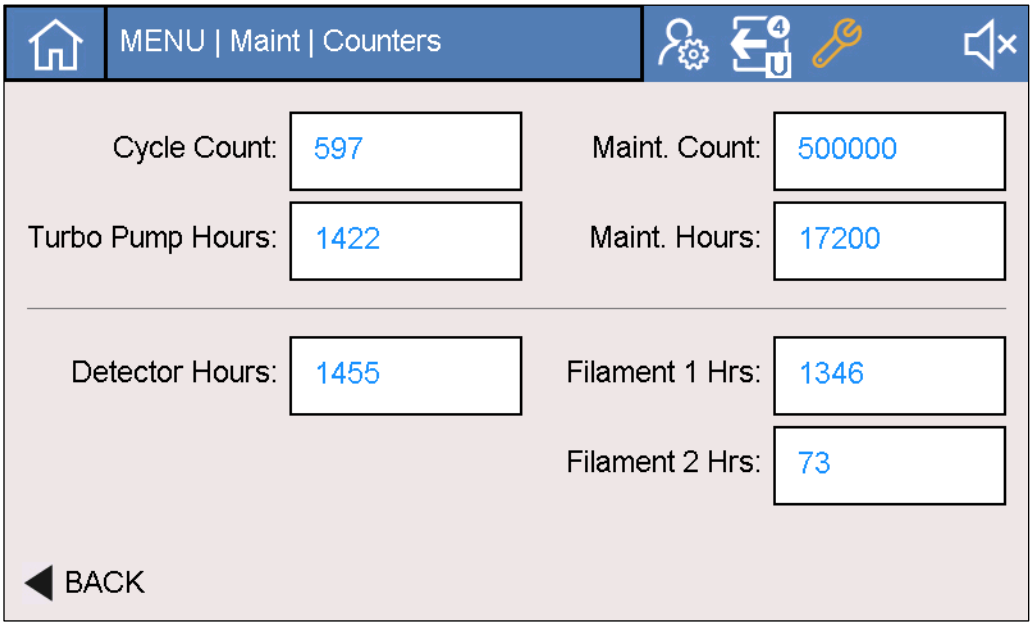


Ignore Maintenance

In rare cases, the user may need to temporarily ignore a maintenance warning. However, this is not recommended in usual practice. In this case the dialog below appears. The maintenance due date will remain the same even if the warning is ignored, but the warning will be suppressed.



6.10.2. Counters



Cycle Count Displays the current cycle count.

Valve Maint. Counter At over 500,000 cycles the valves should be replaced.

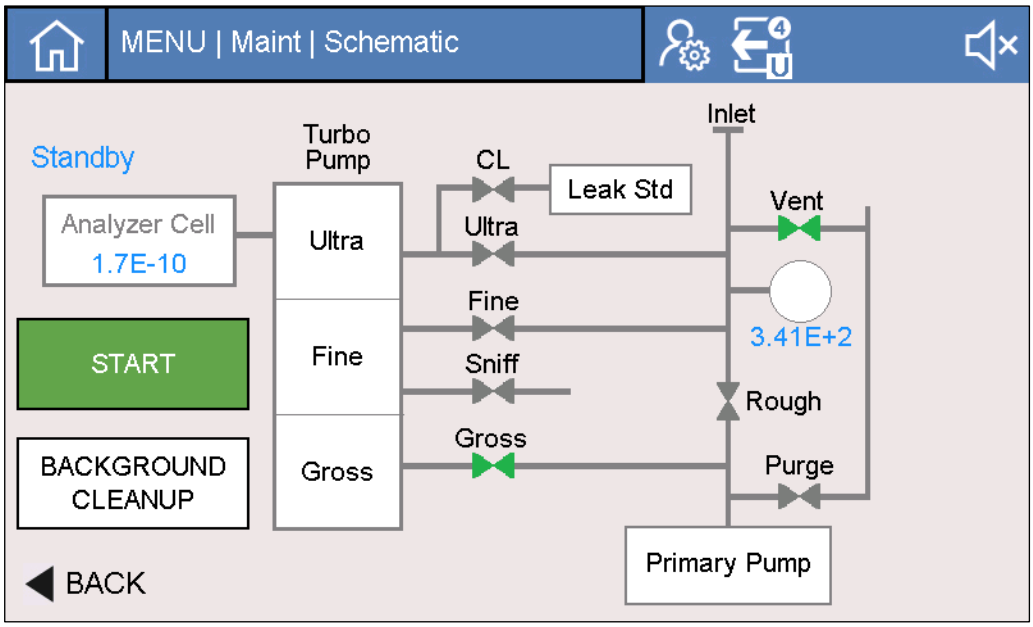
Turbo Pump Hours Displays current turbo pump hours. Reset only with a new or refurbished turbo pump.

Turbo Maint. Hours Turbo pumps should be serviced every 17,200 hours.

Filament 1 / 2 Hours Displays the current hours for filaments 1 and 2. When filaments are replaced the hour counters should be reset to 0.

Detector hours Display the current total detector hours.

6.10.3. Manual Control

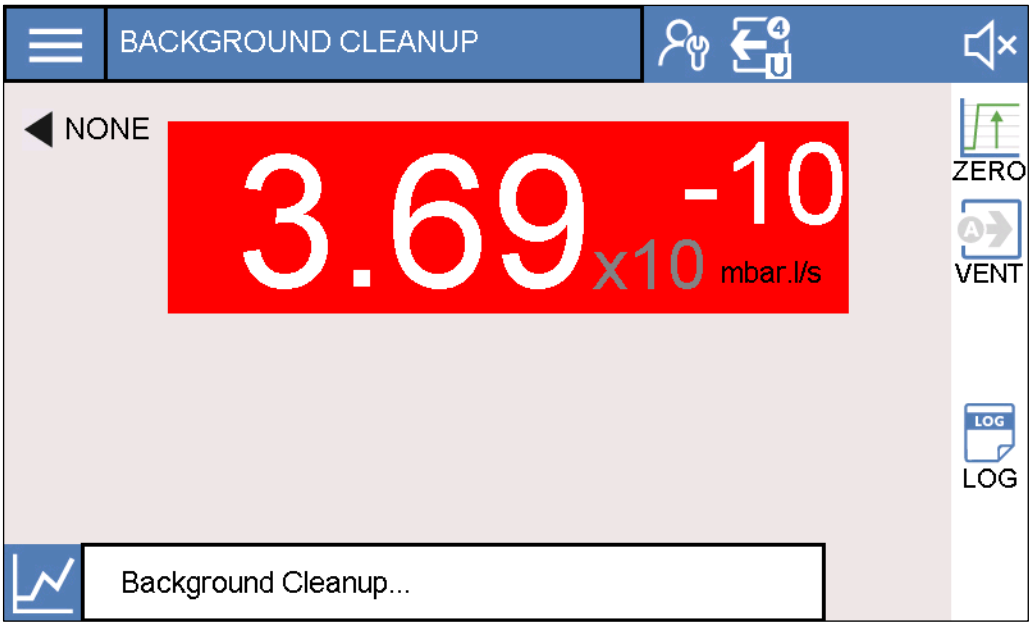


The manual control screen provides the following tools to view and troubleshoot the leak test process.

- Vacuum schematic view of leak detector. User can run a test cycle or calibration to observe valve cycle process.
- Visual indications of valve state, system status, pressure and leak rates.
- Control of purge valve. This is the only valve that can be controlled through the HMI.
- Ability to Start and Stop leak test cycles.

Background Cleanup

When Background Cleanup is selected, the main screen appears and a background cleanup process runs. This process consists of running the detector for one hour while the unit undergoes an automatic, continuous cycle and vent process. This process can be viewed either from the Test screen or the Manual Control screen, and is ideal for applications where the background requires improvement or when new valves are installed on the valve block.



6.10.4. Event History

The Event History screen provides a review of the last 30 leak detector events. Six events can be viewed per screen. Use the scroll button to toggle through the event history. Select the desired the event to review and the screen below will appear. All faults, warnings, and events are logged to event history. Reviewing these events can aid in troubleshooting. Table 40 outlines all available event codes

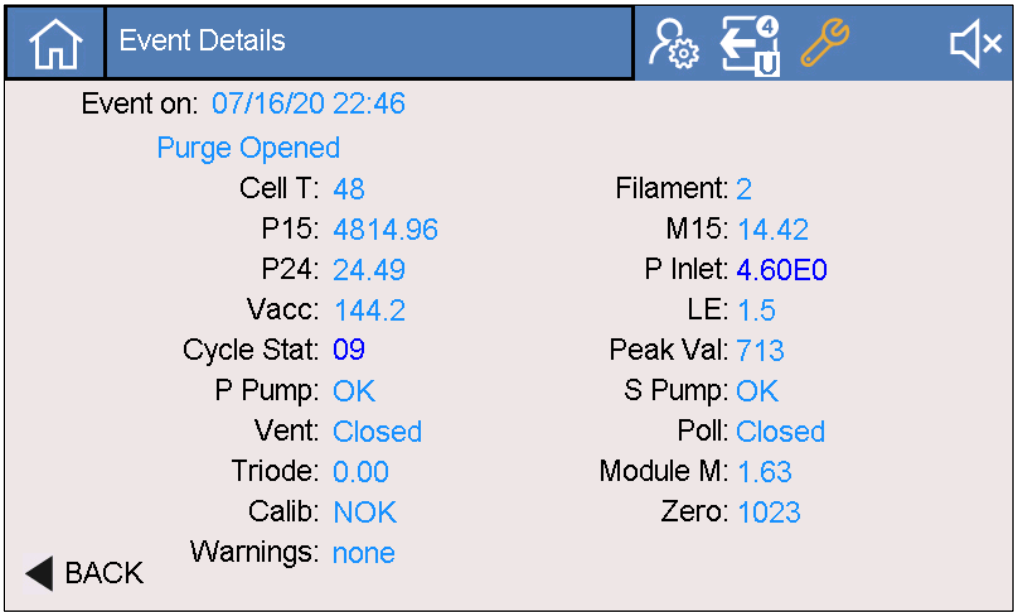
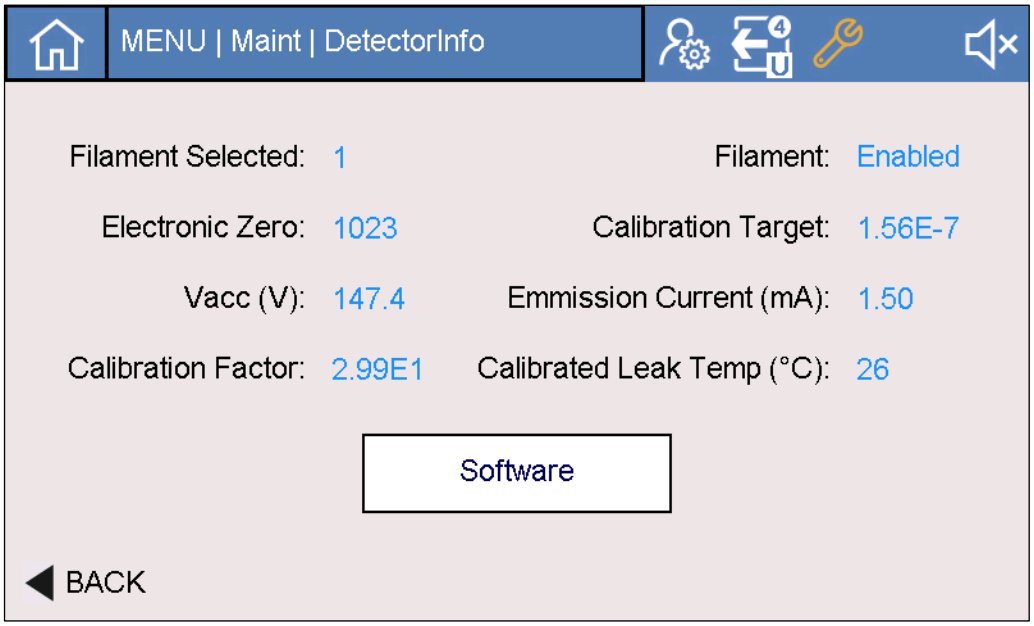


Table 40 *Event Logging*

Code	Description
300	Air inlet
301	Stop Cy He>He max
302	Reset count RVP
303	Reset count TMP1
304	Reset count TMP2
305	Reset count TMP3
306	Reset count Fil1
307	Reset count Fil2
308	Reset count cycle
309	Ie increase
310	Auto-cal restart
313	Date/Time update
318	Full param Reset
319	Fil change
320	Cal Pirani int
321	Storage delay

6.10.5. Detector Info

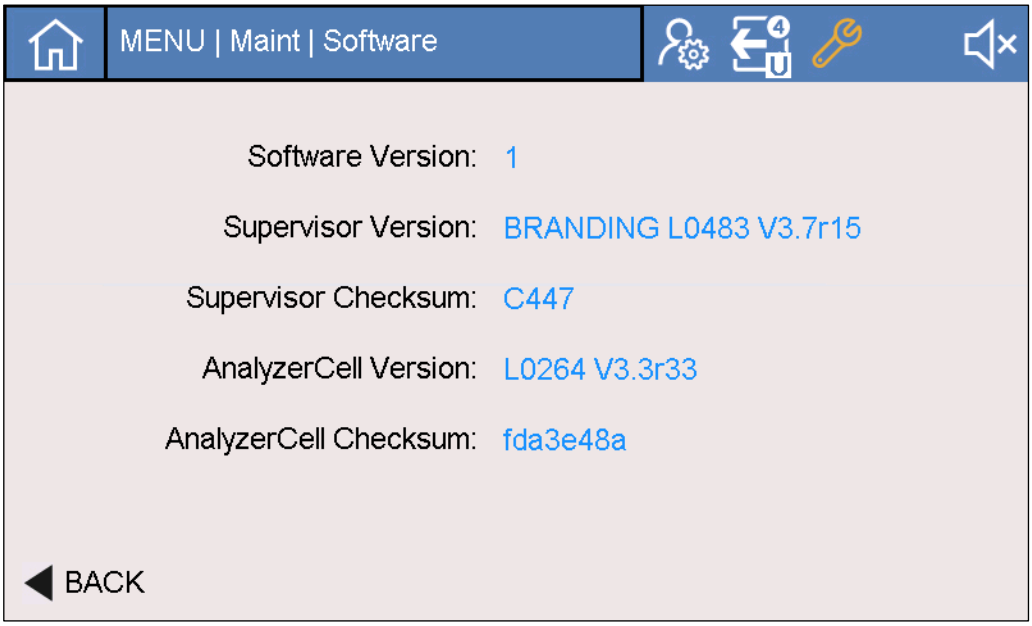
The Detector Info screen summarizes key performance data as shown below. This information can aid in troubleshooting.



6.10.5.1. Software Versions

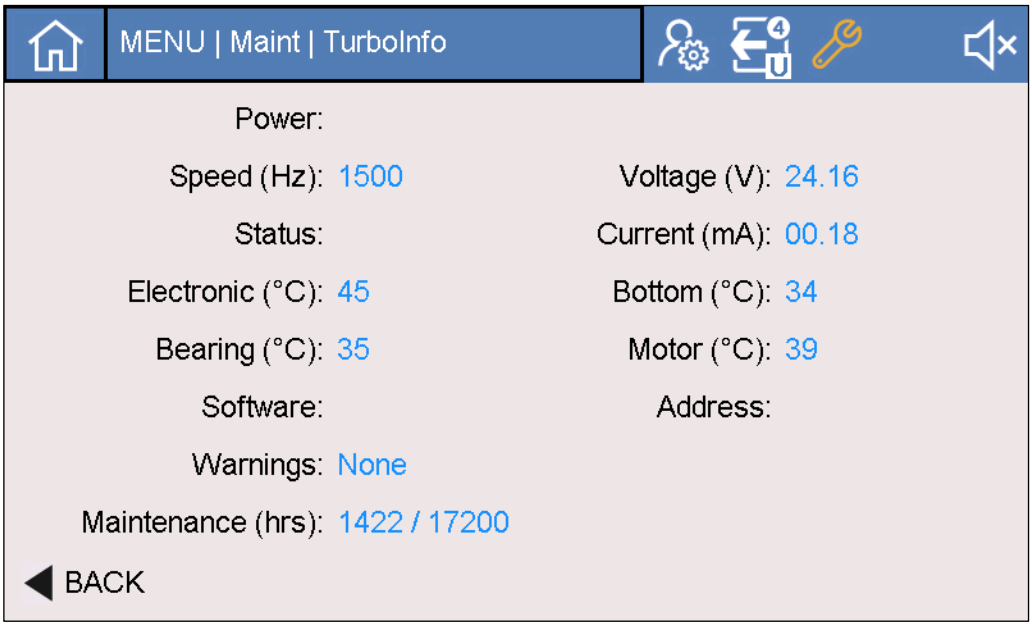
Press the Software button to display the Software versions screen. For informational purposes, the software revisions the of the following items are summarized.

- HMI Software
- Supervisory Board Software
- Mass Spec Software



6.10.6. Turbo Pump

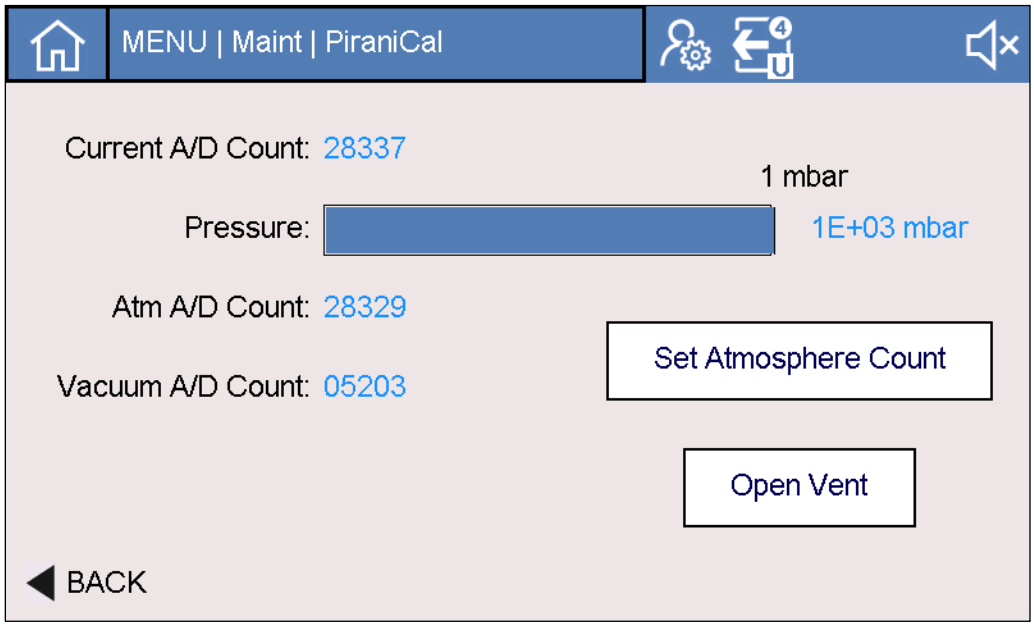
The Turbo pump screen summarizes key pump performance data as shown below. This information can aid in troubleshooting.



