LACO TECHNOLOGIES

ORIGINAL

- OPERATING INSTRUCTIONS
- MAINTENANCE INSTRUCTIONS
- COMMUNICATION PROTOCOL

TiTAN TEST

LEAK DETECTOR

TitanTest Production and Maintenance Models

From Software Version 1.16

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** Feature not available in TitanTest™ Maintenance model

1. About this manual

This document applies to the software version stated on the title page.

Devices of the TITANTEST™ Production Series (P-Series) have a particularly large capacity oil mist filter as well as an external oil drain fitting. This allows the user to change the oil without removing the cover.

Some features are not available on the TITANTEST™ Maintenance Series (M-Series) and are indicated in the text of the manual.

Documents for other software versions are available from our sales department. For the latest software version contact Laco Technologies.

1.1 Target groups

These operating instructions are intended for the owner of the TITANTEST™ helium and hydrogen leak detector and for technically qualified personnel with experience in leak detection technology.

1.2 Additional documents on the USB stick

- Spray Probe User Guide, SMT-07-1003
- Sniffer Probe User Guide, SMT-07-1004
- Calmaster User Manual, SMT-07-1014
- TITANTEST™ Accessory Manual, SMT-07-1029

1.3 Other applicable documents

- TITANTEST™ Sniffer Probe, Document no. ltna01en1
- UNO 006 Rotary Vane Pump, Operating Instructions, Document no. PD 0072 BDE/A (1404)
- Operating Instructions SplitFlow 80
- TCM, SMT-07-1027
- ATLAS

1.4 Displaying information

1.4.1 Warnings

⚠ DANGER

Imminent threat of danger resulting in death or severe injuries

⚠ WARNING

Dangerous situation potentially resulting in death or severe injuries

⚠ 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 helium and hydrogen leak detector TITANTEST™ is used to measure and locate leaks on components, assemblies, apparatuses and systems.

It is suited for both vacuum methods with or without partial flow mode and for overpressure leak tests (sniffer method).

TITANTEST™ may only be used for leak tests for the gases specified in the "Technical data".

- ▶ You must install, operate and service the device only in compliance with these operating instructions.
- ▶ Adhere to the restrictions of use, () (*see Chapter 4.3: "Technical Data", page 10