6.10.7. Pirani Calibration

The Pirani vacuum gauge sensor should be calibrated every six months. The calibration process had two main steps:

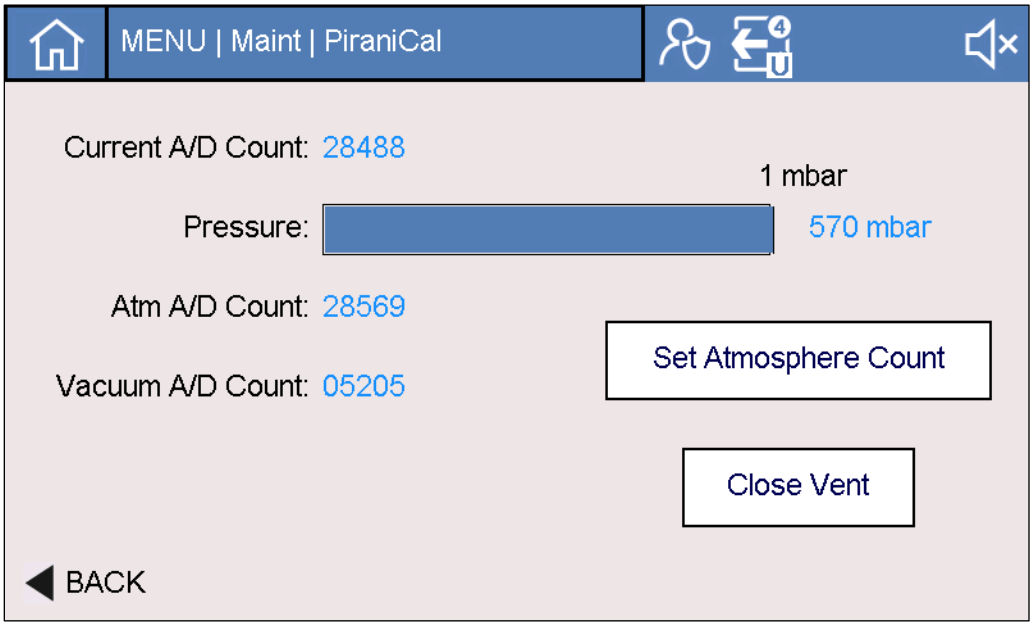
- Atmosphere reading
- Deep Vacuum reading (take 3-5 minutes to ensure deep vacuum has been reached).



Atmospheric Reading

To set atmospheric pressure:

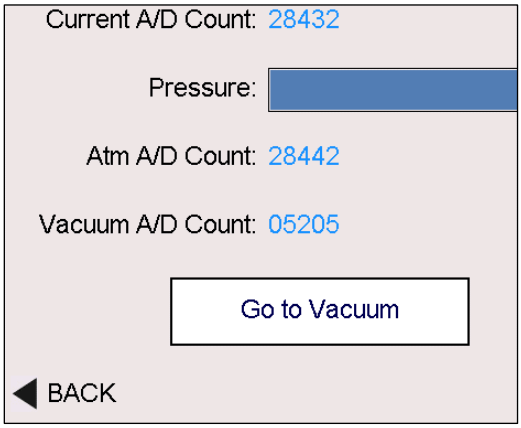
1. Stop the test, if running.
2. Perform an inlet vent.
3. Verify system is fully vented by removing flange or chamber.
4. Wait for Atmospheric reading to stabilize for at least 30 seconds.
5. Press the “Set Atmosphere Count” button.
6. Proceed to Deep vacuum section below.



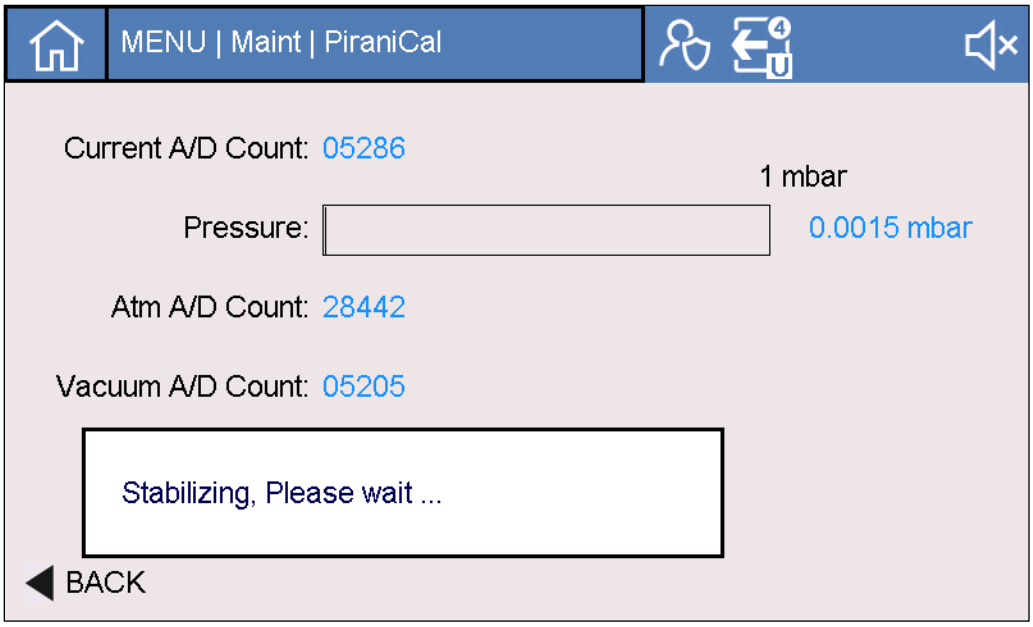
Deep Vacuum Reading

Setting deep vacuum pressure

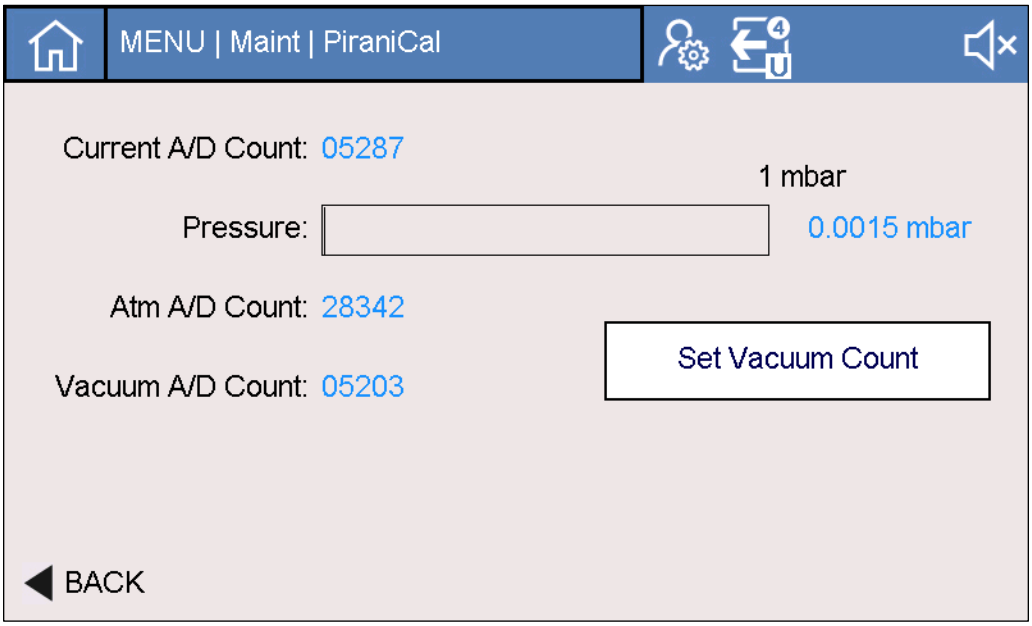
1. Place KF-25 blank-off on vacuum inlet.
2. Verify test mode is in Ultra.
3. Press “Go to Vacuum Button”.

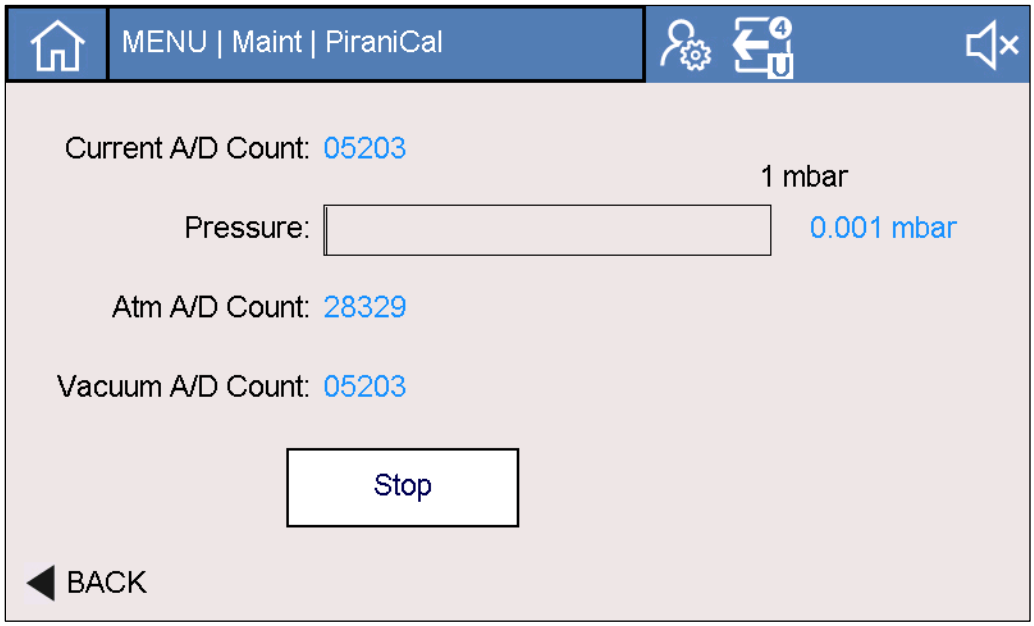


4. Leak detector will go into test and evacuate for five minutes. The text “Stabilizing, Please wait” will show.

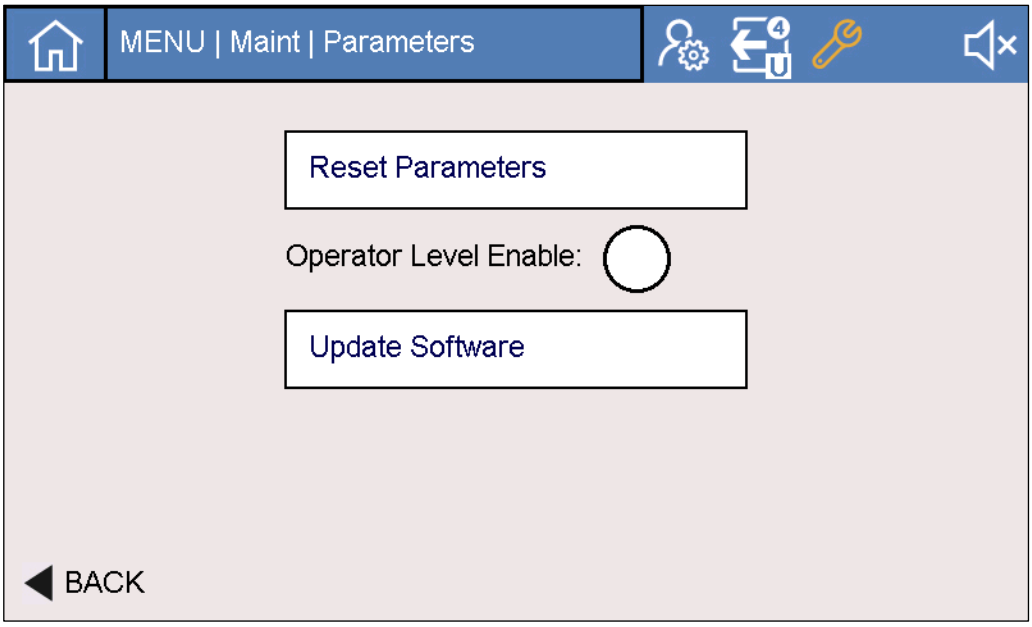


5. After five minutes, press the Set Vacuum Count button and then press the Stop button and the screen will automatically close.





6.10.8. Parameters



Parameter Reset

This button sets all parameters back to factory defaults. This feature should only be performed when needed.

Operator Level

This option allows the user to setup a new user level called Operator. Once active, most parameter settings will be locked out. This setting is ideal for customer applications where users want to restrict parameter access.

Select the “Set Technician Level Password” button. Set up a four-digit password. This new password enables the technician user to have access to the all parameters except Advanced.

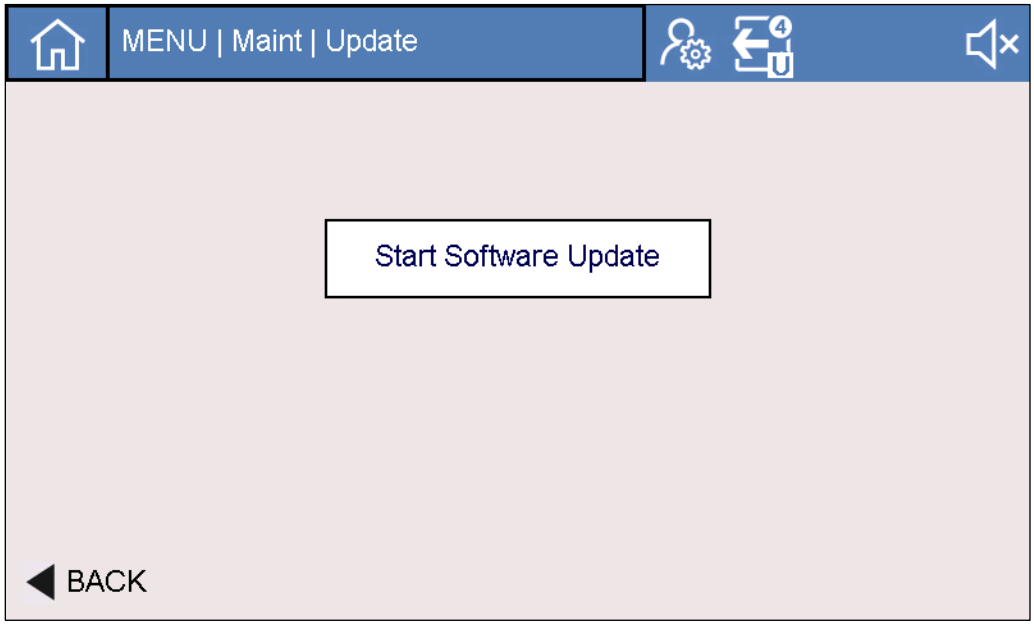
NOTICE: By default, the Operator level is not enabled, and the Technician level is accessible without password.

Software Update The button will launch a new screen where the user can install new software.

6.10.8.1. Software Update

LACO will provide three files (firmware, application, and key file). To perform a software update:

1. Place USB drive into PC and copy and paste these files onto a Windows-formatted USB drive.
2. Place USB drive into USB port on TITAN VERSA.
3. Navigate to the following screen: Settings > Maintenance > Parameters and press the Software Update button. The screen below appears.



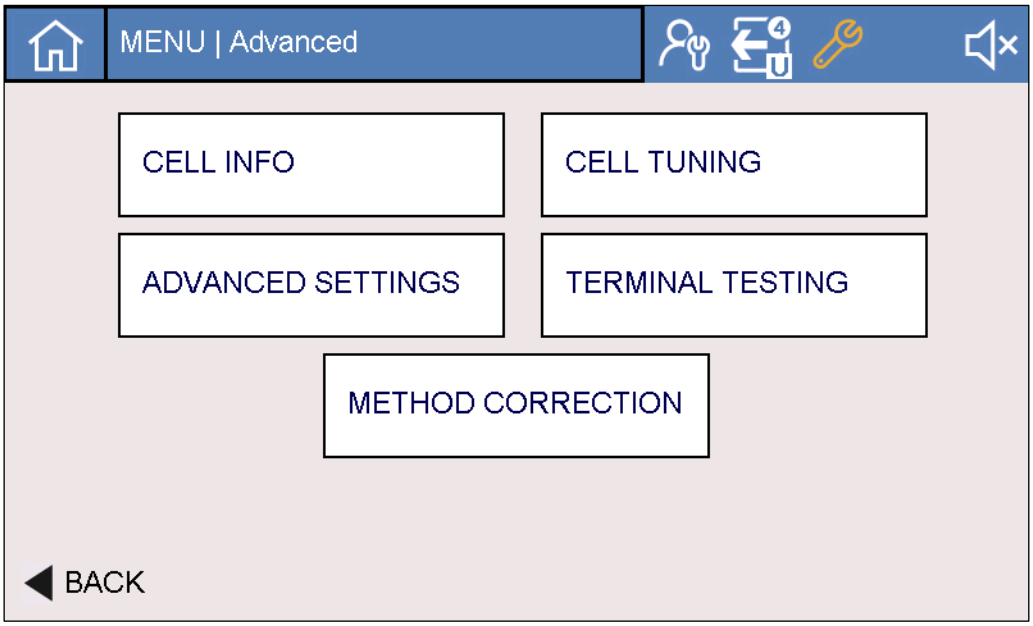
4. Press the Start Update button.
5. The update will take approximately two to four minutes. Status text will be displayed.
6. The system will reboot after the update is completed.

6.11. Advanced Settings

NOTICE: Advanced Settings should only be used by qualified technicians and used with extreme caution. Careless changes of settings could result in poor performance or device damage.

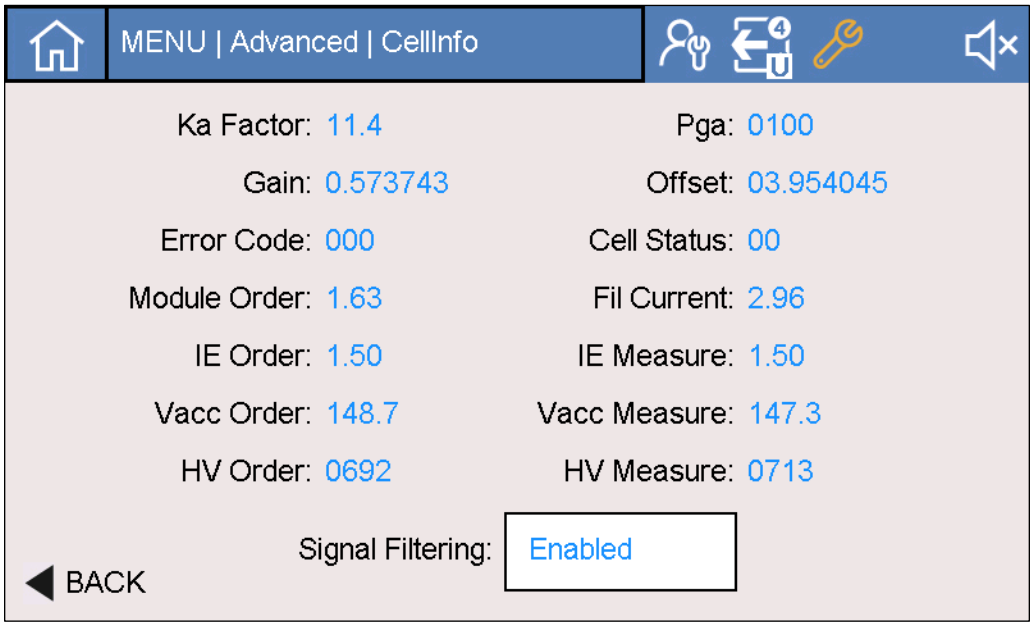
The Service settings section has the following sub-menus:

- Cell Info
- Advanced Settings
- Method Correction
- Cell Tuning (Characterization)
- Terminal testing (Serial, Ethernet and barcode)



6.11.1. Cell Info

The Cell Info screen summarizes key performance data of the mass spectrometer cell. This information can aid in troubleshooting.



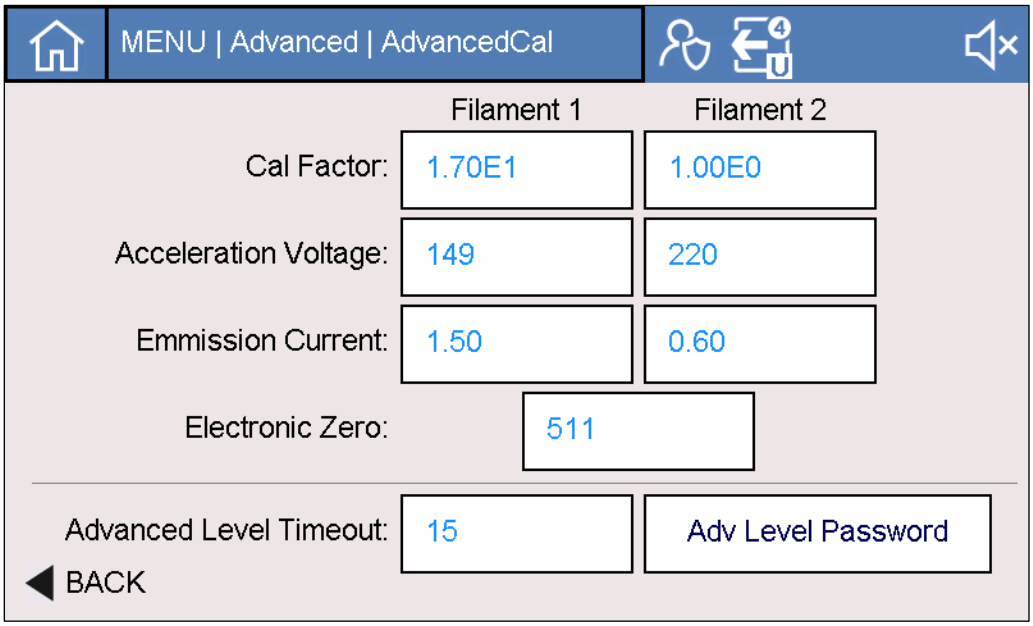
Signal Filtering There are two options for signal filtering: Disabled and Stable.

6.11.2. Advanced Settings

NOTICE: Careless changing of these parameters can lead can cause serious issues with the detector. Use with caution.

The advanced settings page allows access the following parameters:

- Cal Factor
- Acceleration Voltage
- Emission Current
- Electronic Zero



Advanced Level Timeout The options for Advanced Level Timeout are Disabled, 2 minutes, 5 min, 10 min or 15 min (default).

Advanced Password Select this button to enter a different password other than the default 5226.

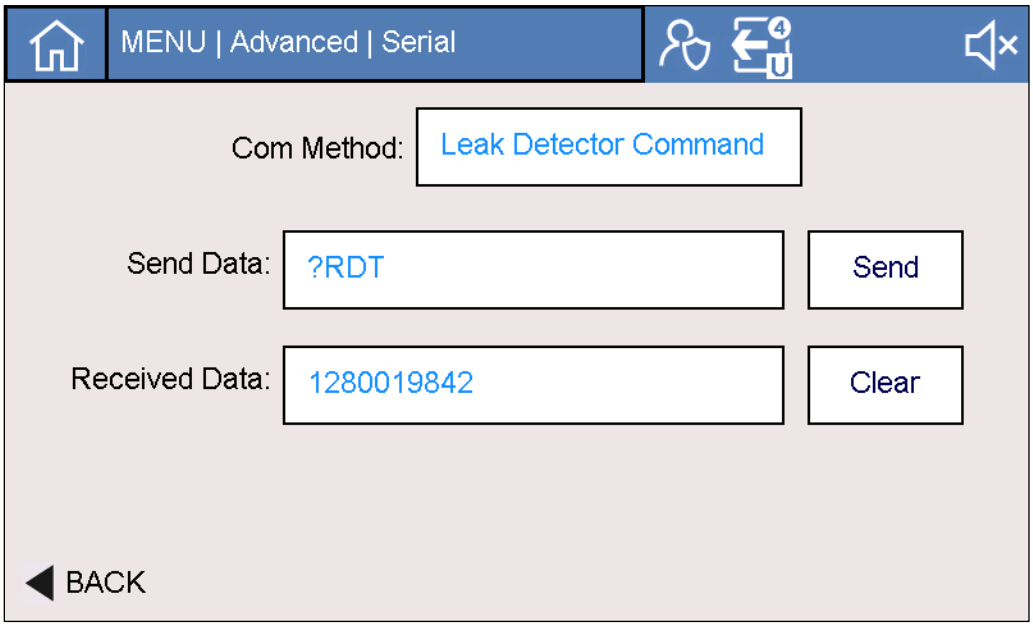
6.11.3. Method Correction

This screen is only available for factory use.

6.11.4. Cell Tuning

This screen is only available for factory use.

6.11.5. Terminal Testing



The Terminal Testing screen allows the user to test and debug the following communication interfaces listed in the table below.

Table 41 *Terminal Testing Communication Method Summary*

Communication Interface Methods	Needed connections
RS232	Serial enabled device connected to Serial DB9 Connector.
RS485	
Barcode	Connected barcode reader.
LD Command	None. Type command in Send field and press Send. Response will show in Receive box.

The interface allows the user to see the communication interface transactions happening in real time. Reference the *TITAN VERSA Communication Interface Manual* for a list of all commands required for all methods except the barcode method.

- ➔ For barcode method, the user can verify the correct barcode reading by scanning any 1D or 2D barcodes.
- ➔ For serial methods, the user must initiate the send commands from a separate PC or PLC. Verify cables and Baud Rate settings for all serial testing.

Communication Method

Select the desired communication method per the list in the table above. Received data and corresponding responses are displayed in the Send and Receive boxes. Received barcode data is shown in the Received Data box.

The LD Command method transmits data via the Send Data box, and responses are displayed in the Received Data box. Press the Send button to transmit the entered command to the leak detector. The LD Command method does not require any external communication devices.

6.12. Factory Default Settings

Table 42 *General Factory Settings*

Group	Parameters	Default value	Serial Command
Advanced	Pump Configured	TBD	@PP
	Debug features	Off	N/A
	VERSA Pro	Off	N/A
	HMI cycle button	Off	N/A
	Advanced Level Password	5226	@PWA
	Advanced Level Timeout	15 (2,5,10,15, disabled)	N/A
	Operator Level	Off	N/A
	Technician Password	1234	@PW
	Software Revision	N/A	@SW
Data Log	Data Log Activated	Off	@DL
	Data Log Mode	Test Summary	
	Data Log Interval	1 sec	
Test ID	Test ID Descriptions (5)	All null	N/A
	ID entry required	Off	
	Required data (5)	All off	
	Clear After (5)	All off	
Graphing	Sample Interval	1 sec	N/A
	Graph Time Scale	2 min	
	Scaling Method	Automatic	
	Automatic Scale Based On	Current Value (Current Value, Reject Limit)	
	Manual Scale Low Decade	-10	
	Decade Range	3	
	Logarithmic	Yes	
	Show Grid	Yes	
Communications	232 Baud Rate	9600 (9600, 19200, 56000, 115200)	@S2
	485 Baud Rate	9600 (9600, 19200, 56000, 115200)	@S4
	Remote Screen	Off	@RS
Accessory	Accessory 1 function	None (High-Flow Evac, High-Flow Vent, Pass, Fail, None)	@AC1 and @AC2
	Accessory 2 Function	None (High-Flow Evac, High-Flow Vent, Pass, Fail, None)	
	High-Flow Evac Pump down State	High-Flow Only (High-Flow Valve Only, High-Flow and LD Rough)	
	High-Flow Evac Measure State		

Group	Parameters	Default value	Serial Command
Remote I/O	Remote I/O enabled	Off	N/A
	Digital Input 0-7 (8)	See Remote I/O default options (Mantissa, Exponent)	
	Digital Input Trigger (8)		
	Digital Output 0-7 (8)		
	Digital Output Trigger (8)		
	Analog Input 0-1 (2)		
	Analog Output Type	Voltage (Voltage or Current)	
Vent	Manual Vent Verify	Off	N/A
AutoTest	Save Results	Off	N/A
Display	Decimal Places	1	N/A
	Screen Dim	None (None, 5, 10, 20, 30)	N/A
	Show Vacuum Pressure	On	N/A
	Option Button	Vent (None, Zero, Vent, Data Log On, Alarm)	@OP
	Language	English	@LA

Table 43 *Leak Detector Settings*

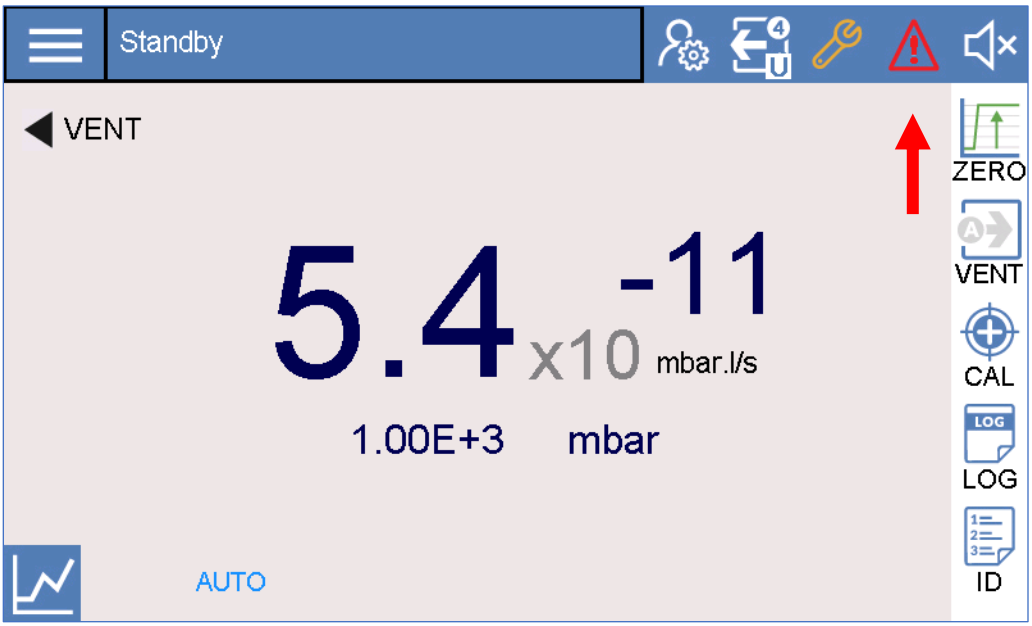
Group	Parameters	Default value	Serial Command
Test Method	Test Method	Vacuum (Vacuum, Sniff)	TST
	Vacuum Mode	Ultra (Gross, Fine, Ultra)	CYT
	Ultra Crossover	0.5 mbar	P2
	Fine Crossover	5 mbar	P5
	Gross Crossover	25 mbar	P1
	Massive Mode	Off	MAS
Reject Limits	Vacuum Setpoint	1.0e-8	S1H
	Sniff Setpoint	1.0e-4	S1S
	Probe Clogged	1.0e-6	S6
	Gross Leak Setpoint	1.0e-5, Off	AA
	Gross Leak Auto Cleanup	3.0e-4, On	AP
Vent	Vent Method	Automatic (Manual, Automatic)	IVP
	Vent Delay	0	
	Vent Timer	Off (0 seconds)	
AutoTest	Cycle End Method	Manual (Manual, Automatic)	CA
	Test Time	10 seconds	
	Roughing Time	On, 10 seconds	
	Sniff Auto Test		CAS

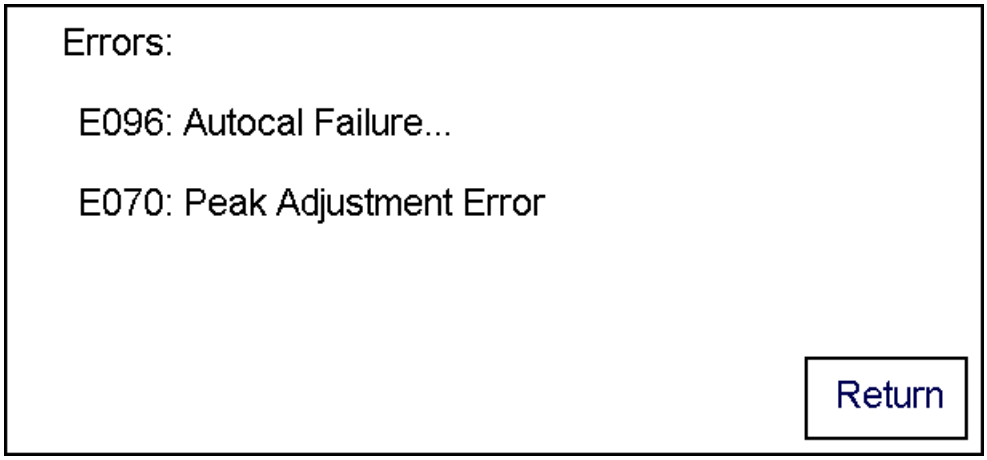
Group	Parameters	Default value	Serial Command
Zero	Zero Method	Manual (Manual, Automatic)	AU, AUZ, ZB
	Zero Trigger	Threshold (Threshold, Timer)	
	Zero Threshold	5e-7	
	Background Suppression	On	RBF
Calibration	Calibrated leak standard info	Per leak standard	FEM
	Calibration Start Method	Manual	AC
	Calibration Check Start Method	Manual	ACA
	Machine Factor – Vacuum	Off, 1.00e00	HV
	Machine Factor – Sniff	Off, 1.00e00	SN
Mass Spec	Test Gas	Helium 4 (He4, He3, Hydrogen)	GZ
	Filament Settings	On, 1	SW, SC
Units	Leak Rate Units	mbar	UN
	Date	As needed	DA
	Time	As needed	TI
	Audio Setting	Off, 3 (1-9)	SO, SY
	Digital Voice Setting	Off, 4 (1-9)	
Local I/O	Analog Out 1	Mantissa	AO1
	Analog Out 2	Logarithmic, -12	AO2
	Analog Out 3	Exponent, -12	AO3
Advanced	Signal Filtering	Stable (Disabled, Stable)	TCM

7. Troubleshooting

7.1. Warning and Error Messages

When a warning or fault condition occurs, the “error status icon” will appear in the upper right corner of the test screen. Select the icon and a pop-up screen summary of all current warnings or faults will be displayed.





➔ Warning messages warn of device modes that can impair the accuracy of measurements. Operation of the device is not interrupted.

➔ Errors are events where device operation will stop until the fault is corrected.

The five levels of warnings or faults are outlined in the following table.

Table 44 *Warning Levels*

Level	Description
1	Warning
2	Major Fault – Bad reading
3	Critical Fault – Test not possible
4	Service Fault – Temporary
5	Warning – Detector not in normal condition

Table 45 *Warning and Error Messages*

Fault Level	Type	Code	Short Description	Long Description	Possible Solution (s)
1 - Warning	?ER	59	Cal test mode lost	Calibration with an external leak in progress, most sensitive mode not reached or lost.	Adjust PI1 inlet gauge
	?ER	93	Dynamic cal fail	Calibration coefficient is out of range. (Correct range: 0.5 to 3.)	Check that dynamic calibration is done under the specified conditions
	?WA	60	Probe type or connector		
	?WA	145	Maintenance required	“Maintenance required” timer threshold reached	Do the required maintenance operation
	?WA	150	Primary pump maint.	“Primary pump maint.” timer threshold reached	Do the required maintenance operation
	?WA	160	High vac. pump maint.	“High Vac pump maint.” timer threshold reached	Do the required maintenance operation
	?WA	180	New filament 1 required	Filament 1 defective	Change filament 1
	?WA	181	New filament 2 required	Filament 2 defective	Change filament 2
	?WA	182	No output on wire 2	N/A	N/A
	?WA	183	No output on wire 1	N/A	N/A
	?WA	211	Manual calibration	N/A	N/A
	?WA	235	Auto. cal. required	Autocalibration to launch because set time between two calibrations reached	Launch an autocalibration
	?WA	240	Auto. cal. required	Autocalibration to launch because set time between two calibrations reached	Launch an autocalibration
	?WA	242	Int Pirani Cal Error	N/A	N/A
	?WA	245	Temperature too High	Ambient temperature too high	Ensure leak detector is used in the required temperature tolerance
	?ER	50	Cell zero stability	N/A	N/A

Fault Level	Type	Code	Short Description	Long Description	Possible Solution (s)
2 - Major Fault – Bad reading	?ER	56	Background trouble	Background higher than 20% of the calibrated leak value of reference for the calibration	1. Degas the analyzer cell: pump in the cell for 10 minutes 2. Launch a calibration
	?ER	57	Lack of sensitivity	Integrable models: • Switch off the customer primary pump on OFF • Calibrated leak parameters	1. Place switch ON 2. Check the calibrated leak parameters
	?ER	58	Sensitivity too high	Measured leak value to high	Check the calibrated leak parameters
	?ER	65	Background too high	Calibration with an external leak in progress, most sensitive mode not reached or lost	Adjust PI1 inlet gauge
	?ER	70	Peak adjust error	Leak rate measured but background too high to validate the calibration	• Do a calibration with an external leak • Check the calibrated leak parameters
	?ER	80	Cal. leak year error	• Incorrect internal calibrated leak parameters • Incorrect day date	• Correct the internal calibrated leak parameters • Correct the day date
	?ER	85	Temperature too high	Ambient temperature too high	Ensure leak detector is used in the required temperature tolerance
	?ER	89	Emission lost	N/A	N/A
	?ER	95	Cell. zero off limits	N/A	N/A
	?ER	96	AutoCal failure+2nd code	Filament switched off (OFF) in the mass spec menu	3. Switch on the filament (ON) in the Spectro menu 4. Launch an autocalibration
	?ER	97	Temperature too high	Air filter N01 obturated, ambient temperature too high (black filter)	• Change filter • Ensure leak detector is used in the required temperature tolerance • Change the fan
	?ER	98	Temperature too low	Ambient temperature too low	Ensure leak detector is used in the required temperature tolerance
	?ER	160	Snif. probe clogged	Standard probe filter clogged	• Change the sniffer probe filter • Change the air filter of the vacuum block
	?WA	220	Filament Request Off	N/A	N/A
3 - Critical Fault – Test not possible	?ER	188	High. vac pump speed	N/A	N/A
	?ER	192	Fil. current too high	N/A	N/A
	?ER	194	Filament 2 collector short	N/A	N/A
	?ER	195	Filament 1 collector short	N/A	N/A

Fault Level	Type	Code	Short Description	Long Description	Possible Solution (s)
	?ER	205	Primary pump failure	Primary pump temperature too high	• Allow the pump to cool down • Check room temperature
	?ER	206	ACP temp. too high	• Ambient temperature too high • Pump fan obstructed	• Allow pump to cool down • Check room temperature • Clean the fan
	?ER	210	Primary pump failure	Primary pump switch OFF	Place switch ON
	?ER	220	No collector voltage	Filament switched off (OFF) in the Spectro menu	5. Switch on the filament (ON) in the Spectro menu 6. Launch an autocalibration
	?ER	224	-15 V cell failure	N/A	N/A
	?ER	230	Filaments 1 and 2 bad	Two filaments defective	Change the both filaments
	?ER	231	No output on wire 1 and 2	N/A	N/A
	?ER	235	Cell pressure > 1e-03 mbar	Analyzer cell pressure too high	Degas the analyzer cell: pump in the cell during 10 min and launch a calibration
	?ER	238	No cell com.	N/A	N/A
	?ER	239	No high vac pump com.	N/A	N/A
	?ER	241	High vac pump speed	N/A	N/A
	?ER	243	EEPROM error	N/A	N/A
	?ER	245	High vac pump fail	N/A	N/A
	?ER	247	Check ATH connector	N/A	N/A
	?ER	248	Check MDP connector	N/A	N/A
	?ER	251	+15 V cell failure	N/A	N/A
	?ER	252	24 V cell failure	N/A	N/A
	?ER	253	Time keeper ram fail	N/A	N/A
	?ER	255	An error occurred +2nd code	N/A	N/A
	?WA	241	Auto. cal. required	Select filament defective	Change the defective filament and launch an autocalibration
	?WA	244	VHS uncalibrated	N/A	N/A
4 - Service Fault – No Display	?ER	180	No electrical current	N/A	N/A
	?ER	185	Triode SECU active	N/A	N/A
	?ER	248	Check MDP connection	N/A	N/A
	?ER	75	PIC no found	N/A	N/A
	?ER	99	24 VDC problems	N/A	N/A
	?WA	203	Calibrated leak external	N/A	N/A
	?WA	205	Shutdown of Autocal	N/A	N/A

Fault Level	Type	Code	Short Description	Long Description	Possible Solution (s)
5 - Warning – Detector not in normal condition	?WA	97	Temperature too high	• Ambient temperature too high • Fan defective	• Ensure leak detector is used in the required temperature tolerance • Replace the fan
	?WA	98	Temperature too low	Ambient temperature too low	Ensure leak detector is used in the required temperature tolerance
	?WA	230	Auto. cal. required	Calibration checking results: defective detector calibration	Launch an autocalibration
	?WA	255	Out start condition	• Leak detector cannot start because the use conditions at startup are not met • Ambient temperature too low	Ensure leak detector is used in the required temperature tolerance

8. Maintenance and Service

8.1. Maintenance Cautions and Requirements

CAUTION: Risk of injury from improper maintenance work

Maintenance on the TITAN VERSA may only be performed by personnel who have been authorized by LACO Technologies to execute these tasks.

- ➔ When handling gases, comply with the applicable regulations and safety measures.
- ➔ Helium gas has an asphyxiating effect in large concentrations.
- ➔ The test objects, fixtures, and fittings must be capable of withstanding the existing pressure differential for the given test.
- ➔ Customers must declare all chemicals and gasses that have been in contact with the TITAN VERSA leak detector when sending the product to LACO for repair or maintenance. If the device contains pollutants (e.g. radioactive, toxic, caustic, or biological substances) the unit will likely be rejected.
- ➔ The power entry module, power supply unit, wiring board, and backing pump contain parts supplied with a voltage of 50V. During servicing, therefore, it is necessary to remove the mains plug before opening the device.
- ➔ Electrical components (circuit boards, integrated circuits, electrical connections) are sensitive to electrostatic charges. Use anti-static packaging for circuit boards and Flash-ROM.
- ➔ If defects arise by disregarding recommended maintenance and protective measures, warranty claims may no longer be applicable.
- ➔ LACO Technologies does not accept responsibility and warranty claims
  - o if the device is converted, or
  - o if the device is operated with accessories that are not listed in the associated product documentation.

8.2. Protective Equipment

To protect both you and the equipment, protective equipment must always be worn, including:

- Safety glasses
- Latex gloves
- Ear protection (required only in some cases)
- Protective masks

8.3. Maintenance Documentation

Maintenance documentation for the TITAN VERSA is contained in this manual section and on the TITAN VERSA USB drive. The following manuals are on the USB drive, under the "Maintenance Folder".

- Manual for 1015 pump
- Pump manual, UNO 6
- Pump manual, MVP030
- Pump manual, ISP-90
- Pump manual, SplitFlow 50 turbo pump

8.4. Maintenance Tools and Parts

Included with the product is a tool and maintenance kit in a carry case. The table below outlines maintenance item contents and where they are used.

Description	Part Number	Where Used
Fuse, 5 x 20 mm, 10-amp, slow blow, ceramic	LMSA3844-C	Main power entry module
Fuse, 5 x 20 mm, 2-amp, slow blow, glass	LMSA3850	Remote terminal blocks
Oil refill cap assembly	TV118494	Pump oil easy refill
Oil drain connector assembly	TV118495	Drain wet pump oil

Tool Description	Part Number
Hex bit, metric hex head, 2 mm	LMSA5939
Hex bit, metric hex head, 2.5 mm	LMSA5929
Hex bit, metric hex head, 3 mm	LMSA5930
Hex bit, metric hex head, 4 mm	LMSA5931
Hex bit, metric hex head, 5 mm	LMSA5932
Hex bit, metric hex head, 6 mm	LMSA5941
Hex bit, torx tamper proof, TT20	LMSA5933
Hex bit, torx tamper proof, T6	LMSA5934
Hex bit, nutsetter, 7 mm hex bit	LMSA5935

8.5. Maintenance Tasks and Intervals

For optimum product performance, follow the maintenance tasks and intervals outlined in Table 46 below. Service sites include either on-site (OS) or at a LACO Authorized Service Center (LS).

There are three qualification levels for performing maintenance on the TITAN VERSA:

- Operator – Level 1
- Technician or Trained Operator – Level 2
- Service Center – Level 3

If two maintenance intervals are listed, follow whichever interval comes first.

Table 46 *Maintenance and Service Schedule*

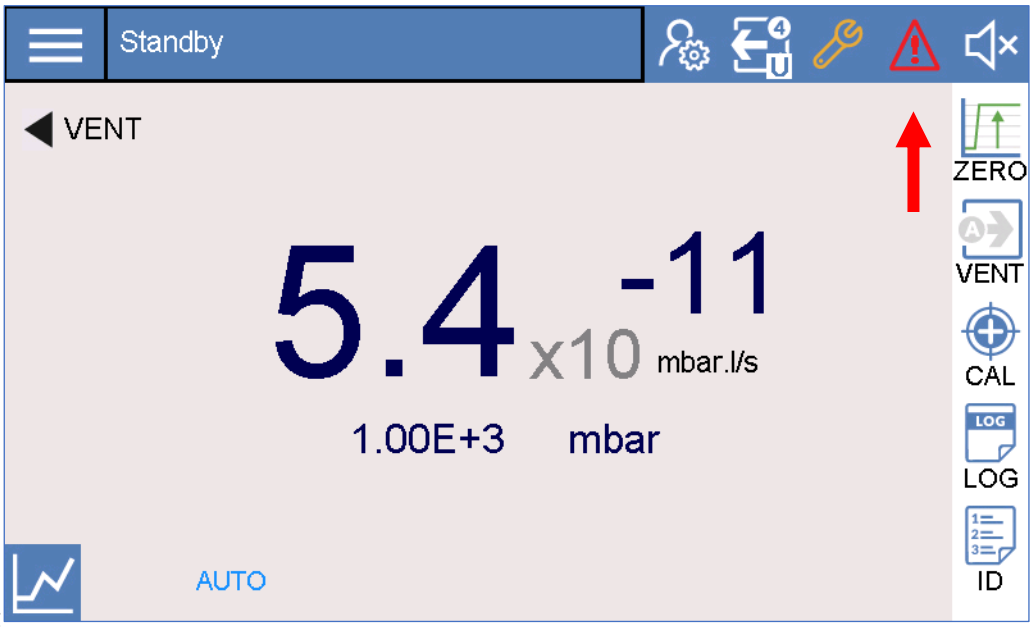
Model/Pump	Maintenance Task	Part Number	Maintenance Interval	Level	Site
VERSA T/ wet pump	Change pump oil	LVOEZUNO6	1500 h or 6 months	2	OS
	Change oil mist eliminator filter	PFPKE07025T	3000 h or 18 months	2	OS
	Repair or exchange pump	LS-TVT-1 (Repair) LS-TVT-2C (Exchange) LS-TVT-2L (Exchange)	24000 h or 48 months	2-3	OS or LS
	Replace pump	PFPKD07711	36000 h or 72 months	2-3	OS or LS
VERSA L/ wet pump	Change pump oil	LVOEZ1015	1500 h or 6 months	2	OS
	Change oil mist eliminator	PF121494	3000 h or 12 months	2	OS
	Major pump repair or pump exchange	LS-TVL-1 (Repair) LS-TVL-2C (Exchange) LS-TVL-2L (Exchange)	24000 h or 48 months	2-3	OS or LS
	Replace pump	PF115SDMLAM	36000 h or 72 months	2-3	OS or LS
VERSA T/ dry pump	Repair diaphragm and valves	LMK-TVTD-1 (Kit) LS-TVTD-1 (Repair)	12000 h or 24 months	2	OS or LS
	Exchange pump	LS-TVTD-2C LS-TVTD-2L	36000 h or 72 months	2-3	OS or LS
	Replace pump	PFPKT01190	36000 h or 72 months	2-3	OS or LS
	Exhaust muffler	PFP0995942	12000 h or 24 months	1	OS
VERSA L/ dry pump	Minor pump repair	LMK-TVLD-1 (Kit) LS-TVLD-1 (Repair)	6000 h or 12 months	2	OS or LS
	Major pump repair	LMK-TVLD-1 (Kit) LS-TVLD-2 (Repair)	12000 h or 24 months	2	OS or LS
	Exchange pump	LS-TVLD-3C LS-TVLD-3L	36000 h or 72 months	2	OS or LS
	Replace pump	AIISP-90	36000 h or 72 months	2	OS or LS
	Exhaust muffler	PFP0995942	12000 h or 24 months	1	OS

Model/Pump	Maintenance Task	Part Number	Maintenance Interval	Level	Site
All models	Calibrate Pirani gauge	N/A – software	6 months	1	OS
	Change fan filters	LMK-TV-1 (Kit – 2)	3000 h or 12 months	1	OS
	Change all fans	LMK-TV-7 (Kit) LMK-TV-8 (Kit, Compact)	48000 or 96 months	2	LS
	Turbo pump bearing lubricant	T10034	12000 h or 24 months	2	OS or LS
	Turbo pump exchange or replacement	LS-TV-2C (Exchange) LS-TV-2L (Exchange)	24000 h or 48 months	2	OS or LS
	Valve inspection and cleaning	LMK-TV-4	250000 cycles	2	OS or LS
	Valve replacement	LMK-TV-3	500,000 cycles	3	LS
	Change extraction electrode	AL119641	Filament Status <30	3	LS
	Change filaments	AL114864S	Filament Status <15	3	LS
	Calibrate external leak standard	LS-TV-1C LS-TV-1L	24 months	2	OS or LS

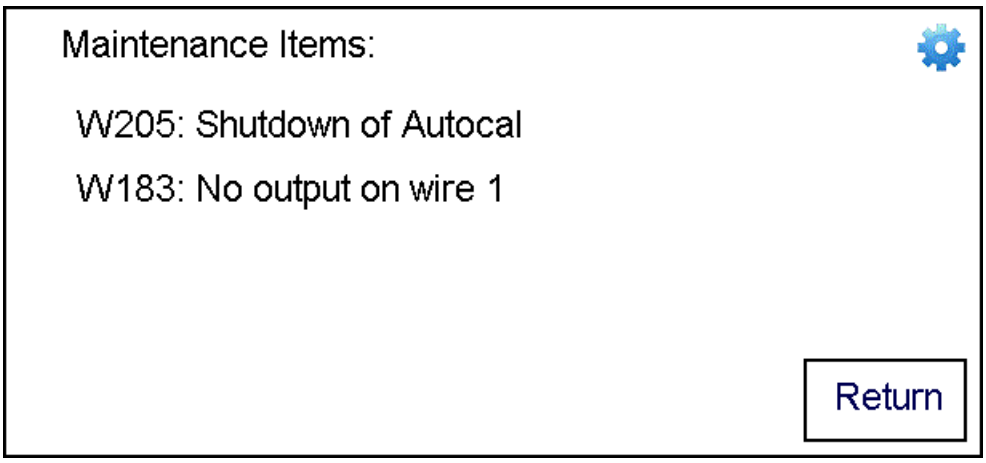
8.6. Software Maintenance

8.6.1. Maintenance Reminders on Test Screens

When maintenance tasks are near due from the Maintenance and Service Schedule, the “maintenance wrench” icon in in the status icon area (upper right) will change to orange. When maintenance tasks are due, the icon will change to red and flash. Press the icon to see a list of all due or almost due maintenance items.



z

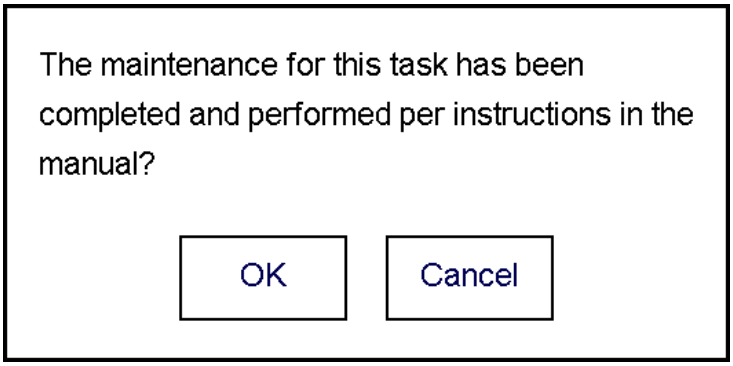


8.6.2. Completing Maintenance Tasks in Software

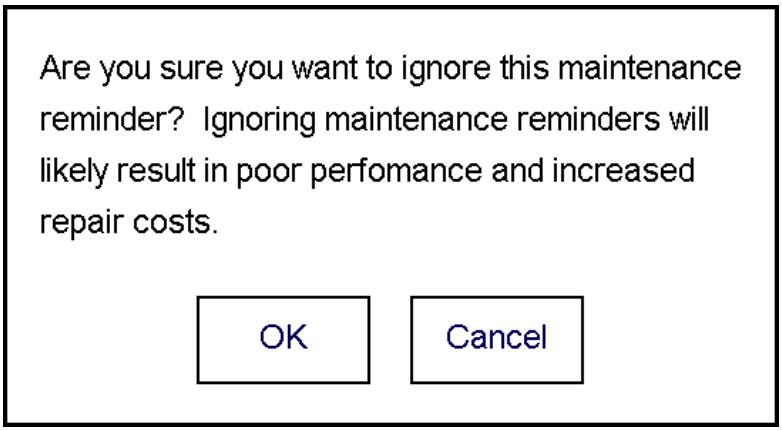
To edit the maintenance status of tasks, either 1) press the settings icon on the maintenance pop-up reminder, or 2) navigate the following menu:
Menu > Maintenance > Maintenance Tasks.

CAUTION: Ensure all maintenance is performed at the required time per instructions in this manual.

When a maintenance task is completed, press the reset button to reset the maintenance timer and reminder.



A maintenance reminder can be ignored, but this not recommended.



8.7. Maintenance Support

LACO offers both Preventative Maintenance (PM) and Service Agreements to support our customers.

Service can be performed either on-site or at a LACO authorized service center. Service agreements offer the following advantages:

- Extended warranty
- Three- or six-month automatic shipments of essential maintenance kits (pump oil, filters, etc.)
- Calibrated leak exchange
- 72-hour uptime guarantee

PM services offer the same basic service items as a service agreement, but without the benefits listed above. Contact us to learn how you can benefit from LACO's service offerings.

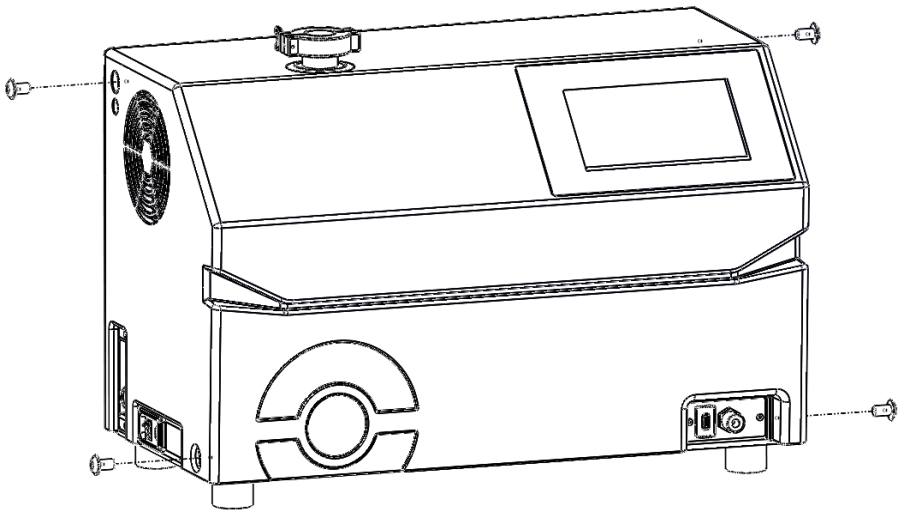
Table 47 *LACO Advanced Service Options*

Model/Pump	PM Services P/N	Service Agreements
VERSA L/wet pump	LS-TVL-3 (2-3 year) LS-TVL-4 (3 year)	LSA-TVL-2 (2 year) LSA-TVL-3 (3 year) LSA-TVL-4 (4 year)
VERSA L/dry pump	LS-TVLD-3 (2-3 year) LS-TVLD-4 (3 year)	LSA-TVLD-2 (2 year) LSA-TVLD-4 (4 year)
VERSA T/wet pump	LS-TVT-3 (2-3 year) LS-TVT-4 (3 year)	LSA-TVT-2 (2 year) LSA-TVT-3 (3 year) LSA-TVT-4 (4 year)
VERSA T/dry pump	LS-TVTD-3 (2-3 year) LS-TVTD-4 (3 year)	LSA-TVTD-2 (2 year) LSA-TVTD-4 (4 year)

8.8. Removing Covers

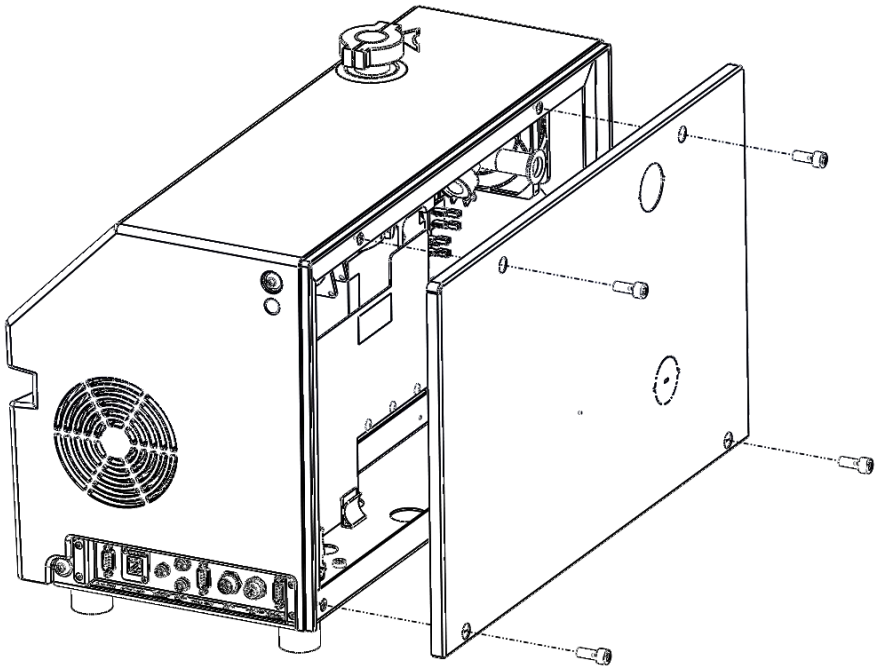
8.8.1. Front Cover (all Models)

7. To remove front cover, you must first remove the back cover (see Sections 8.8.2 and 8.8.3 below).
8. Remove the two bolts on either side of the front cover with a 5 mm Hex wrench.
9. Remove the test port connections and rubber dust cover.
10. Lift cover until the top is above the test port, then lift at a forward angle.
11. Carefully pull cover away from leak detector to locate and detach the 40 pin IDC screen cable from screen.



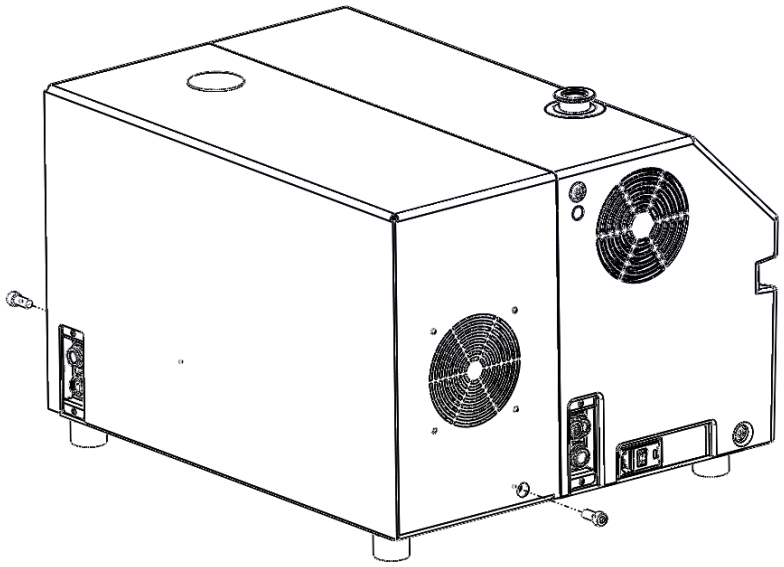
8.8.2. Removing Back Cover (Compact Configuration)

To remove back cover, use a 6 mm Hex wrench to remove the four bolts shown below and pull off cover.



8.8.3. Removing Back Cover (Horizontal Configuration)

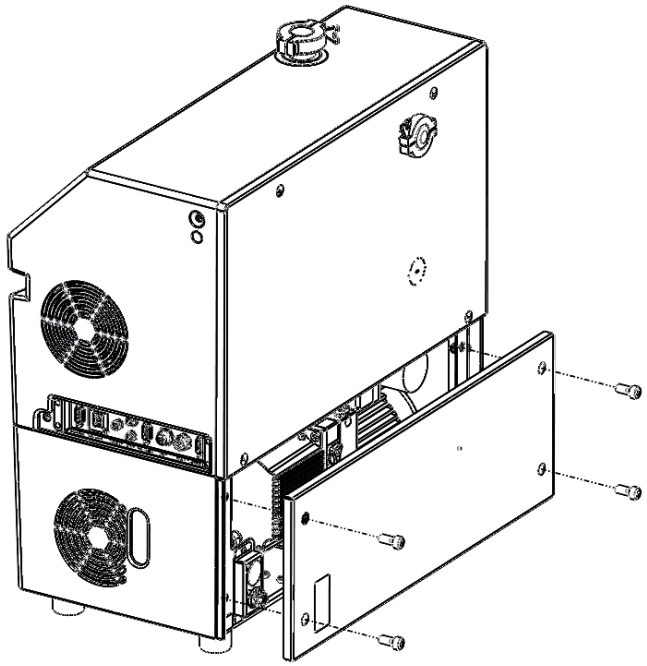
1. Remove two M8 screws using a 6 mm Hex wrench.
2. Lift metal cover straight up until it comes free from leak detector.
3. Slowly pull cover away from leak detector and locate fan power cable.
4. Disconnect fan power cable from fan.



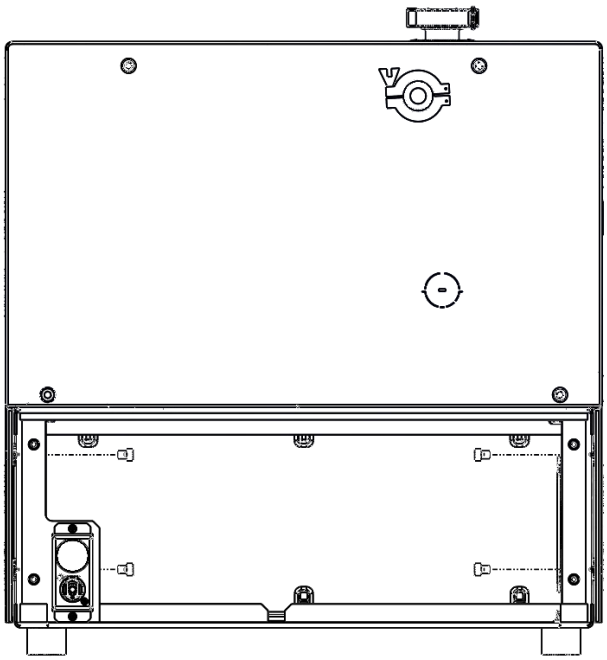
8.8.4. Removing Back Cover (Tower Configuration)

In addition to removing the upper back and front covers shown in the section above, the tower configuration has two lower covers.

1. Remove the lower back cover using a 6 mm Hex wrench to remove the 4 M8 screws. Pull off the panel.



2. Use a 5 mm Hex wrench to remove the four M6 screws located inside of the bottom compartment and slide the plastic cover forward off the leak detector.



8.9. Cleaning

8.9.1. External Covers

Covers should be cleaned whenever maintenance is done or at least every six months.

- Wipe the housing with a soft damp cloth.
- Use only water to moisten. Avoid cleaners that contain alcohol or harsh chemicals.

8.9.2. Internal Surfaces

Whenever covers are off unit, use a soft damp cloth to wipe away any buildup of dust or dirt on internal hardware.

8.10. Electrical

DANGER: Life threatening hazard from electric shock

Incorrectly secured products may be life threatening.

- Only use fuses with the prescribed values.

DANGER: Life threatening hazard from electric shock

Considerable voltages arise inside the device. Touching parts where electrical voltage is applied can result in death.

- Disconnect the device from the power supply before any cleaning or maintenance. Ensure the electric power supply is reconnected with authorization.

8.10.1. Fuses

Table 48 *TITAN VERSA Fuses*

Loc. ID	Designation	Rating	Quantity	Part Number
1	Mains Fuse	T 10.0 A	2	LMSA3844-C
2	Remote I/O Fuse (F2)	T 2.0 A	1	LMSA3850
2	Remote Screen Fuse (F3)	T 2.0 A	1	LMSA3850
2	Accessories Fuse (F1)	T 2.0 A	1	LMSA3850

8.10.1.1. Replacing the main fuse

1. Switch the device off at the mains plug.
2. Disconnect the device from the power supply and pull out the main plug.
3. Pry the cover of the fuse holder and fold it to the side.

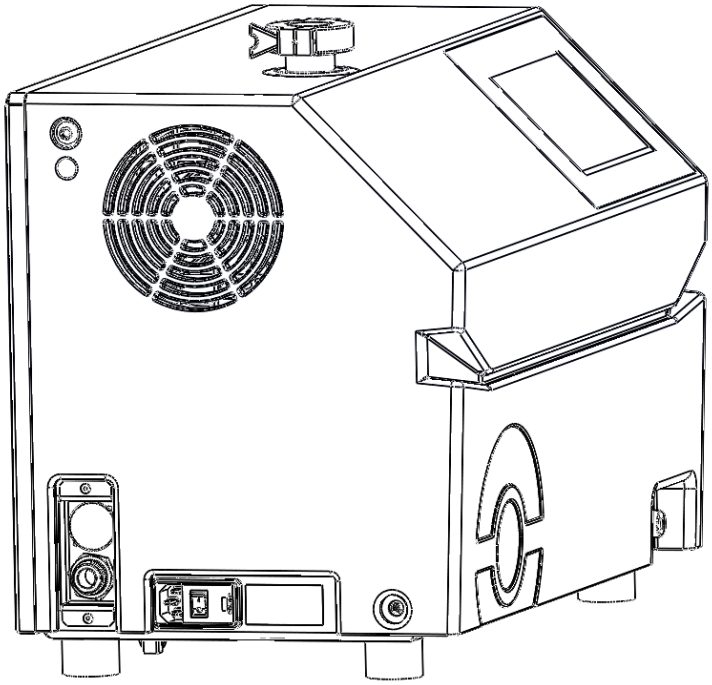


Figure 12: Replace the mains fuses.

4. Remove the two fuse holders and replace the defective fuses (10.0 AT, 250 V, Ø5 x 20 mm).

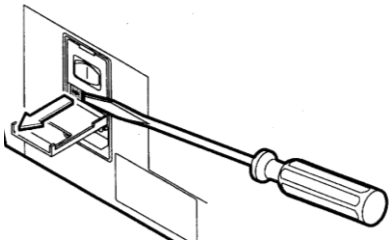
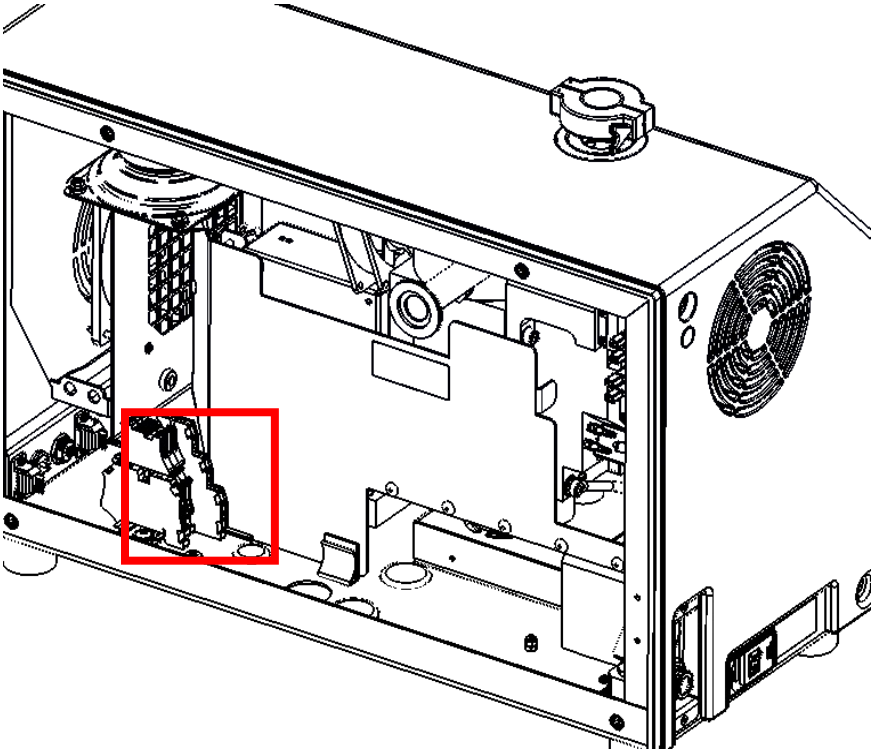


Figure 13: Replace the mains fuses.

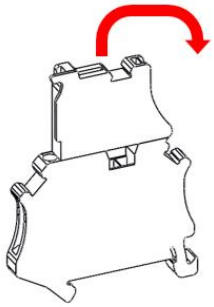
5. Lock the fuse holders back into place.
6. Close the cover.

8.10.1.2. Replacing terminal block fuses (F1, F2, F3)

1. Turn off power to unit.
2. Remove back cover (see Removing Covers).



3. Locate corresponding fuse holder terminal block (see fuse table) and use hand to swing to open position.



4. Open fuse terminal block fuse compartment to reveal defective fuse and replace (2.0 AT, 250 V, Ø5 x 20 mm).
5. Close fuse compartment and rotate terminal block top to closed position.

8.10.2. Power Cords

If new or replacement power cords are needed, order using the part number in Table 49 below.

Table 49 *TITAN VERSA Power Cords*

Configuration	Part Number	Description
Non-Compact	LMSA5821	Power cord, C13 right angle (down) x NEMA-5-15P, 18AWG, 6 feet
	LCA069-C	Power cord, China X IEC C13, 18AWG, 6 feet
	LCA069-E	Power cord, Europe X IEC C13, 18AWG, 6 feet
	LCA069-P	Power cord, bare pigtail X IEC C13 18AWG, 6 feet
	LCA069-U	Power cord, UK X IEC C13, 18AWG, 6 feet
Compact	LCA070-C	Power cord, China X IEC C13, 14 AWG, 6.5 feet
	LCA070-E	Power cord, Europe X IEC C13, 14 AWG, 6.5 feet
	LCA070-P	Power cord, bare pigtail, X IEC C13, 14 AWG, 6.5 feet
	LCA070-U	Power cord, UK X IEC C13, 14 AWG, 6.5 feet

8.10.3. Touchscreen and Overlay

For replacement parts relating to the touch screen interface, use the part numbers in Table 50 below.

Table 50 *TITAN VERSA Screen Parts*

Part Number	Description
LL0233-1	Overlay, Compact Configuration
LL0233-2	Overlay, Tower Wet Pump Configuration
LL0233-3	Overlay, Tower Dry Pump Configuration
LL0233-4	Overlay, Horizontal Wet Pump Configuration
LL0233-5	Overlay, Horizontal Dry Pump Configuration
LMSA5847	Touchscreen
LMSA115901	Screen board
LMSA5965	40 Pin screen board cable

8.10.4. Circuit Boards

For replacement boards refer to the drawing below and part numbers in Table 51.

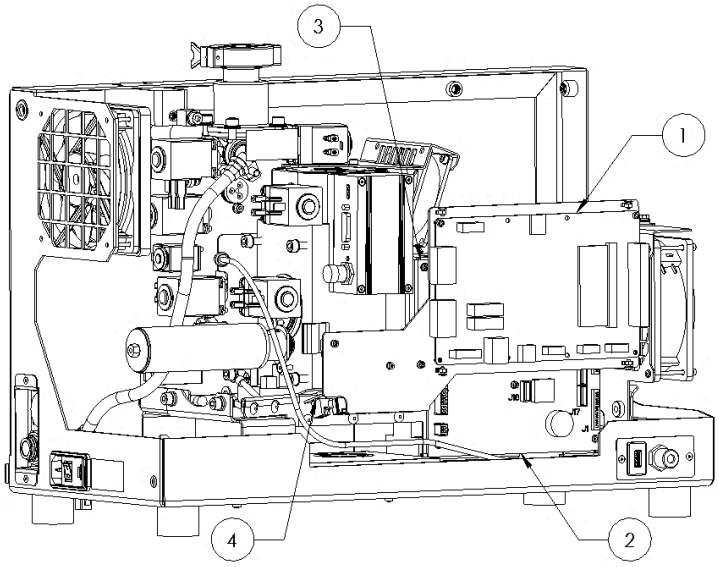


Table 51 *TITAN VERSA Circuit Boards*

ID	Part Number	Description
1	LMSA115899	Main Carrier Board
2	PFP0518E1	Supervisory Board
3	PFP0392	Mass Spec Cell Board
4	PFP0513E1	Power Distribution board

8.11. Fans and Fan Filters

For fan part replacements refer to the part numbers in Table 52 below.

Table 52 *TITAN VERSA Fan Components*

Part Number	Description
LMSA5802	Fan, Main Enclosure and Pump
PF121658	Fan, Turbo Unit
PF101094	Fan, Mass Spectrometer
LMSA5987	Fan Filter

8.11.1. Fans

There are three to four fans within the TITAN VERSA. All models have an inlet fan in the main enclosure, a turbo fan, and a mass spectrometer fan. The tower and horizontal units also include a pump fan.

8.11.2. Filters

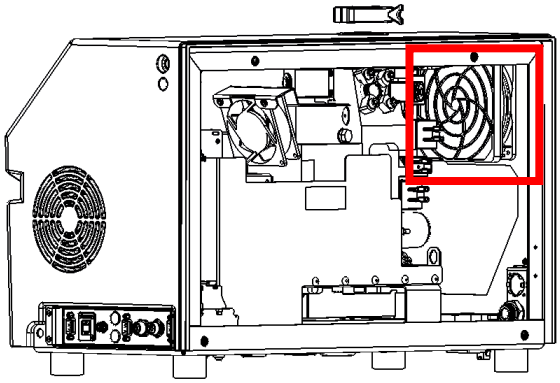
Fan filters should be checked regularly and replaced every 3000 hours or 12 months (whichever comes first). Compact units have one fan filter (shown below) inside the main enclosure. Tower and horizontal units have an additional pump fan filter located in the pump sections of the leak detector (shown below).

8.11.2.1. Replacing Filter

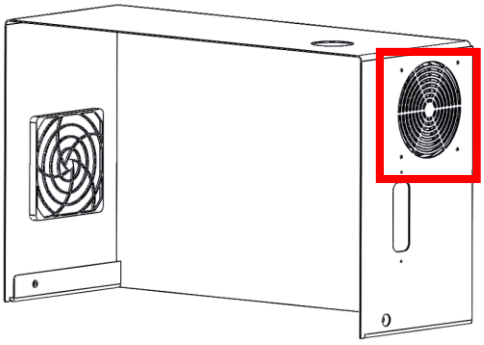
1. Remove necessary covers to access fan.
2. Use hand to pop off plastic guard on fan.
3. Replace filter (center filter to avoid major gaps).
4. Replace plastic guard.

8.11.2.2. Filter Locations

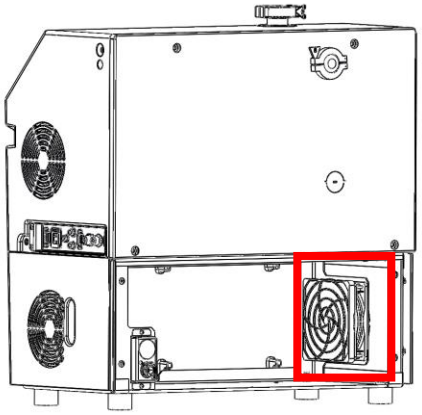
Inlet Fan Filter (all models)



Pump Fan Filter – Horizontal Configuration



Pump Fan Filter – Tower Configuration



8.12. Calibrated Leak Maintenance

Table 53 *TITAN VERSA Leak Components*

Part Number	Description
CM112498/L-7/4	Calibrated Leak
PFP0488E1	Temperature Board
LSLC0001	Calibrated Leak Standard Calibration, Single Point
LSLC0003	Sniffer Calibrated Leak Standard Calibration, Single Point

8.12.1. Recalibration

NOTICE: Leak Standard Calibration Frequency

LACO recommends that the internal calibrated leak standard be calibrated at least every two years.

Sniff calibrated leaks and higher leak rate external leaks (> 1.0 e-6 mbar*L/sec) should be calibrated yearly, or more frequently if the depletion rates are large.

- Depletion rate is indicated on the calibrated leak identification label.
- Return leak standards to LACO Technologies calibration lab for recalibration.

8.12.1. Replacement

1. Remove leak detector cover (see Removing Covers).
2. Loosen retaining screws with a 2.5 mm hex wrench and rotate leak unit until it is free.
3. Disconnect the temperature sensor from the calibrated leak using a 2.5 mm Hex wrench.
4. Connect Temp Sensor to replacement leak and insert into retaining device.
5. Update the settings of the internal calibrated leak.

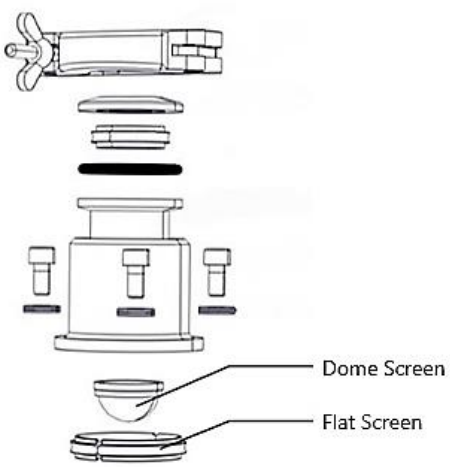
8.13. Valve Block

Table 54 *TITAN VERSA Valve Block Parts*

Part Number	Description
PF103395	Dome Screen
PF067636	Flat Screen
PF121539	Vent Filter
PF121543	Flow Reducer 50 sccm
PF121688	Bacosol Valve
PF106009	Minisol Valve 3/2
PF101303	Minisol Valve 2/2

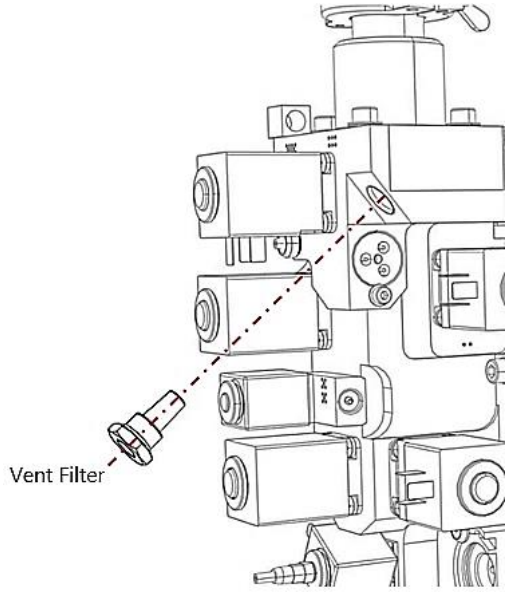
8.13.1. Vacuum Inlet Screens

The two vacuum inlet screens on the KF-25 inlet are shown below. Inlet screens may require replacement if they become damaged or clogged.



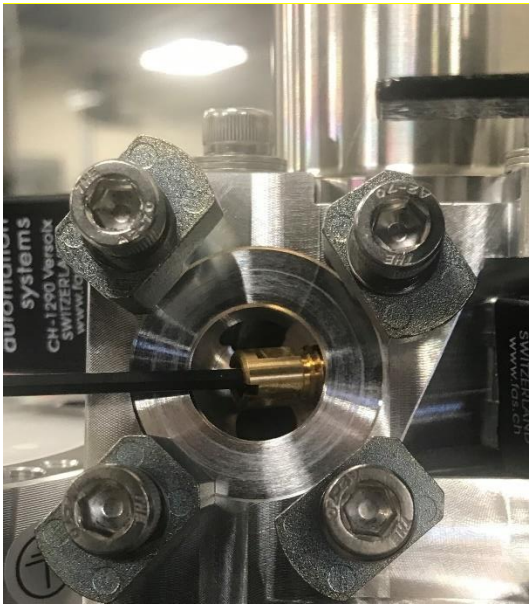
8.13.2. Exhaust Vent Filter

The exhaust vent (P/N: PF121539) includes a filter located behind the push tube fitting at the beginning of the vent line (shown below). The filter may require replacement if it becomes damaged or clogged.

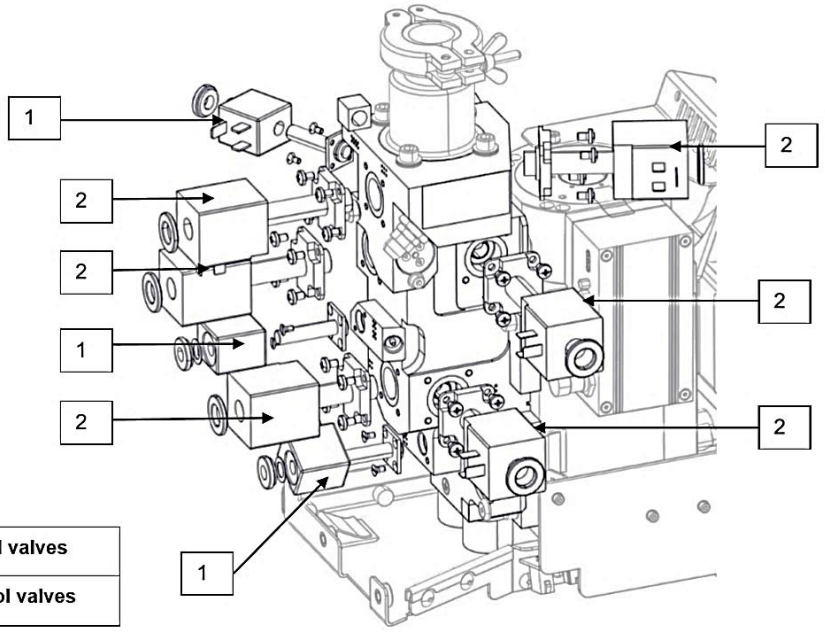


8.13.3. Purge Valve Restrictor / Filter

The VERSA TD dry pump configurations include a 50 sccm flow reducer per diagram below. Use a 2.5 mm hex wrench to remove.



8.13.4. Valves



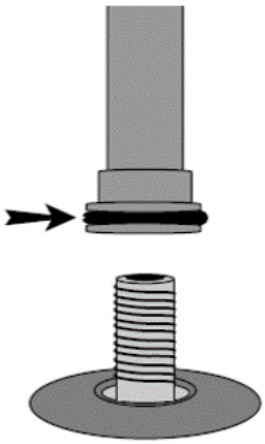
1	Minisol valves
2	Bacosol valves

8.13.4.1. Valve Cleaning

- Clean all surfaces—especially the valve seat area—of valve parts with alcohol.
- Improve the cleaning by blowing off the parts with dry filtered air—particularly the o-ring grooves.

8.13.4.2. Seal Preparation

Place the “piston” o-rings as shown below and add a small amount of vacuum grease to the rings. Grease quantity should be limited to avoid helium retention and difficult assembly.



8.13.4.3. Reassembly

For Bacosol valve:

1. Tighten the four screws diagonally.
2. Clamping torque is 1.5 Nm.

For Minisol valve:

3. Tighten the two screws diagonally.
4. Clamping torque is 0.6 Nm.

8.13.4.4. Testing

After new valve installation, LACO recommends running a Background Cleanup or running at least 20 test cycles. Test external tightness with a tracer gas to check the vacuum quality.

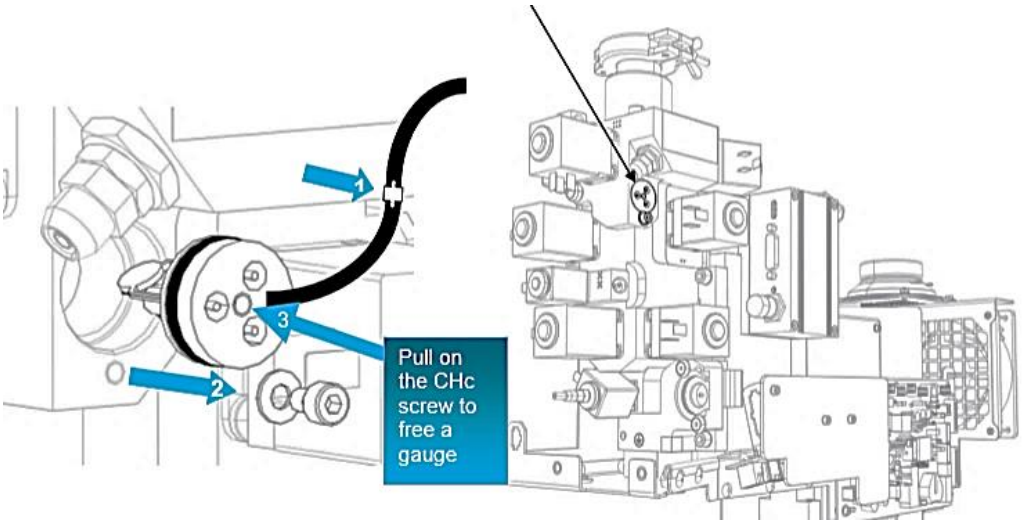
8.13.5. Pirani Vacuum Gauge Sensor

Table 55 *TITAN VERSA Pirani Gauge Components*

Part Number	Description
PF795706	Pirani Gauge
PF057972	Gauge Filament

8.13.5.1. Pirani Gauge Replacement

1. Disconnect cable connector.
2. Remove socket head cap screw with M3 hex wrench.
3. Insert Screw into Pirani assembly (to add grip) and use it pull assembly out with pliers.
4. Install new Pirani assembly by repeating above steps.



8.14. High-Flow Valves

Table 56 *TITAN VERSA High-Flow Valve Components*

Part Number	Description
LMSA0475-K	Solenoid valve operator and plunger kit
LCA059	Valve Cable – High-Flow Evac
LCA060	Valve Cable – High-Flow Vent

8.14.1. Valve Cleaning

Vales should be inspected and cleaned every 100,000 cycles or every two years (whichever comes first). Valve plunger seals and the internal valve body should be lightly cleaned with methanol or water if dirty or contaminated. Follow the valve replacement instructions below to inspect valves.

8.14.2. Valve Replacement

Valves should be replaced every 200,000 cycles or every four years (whichever comes first).

1. Disconnect power from leak detector.
2. Remove covers on module enclosure (see Removing Covers).
3. Remove valve electrical (DIN) connectors with Philips screwdriver.
4. Remove four long screws on valve coil assembly.
5. Remove valve coil and plunger (shown above).
6. Replace with new valve coil and plunger.
7. Reconnect items per instruction above.

8.15. Turbo Pump

Table 57 *TITAN VERSA Turbo Pump Parts*

Part Number	Description
T10034	Oil Wick SplitFlow 80

8.15.1. Replace the Oil Wick in SplitFlow 50

The turbo pump is filled with operating fluid upon the delivery of the SplitFlow 50. Replace the oil wick cartridge every 12000 hours or 24 months (whichever comes first).

WARNING: Danger of poisoning due to contact with harmful substances

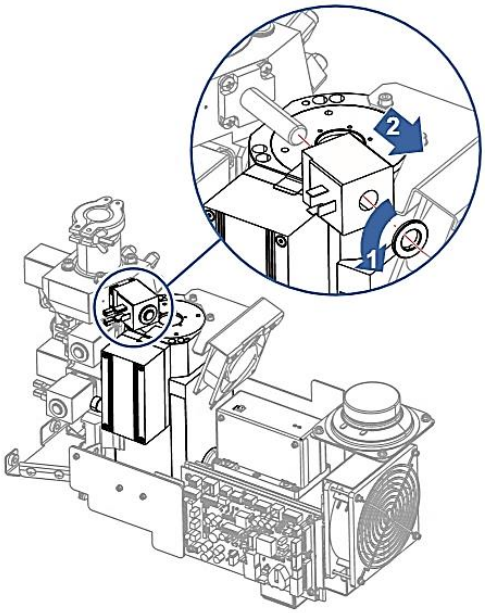
The oil wick cartridge and parts of the pump may be contaminated with toxic substances that are contained in the pumped media.

- Dispose of the oil wick cartridge as stipulated by local regulations.
- Prevent health hazards or environmental pollution from contamination by means of suitable safety precautions.
- Decontaminate affected parts prior to executing maintenance work.

NOTICE: Material damage from changing the oil wick cartridge without prior venting

- Ensure the mass spectrometer and the turbo pump are completely vented before starting maintenance. Only when in a vented state can the cover for the oil wick cartridge be removed.

1. Switch off the leak detector power.
1. Pull out the main plug.
2. In case an external backing pump is used, detach the KF-25 connection to the external backing pump.
3. Remove front cover.
4. Vent turbo pump and mass spec by removing turbo vent plug.
5. Access fluid tank by removing valve shown below.



6. Carefully place the device on its back or left side (as seen from the front).
7. Use the special tool (P/N: T10071 or PFPVM40813) to unscrew the cover on the back.
8. Pry the oil wick cartridge with two screwdrivers and dispose of it according to local regulations.
9. Remove the Porex rods (8x) from the guides using tweezers.

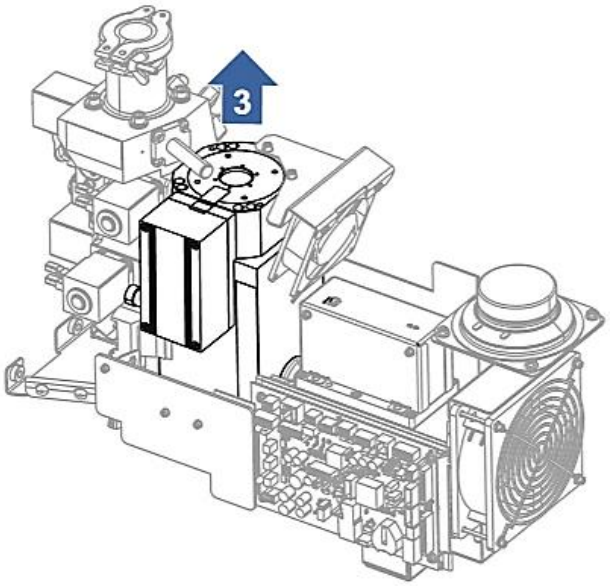


Figure 14: TITAN VERSA: Oil Wick Access

a) O-ring
b) Operating fluid reservoir
c) Porex rod
d) Ventilating screw

10. Remove the contamination on the turbo molecular pump and cover with a clean, lint-free cloth. Do not use cleaning liquids.
11. Insert the new Porex rods (8x) using tweezers.
12. Slide in the new oil wick cartridge into the pump up to the o-ring.

NOTICE: Material damage due to incorrect position of the oil wick cartridge.

- Do not press in the new oil wick cartridge completely. The new oil wick cartridge will be positioned correctly when you screw in the cover.

13. Screw in the cover with a new o-ring. Note the tightening torque for the cover of 13 Nm +/-10%.
14. Make sure that the new o-ring is inserted in the correct position. An incorrectly mounted o-ring can result in gross leaks and a malfunction of the device.
15. Reinstall all previous parts.
16. Reconnect the power supply and power on unit.
17. Verify proper turbo pump performance.
18. Enter your maintenance work on the TMP in Maintenance Tasks section.

8.15.2. Replace SplitFlow 50 for Bearing Change

Bearing changes are recommended at least every four years. Under severe usage this may need to be done more frequently. A bearing change can only be carried out by LACO Service Center.

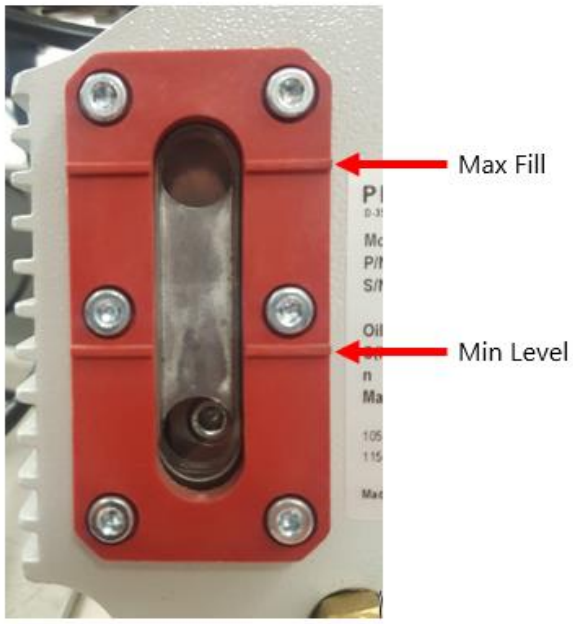
8.16. VERSA T Wet Pump Maintenance

CAUTION: Ensure all maintenance is performance properly per instructions in this manual.

8.16.1. Check Oil Level and Color

Check the pump oil level and color monthly, or more frequently under heavy usage. Change the oil if the level is below the minimum level mark. Oil level verification is most accurate if checked while pump is off, hot, and on a horizontal plane.

LACO recommends changing the pump oil if the oil color appears to be heavily discolored or white in appearance.



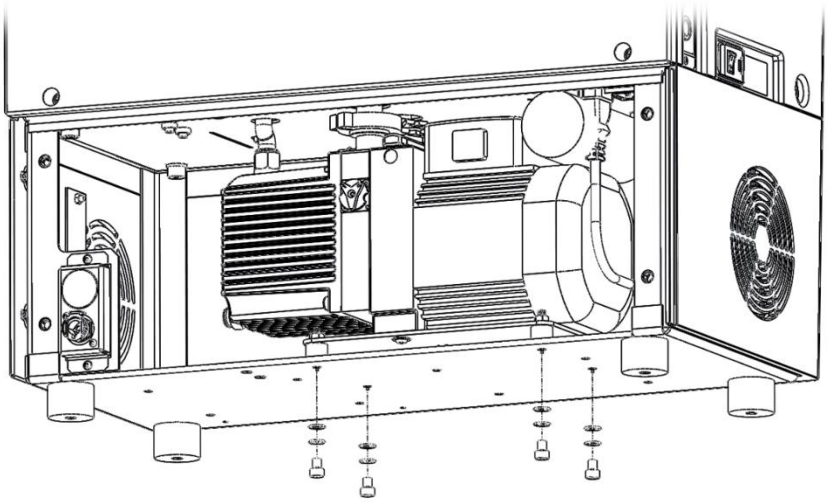
8.16.2. Accessing Uno6 pump

Most pump maintenance requires the covers to be removed. The Uno6 pump is in the bottom section of the leak detector. With the covers off, LACO recommends cleaning the interior area and pump surfaces.

8.16.2.1. Removing Pump

1. Place leak detector on blocks to gain access to pump bolts under the unit.
2. Remove lower tower covers.

3. Remove power plug from pump.
4. Detach vacuum hose and OME from the top of the pump.
5. Remove oil refill tube from push tube fitting.
6. Unscrew four mounting screws.
7. Remove pump.



8.16.3. Oil Change – Quick Method

CAUTION: The User shall change the pump oil every 4300 hours or 3-6 months (3 months for normal usage and 6 months for light usage). Changing the pump oil regularly is the foundation of high performing and long-lasting leak detection system. Failure to change the pump oil regularly will cause decreased performance and often leads to other failure points in the system.

Oil Type – LACO recommends the use of Elite-Z synthetic vacuum oil. Synthetic vacuum pump oil ensures the pump runs cooler with longer intervals between maintenance.

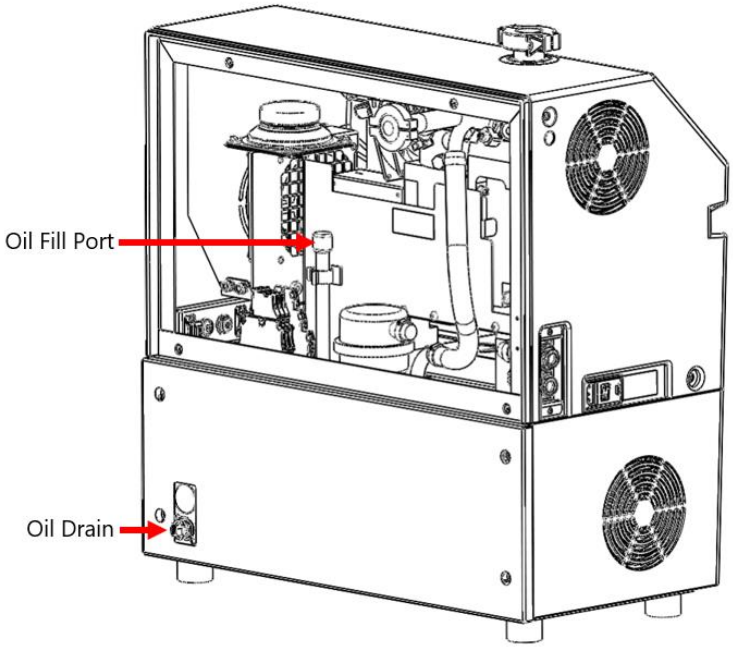
The user will need the following items to perform an oil change using the quick-change method:

- Oil Refill Cap
- Oil drain line (In TITAN VERSA Spares and Tools Kit)
- LVOEZUNO6 – Quick Fill Container
- LVOFFUNO6 – Flushing Fluid is recommended for contaminated, older or heavily used pumps.

1. It is recommended the UNO6 be a little hot to make the oil drain easy. Open the oil fill port to drain the oil faster

2. Connect the quick connector drain tube assembly and start to drain the oil in a container.

3. Remove Top back cover



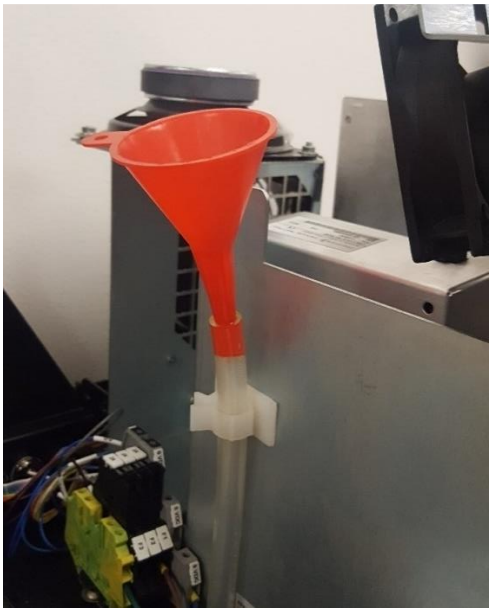
4. Unplug oil drain line. Clean up any excess oil. Recycle used oil.
5. Remove tube cap from Oil fill port
6. Remove cap from quick-change oil fill bottle. Install oil refill cap onto the bottle.
7. Place cap connector onto fill tube end, as shown below, and let oil fully drain from container into pump.

8. Remove fill container and place tube cap back on fill hose.
9. Connect power plug and turn device back on. Verify proper pump operation and ensure there are not oil leaks.
10. Replace top back cover with four screws.

8.16.4. Oil Change – Traditional Method

The traditional oil change method requires the user fill pump manually using a funnel.

1. Remove the leak detector back cover.
2. Remove the oil cap on the vacuum pump fill line.
3. With the use of a funnel, start to fill the pump with new vacuum oil.

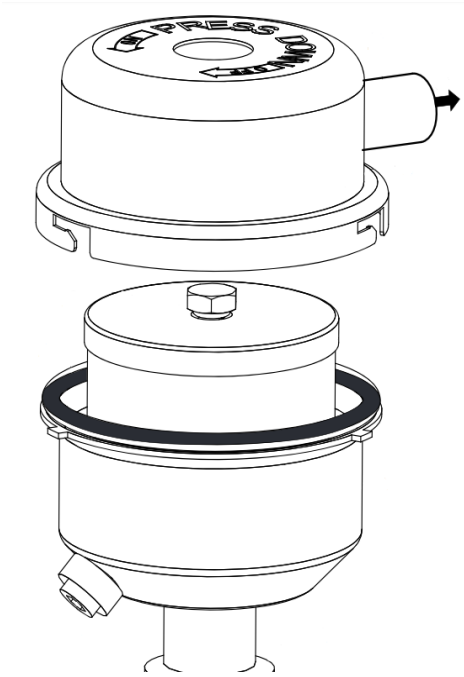


4. Keep watching the oil window to fill to the correct level.

8.16.5. Oil Mist Eliminator Maintenance

Change the oil mist eliminator (OME) filter cartridge (P/N: PFPKE07025T) every 3000 hours or 18 months (whichever comes first).

1. Twist top half of OME to remove cover.
2. Remove bolt on top of filter. Be sure to keep o-ring under bolt attached to the bolt.



3. Replace filter element.
4. Lightly oil all o-rings with pump fluid.
5. Assemble in reverse order.

8.16.6. Pump Repair Options

There are three pump repair options summarized in Table 58 below.

Table 58 *Tower Wet Pump Repair Options*

Maintenance Task	Part Number	Maintenance Interval	Level	Site
Change pump oil	LVOEZUNO6	1500 hours or 6 months	2	OS
Change oil mist eliminator filter	PFPKE07025T	3000 hours or 18 months	2	OS
Repair or exchange pump	LS-TVT-1 (Repair) LS-TVT-2C (Exchange) LS-TVT-2L (Exchange)	24000 hours or 48 months	2-3	OS or LS
Replace pump	PFPKD07711	36000 hours or 72 months	2-3	OS or LS

8.16.7. Other Pump Parts

Table 59 *VERSA T Pump Parts*

Part Number	Description
LMSA119457	UNO 6 hose assembly
LMK-TVT-7	UNO 6 oil drain line
LMK-TVT-8	UNO 6 oil fill line
LMK-TVT-6	UNO 6 oil drain-back assembly

8.17. VERSA T Dry Pump Maintenance

CAUTION: Dry pumps do not typically have short term maintenance concerns but can potentially require major long-term repair if two-year maintenance is not performed. Customers with leak detectors in critical applications should consider purchasing a spare pump for unplanned maintenance.

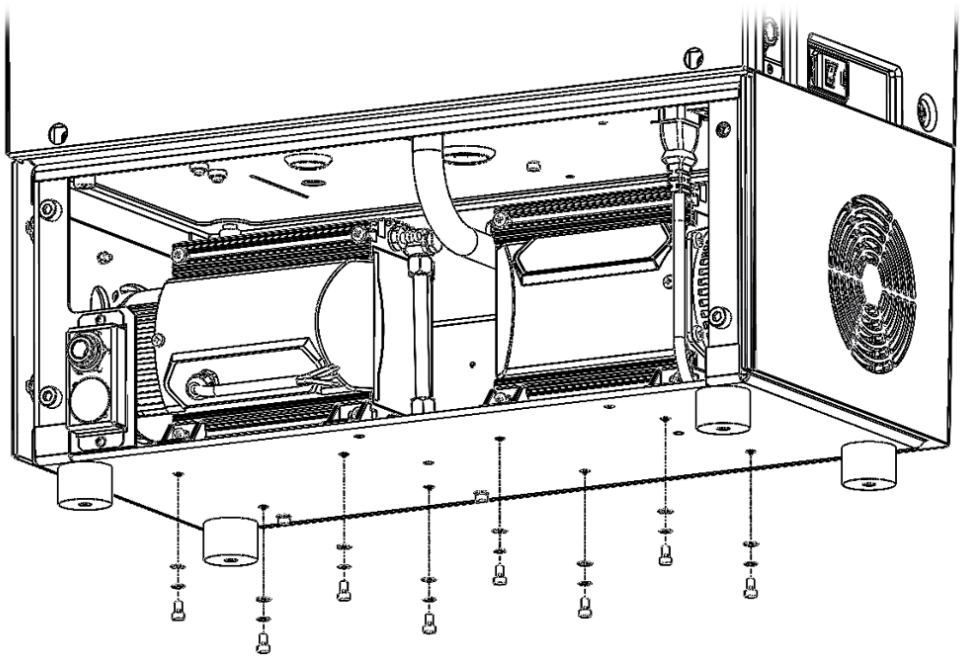
8.17.1. Accessing the MVP-030 Pumps

To access the MSP-030 pumps on the VERSA T model it is necessary to remove the bottom front and back covers (see Removing Covers).

8.17.2. Removing the MVP-030 Pump

1. Place leak detector on blocks to gain access to the bottom of the unit.
2. Unplug the two electrical connections on the side of each pump.
3. Disconnect vacuum connections by loosening the metal hose clamps on tube attached at pump. Slide the tube off the black barbed hose fitting on each pump.

4. Remove the hose vent hose from the push tube fitting on each pump.
5. Remove four bolts from each pump and slide out pumps.



8.17.3. Pump Maintenance and Repair Options

Table 60 *Tower Dry Pump MSV-030 Repair Options*

Maintenance Task	Part Number	Maintenance Interval	Level	Site
Repair diaphragm and valves	LMK-TVTD-1 (Kit) LS-TVTD-1 (Repair)	12000 h or 24 months	2	OS or LS
Exchange pump	LS-TVTD-2C LS-TVTD-2L	36000 h or 72 months	2-3	OS or LS
Replace pump	PFPKT01190	36000 h or 72 months	2-3	OS or LS
Exhaust muffler	PFP0995942	12000 h or 24 months	1	OS
Diaphragm Key*	PFP0995941			

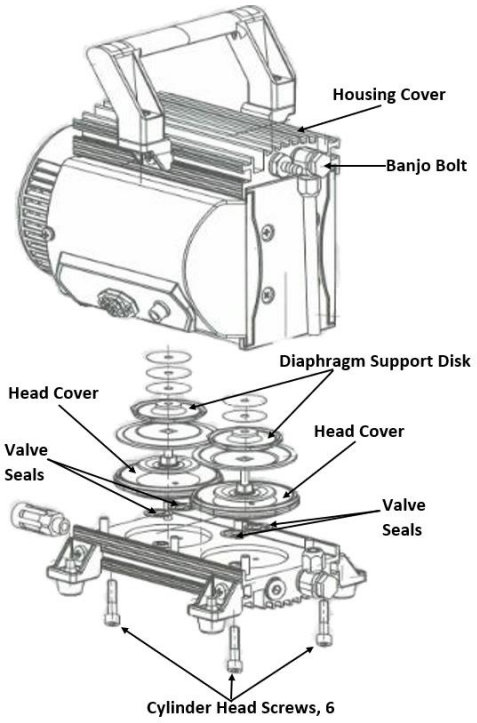
*Utilize to remove/install new diaphragms.

8.17.4. Additional Pump Parts

Table 61 *VERSA TD Pump Parts*

Part Number	Description
LMK-TVTD-4	MVP-030 exhaust hose assembly
LMK-TVTD-3	MVP-030 pump mount assembly
LMSA117070	MVP-030 hose assembly

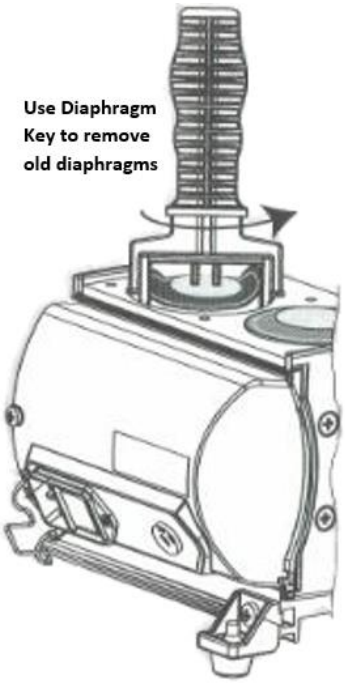
8.17.5. Diaphragm Inspection



1. Uninstall the MVP-030 pump from the TITAN VERSA (see Removing the MVP-030).
2. Unscrew banjo bolt using an open-end wrench. Loosen connecting hose only from the top (see picture above).
3. Unscrew cylinder head screws (six screws) at the pump head and remove housing cover; be mindful of the position of the valve seals. If necessary, take a picture of the original position of the valve seals.
4. If the valve seals stick to the housing cover, carefully loosen the seals. Otherwise, remove the valve seal from the head covers.
5. Replace damaged valve seals.
6. Remove head cover.
7. Either clean all parts and inspect for wear or install new diaphragm.

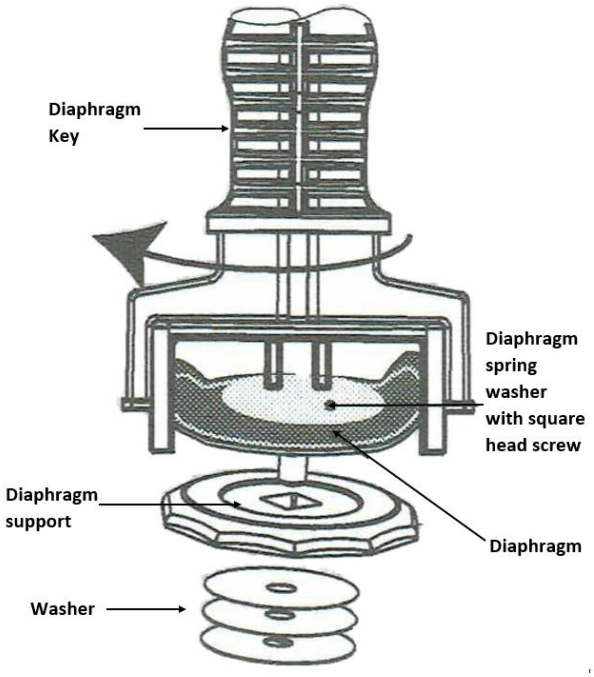
8.17.6. Replacing Diaphragms

1. Carefully raise the diaphragm from the side, taking care to not cause any damage. Do not use sharp-edged tools.
2. Slide diaphragm key (P/N: PFP0995941) under the diaphragm until it reaches the support disk.
3. Use the diaphragm key to loosen the diaphragm support disk and unscrew together with diaphragm and diaphragm clamping disk (see picture below).



4. Detach diaphragm support disk and diaphragm from the square head of the connecting screw of the diaphragm clamping disk. If it is difficult to separate the old diaphragm from the diaphragm support disk, use methanol to loosen it.

5. Reassemble the diaphragms in reverse order.
6. Install the new diaphragm between diaphragm clamping disk with square head screw and diaphragm support disk. Ensure the square head screw of the diaphragm clamping disk is correctly seated in the guide hole of the diaphragm support disk. See picture below.
7. Reassemble pump in reverse order.



8.18. VERSA L Wet Pump Maintenance

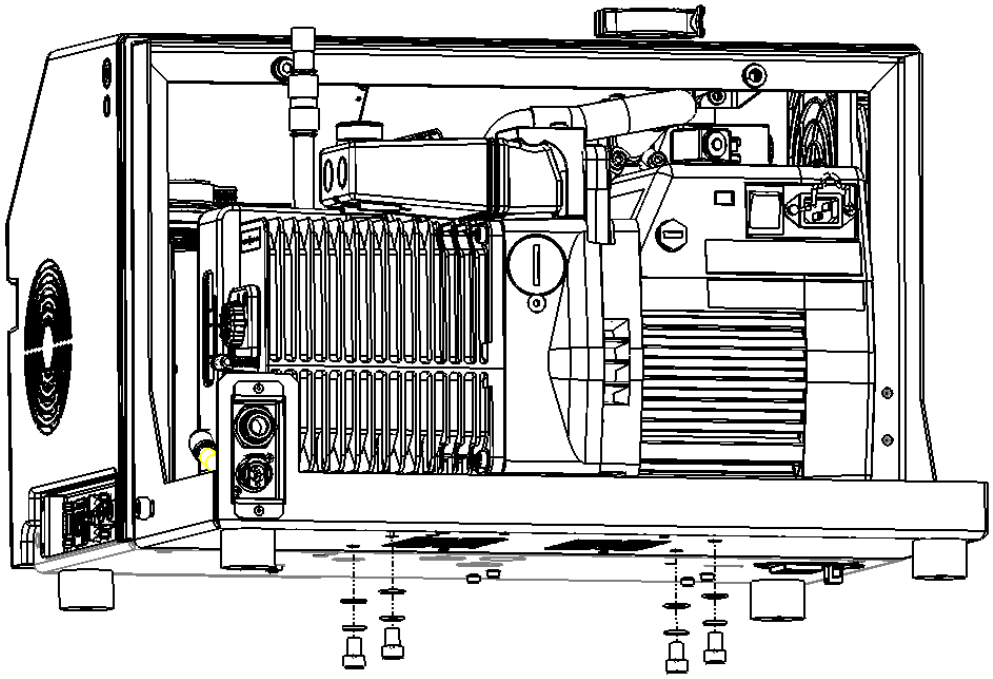
8.18.1. Check Oil Level and Color

Check the pump oil level and color monthly or more frequently under heavy usage. Change the oil if the level is below the minimum level mark. LACO recommends changing the pump oil if the oil color appears to be heavily discolored or white in appearance.

➔ Oil level reading is most accurate if checked while pump is off, hot, and on a horizontal plane.

8.18.2. Accessing 1015 pump

1. Remove the back cover using 6 mm hex wrench.
2. Disconnect the foreline hose from the pump.
3. Disconnect the black exhaust hose from the chassis exhaust port.
4. Unplug the power cord.



5. Place leak detector on blocks to gain access to the bottom of the unit.
6. Remove the four pump mounting bolts.
7. Take the pump off for repair or maintenance.

8.18.3. Oil Change – Quick Method

CAUTION: The User shall change the pump oil every 4300 hours or 3-6 months (3 months for normal usage and 6 months for light usage). Changing the pump oil regularly is the foundation of high performing and long-lasting leak detection system. Failure to change the pump oil regularly will cause decreased performance and often leads to other failure points in the system.

Oil Type – LACO recommends the use of Elite-Z synthetic vacuum oil. Synthetic vacuum pump oil ensures the pump runs cooler with longer intervals between maintenance.

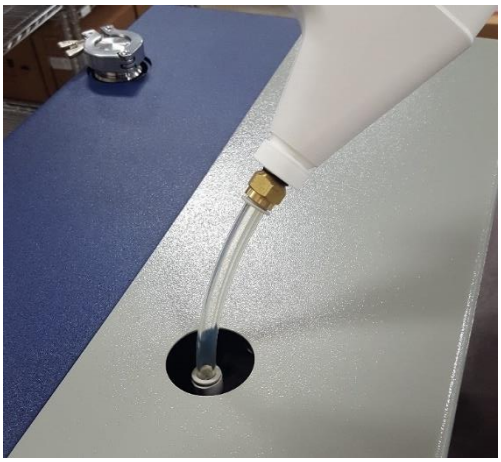
The user will need the following items to perform an oil change using the quick-change method:

- Oil Refill Cap
- Oil drain line (In TITAN VERSA Spares and Tools Kit)
- LVOEZ1015 – Quick Fill Container
- LVOFF1015 – Flushing Fluid is recommended for contaminated, older, or heavily used pumps.

1. Is recommended the pump be a little hot to make the oil drain easy. Open the oil fill port to drain the oil faster.
2. Remove cap from top of rear cover.

3. Connect the quick connector drain tube assembly and begin to drain the oil into a container.

4. Remove metal plug from back cover with small flat head screwdriver.
5. Remove plug from push tube nipple.
6. Unplug oil drain line. Clean up any excess oil. Recycle used oil.
7. Remove cap from quick-change oil fill bottle. Install oil refill cap onto the bottle.
8. Attach 12 mm tube to oil refill bottle and then to fill port, as shown below, and let oil fully drain from container into pump.



9. Remove fill container and place tube cap back on fill hose.
10. Replace back cover with two screws.

8.18.4. Oil Change – Traditional Method

The traditional oil change method requires the user fill pump manually using a funnel.

1. For this method you will need to remove the back cover.
2. After removing the back cover, remove the entire nipple on the vacuum fill line.
3. Use a funnel to fill the pump with new vacuum oil.

4. Watch the oil window to fill to the correct level.

8.18.5. Oil Mist Eliminator Maintenance

The oil mist eliminator filter cannot be replaced individually. To replace the oil mist eliminator, use P/N: PF121494.

8.18.6. Pump Repair Options

There are three pump repair options summarized in Table 62 below.

Table 62 *Horizontal Wet Pump Repair Options*

Maintenance Task	Part Number	Maintenance Interval	Level	Site
Change pump oil	LVOEZUNO6	1500 h or 6 months	2	OS
Change oil mist eliminator filter	PFPKE07025T	3000 h or 18 months	2	OS
Repair or exchange pump	LS-TVT-1 (Repair) LS-TVT-2C (Exchange) LS-TVT-2L (Exchange)	24000 h or 48 months	2-3	OS or LS
Replace pump	PFPKD07711	36000 h or 72 months	2-3	OS or LS

8.18.7. Other Pump Parts

Table 63 *VERSA L Pump Parts*

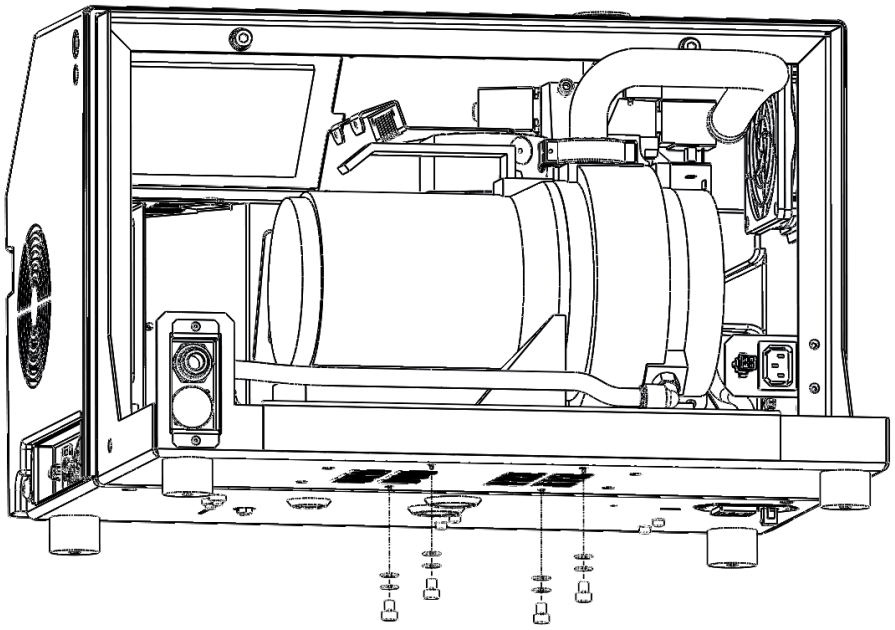
Part Number	Description
LMSA119448	1015 hose assembly
LMK-TVL-5	1015 oil drain line
LMK-TVL-6	1015 oil fill line
LMK-TVL-7	1015 pump mount kit

8.19. VERSA L Dry Pump Maintenance

CAUTION: Dry pumps do not typically have short term maintenance concerns but can potentially require major long-term repair if two-year maintenance is not performed. Customers with leak detectors in critical applications should consider purchasing a spare pump for unplanned maintenance.

8.19.1. Removing the ISP-90 Pump

1. Remove the back cover using 6 mm Hex wrench.
2. Disconnect the Fore line hose from the pump.
3. Disconnect the black exhaust hose from the chassis exhaust port.
4. Unplug the power cord.
5. Place leak detector on blocks to gain access to the bottom of the unit.
6. Remove the four pump mounting bolts with a 5 mm hex wrench.
7. Take the pump off for repair or maintenance.



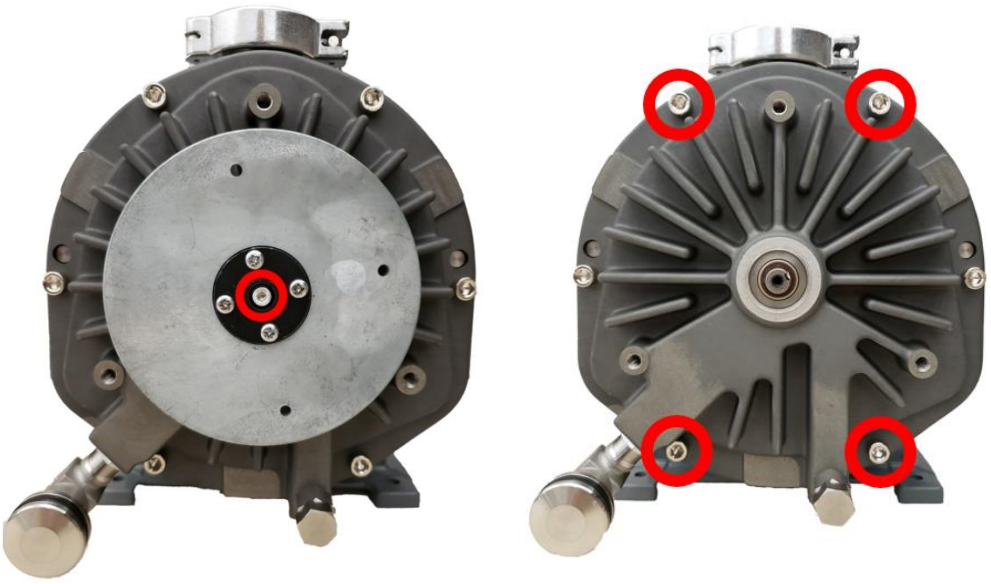
8.19.2. Pump Maintenance and Repair Option

Table 64 *Horizontal Dry Pump ISP-90 Repair Options*

Maintenance Task	Part Number	Maintenance Interval	Level	Site
Major pump repair	LMK-TVLD-1 (Kit) LS-TVLD-2 (Repair)	12000 h or 24 months	2	OS or LS
Exchange pump	LS-TVLD-3C LS-TVLD-3L	36000 h or 72 months	2	OS or LS
Replace pump	AIISP-90	36000 h or 72 months	2	OS or LS
Exhaust muffler	PFP0995942	12000 h or 24 months	1	OS
TIP Seal Kit	AI98885570			

8.19.2.1. Removing old TIP seals

1. Remove the front small cowling covering the flywheel and set the cowling aside along with the metal halo.
2. Remove the flywheel, take the retainer bolt off at the center of the shaft and pull out the flywheel; set the shear key, the retainer bolt, and flywheel aside (see following image).
3. Remove the outboard housing axially from the frame by removing six Allen head bolts (see image below).



4. Remove and discard the worn TIP seals and the main o-ring.
5. If there is compressed air available, blow both scroll parts to remove any seal debris using a razor blade or an exact-o knife to remove debris. Clean the main o-ring and ensure it is in good condition.

8.19.2.2. Installing new TIP seals

1. Unpack the TIP seals. Two TIP seals are provided in the kit; one fits the orbiting scroll and the second one fits the outboard housing scroll.
2. Install the correct TIP seal into the groove of the orbiting scroll.
3. Facing the cutting burrs on the edges of the seal, inserting the tightly curled end into the center of the orbit scroll, until the seal is well-seated in the groove and the anchor inside the groove protrudes into the seal's side. The seal may need to be pushed firmly to sit well into the groove.
4. The seal is correctly installed when it sits in its entirety into the groove, sticking out just slightly over the top.
5. Cut the TIP seal off about 1/8" (3 mm) from the outer end of the groove.
6. Install the correct TIP into the groove of the outboard housing scroll, as in the previous step.
7. Replace the main o-ring into the groove of the frame. Ensure the groove is clean and the o-ring is in good condition otherwise install a brand-new o-ring.
8. Ensure the sealing face of the outboard housing is clean. Carefully replace the outboard housing by lining up the locating pins. Check the TIP seal has no fallen out of the groove.
9. Reinstall the six bolts and torque them to 5.6 N-m (50 in-lb.).
10. Reinstall the flywheel. Ensure the shear key is installed.
11. Place the front flywheel cowling in place and reinstall the three bolts.

8.19.3. Other Pump Parts

Table 65 *VERSA L Pump Parts*

Part Number	Description
LMSA119448	ISP-90 hose assembly
LMK-TVLD-4	ISP-90 exhaust hose assembly
LMK-TVLD-3	ISP-90 pump mount assembly

9. Accessories

9.1. TITAN VERSA Accessories

See Table 66 below for LACO's complete line of leak testing accessories that can be used with the TITAN VERSA Leak Detector.

Accessories with a link in the Reference column have detailed operation instructions in this manual (see linked sections). Accessories with a SMT manual reference indicate a separate user manual which should be consulted before using the device. These manuals are available on the TITAN VERSA USB drive or on www.lacotech.com.

Table 66 *TITAN VERSA Accessories*

Group	Item	Part Number	Reference
Remote I/O	Remote I/O Assembly	TV115893	SMT-07-1040
	Remote I/O cable, 1 m	TV5839	
	Remote I/O cable, 3 m	TV5840	
	Remote I/O cable, 5 m	TV5841	
Wireless Pendant	Wireless Handheld pendant	TV118486	Use PV manual
Remote Screen	Wired Remote Screen, 7" touchscreen	TV115895	SMT-07-1041
	Wired Screen Cable, 1 m	TV5843	
	Wired Screen Cable, 3 m	TV5844	
	Wired Screen Cable, 5 m	TV5845	
Cart	Maintenance Cart Assembly	TV116355	SMT-07-1042
	Gas Bottle Attachment Kit	TV118395	
High-Flow Evac & Vent	VERSA C High-Flow Evac Assembly	TV115787	SMT-07-1046
	VERSA C High-Flow Evac with High-Flow Vent	TV115787-1	
	VERSA L High-Flow Evac Assembly	TV115801	
	VERSA L High-Flow Evac, with High-Flow Vent	TV115801-1	
	VERSA T High-Flow Evac Assembly	TV115802	
	VERSA T High-Flow Evac, with High-Flow Vent	TV115802-1	
	TITAN VERSA High-Flow Vent Valve Assembly	TV115803	
Serial	TITAN VERSA Cable, SERIAL RS232, male to female, 3 m	TV5946	Section 5 and SMT-07-1039
	USB to Serial Adapter	LMSA0360	
Accessories	TITAN VERSA Connector accessory, field wire screw terminal	TV5942	Section 5 or 6
	TITAN VERSA Cable accessory, 5 m, gray	TV5945	
	Pass / Fail Light box	TV118378	
Local I/O	TITAN VERSA Local I/O Connector, Screw Terminal	TV5944	Section 5 or 6

Group	Item	Part Number	Reference
	TITAN VERSA Local I/O Cable, 5 m L, gray	TV5943	Section 5 or 6
	Start / Stop button box	TV118379	
Vent Kits	TITAN VERSA Leak Detector Gas Purge Kit, ¼" tube in, 12 mm tube out	TV118018	SMT-07-1048
External Pump Kits	TITAN VERSA Pump Kit, DUO 35	TV118503-2	SMT-07-1049
	TITAN VERSA Pump Kit, DUO 35	TV118503-4	
	TITAN VERSA Pump Kit, DUO 65	TV118504-2	
	TITAN VERSA Pump Kit, DUO 65	TV118504-4	
	TITAN VERSA Pump Kit, ACP-28	TV118505	
	TITAN VERSA Pump Kit, ACP-40	TV118794	
Oil Fill	Oil Refill Cap Assembly	TV118494	Section 8
	Oil Drain Connector Assembly	TV118495	
Data Logging	Barcode Reader,1D and 2D	TV118566	Section 5 or 6
	USB Drive, 4 Gb	TV5928	
Leak Standards - See www.lacotech.com for many options	10^{-7} atm*cc/sec helium reservoir leak standard for TITAN VERSA with unlimited warranty	CM112498/L-7/4	SMT-07-1014
	1x10-5 atm*cc/sec helium Sniffer reservoir leak standard, 300 cc Res, Sniffer	CM511.0-5102DA0/1	
	$5.0x10^{-4}$ atm*cc/sec helium reservoir leak standard, 300 cc Res, Sniffer	CM515.0-4102DAG/4	
	10^{-4} atm*cc/sec helium reservoir leak standard	CM51X-41161V0/1	
	10^{-5} atm*cc/sec helium reservoir leak standard	CM51L-51121V0/1	
	10^{-6} atm*cc/sec helium reservoir leak standard	CM51X-61141V0/1	
	10^{-7} atm*cc/sec helium reservoir leak standard	CM51X-71111V0/1	
	10^{-8} atm*cc/sec helium reservoir leak standard	CM51X-81111V0/1	
	10^{-9} atm*cc/sec helium reservoir leak standard	CM51X-91111V0/1	
Spray Probes	Helium Spray Probe 10 ft (3 m) poly tube with regulator	LHSP04	SMT-07-1003
	Helium Spray Probe 10 ft (3 m) poly tube with regulator and 620cc reservoir bottle	LHSP07	
	Regulator, Gas bottle, CGA580	LHREG-01	
Sniffer Leak Testing	Sniffer Probe 10 ft (3 m)	LSP-01A-10	SMT-07-1004
	Sniffer Probe 33 ft (10 m)	LSP-01A-33	
Filters	Internal sintered bronze filter, NW25, 40 micron	LVF-B-2.5-0.75-40-NW25	Section 5
Leak Detection Chambers	4" x 4" x 2" LD Vacuum Chamber	LVC040402-2222-LD	SMT-07-1051
	4" x 4" LD Vacuum Chamber	LVC0404-3321-LD	

Group	Item	Part Number	Reference
	6" x 6" LD Vacuum Chamber	LVC0606-3321-LD	
	8" x 8" LD Vacuum Chamber	LVC0808-3321-LD	
	8" x 8" LD Vacuum Chamber (Hinged)	LVC0808-3312-LD	
	10" x 12" LD Vacuum Chamber	LVC1012-3312-LD	
	12" x 12" LD Vacuum Chamber	LVC1212-3323-LD	
	12" x 12" LD Vacuum Chamber (Hinged)	LVC1212-3312-LD	
Bombing Chambers	4" x 4" Leak Test Bombing Chamber (PSI)	LBC0404-60	SMT-07-1016
	8" x 3" Leak Test ASME Pressure Bombing Chamber (60 PSI)	LBC083-60	
	9" x 15" Leak Test ASME Pressure Bombing Chamber (100 PSI)	LBC0915-100	

10. Appendix

10.1. Reference Information

10.1.1. Leak Rate Conversions

Table 67 *Leak Rate Conversions*

Convert From	Multiply By	Convert to
atm-cc/sec	1.013	mbar-liter/sec
atm-cc/sec	0.76	torr-liter/sec
torr-liter/sec	1.13	mbar-liter/sec
Pa-M3/sec	9.87	atm-cc/sec
Air oz/yr	6.96 x 10-4	atm-cc/sec
atm-cc/sec	60	sccm

10.1.2. Pressure Conversions

Table 68 *Pressure Conversions*

Convert From	Pascal	Torr	Atm	Mbar	Micron	Psia	in. Hg Ab.
Pascal (newton/m2)	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}
Torr (mm Hg)	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}
Atmosphere (atm)	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}
Millibar (mbar)	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}
micron	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}
psia	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}
in.Hg Ab	1	7.5×10^{-3}	9.87×10^{-6}	0.01	7.5	1.45×10^{-4}	2.95×10^{-4}

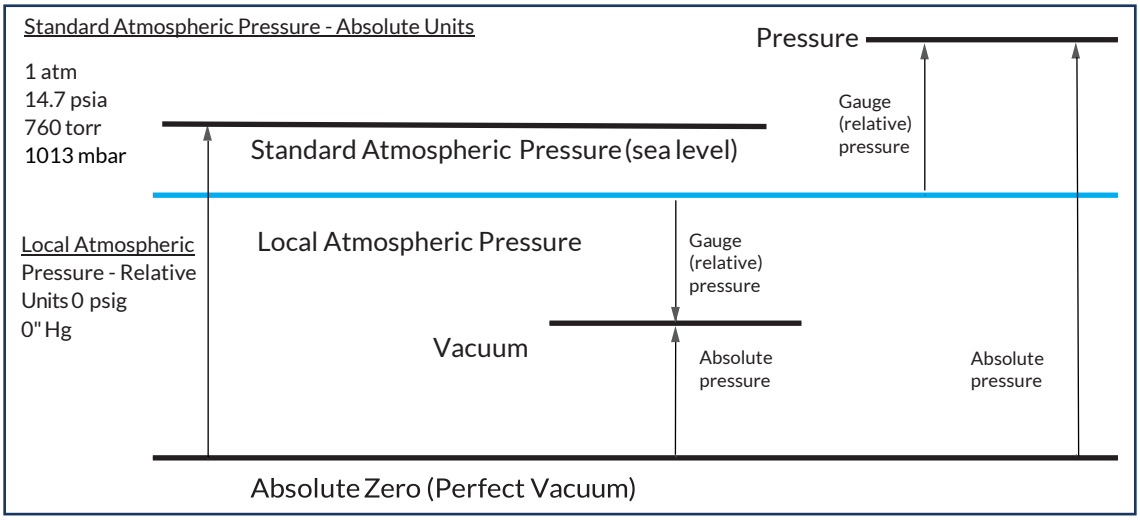


Figure 15: Absolute vs. Relative Conversions

10.1.2.1. Rules of Thumb

- Torr = 75% of Mbar
- 1000 millitorr = 1 Torr
- 1000 millibar = 1 bar
- 1 bar = 1 atmosphere
- Millitorr = Micron
- 1 psi = 2" Hg
- 25 torr = 25 mm Hg = 1" Hg
- mm Hg = Torr

Table 69 *Elevation vs. Vacuum Level*

Elevation (ft.)	Max. Relative Vacuum (in Hg)	Percent Loss
0 (sea level)	29.92	0
1,000	28.85	3.6
2,000	27.82	7.0
3,000	26.82	10.4
4,000	25.84	13.6
5,000	24.89	16.8
6,000	23.98	19.9
7,000	23.06	22.9
8,000	22.20	25.7
9,000	21.38	28.5
10,000	20.58	31.2

10.1.3. Gas Flow Conversions

Table 70 *Gas Flow Conversions*

To Convert From	m^3/sec	Liter/sec	m^3/hr	CFM (feet^3/min)
m^3/sec	1	1.000	3,600	2.12×10^3
Liter/sec	0.001	1	3.6	2.12
m^3/hr	2.78×10^{-4}	0.278	1	0.589
CFM (feet^3/min)	4.72×10^{-4}	0.47	1.70	1

10.1.4. Leak Flow Regime

10.1.4.1. Viscous vs. Molecular Flow Leaks

The flow regime encountered in leak testing is often difficult to determine. It can, however, be estimated by calculating the average mean free path of the gas molecule (l) divided by the estimated leak path diameter (d). Use the following guidelines to determine the flow regime.

- **Viscous Flow** leaks typically occur in systems leaking at atmosphere or larger pressures (l/d < 0.01). Viscous leaks are typically larger than 10-5 atm-cc/sec, but can occur at lower leak rates.
- **Molecular Flow** leaks typically occur under vacuum conditions (l/d > 1.00). Molecular leaks are typically smaller than 10-5 atm-cc/sec.
- **Transitional Flow** occurs between viscous and molecular flow regimes (0.01 < l/d < 1.00).

Table 71 *Helium Leak Rate vs. Other Gases*

Convert to	Multiply Helium Leak Rate by:	
	Viscous Flow	Molecular Flow
Argon	0.883	0.316
Neon	0.626	0.447
Hydrogen	2.23	1.41
Nitrogen	1.12	0.374
Air	1.08	0.374
Water Vapor	2.09	0.469

10.1.4.2. Leak Rate vs. Pressure

- Viscous Flow: $Q_V = K/n (P^2 - P^2)$
- Molecular Flow: $Q_M = K(T/M)^{1/2} (P_1 - P_2)$

Where:

- Q = Leak Rate
- K= Constant relating leak path geometry
- n = Gas Viscosity
- M = Gas Molecular Weight
- T = Absolute Temperature
- $P_{1,2}$ = Upstream and Downstream Absolute Pressure

Example: A helium leak in the viscous flow regime with 10 atm upstream (internal) and 1 atm downstream pressure has a leak rate of 0.001 atm-cc/sec. If the upstream pressure was doubled to 20 atm the new leak rate would be:

$Q_{V'NEW} = Q_{V'OLD} ((P_{1'NEW}^2 - P_{2'NEW}^2) / (P_{1'OLD}^2 - P_{2'OLD}^2))$

$Q_{V'NEW} = 0.001 ((20^2 - 1^2)/(10^2 - 1^2)) = 0.004$ atm-cc/sec

Using the table above, the equivalent leak rate for air under the same conditions is:
$Q_{V,AIR} = 0.004 (1.08) = 0.0043$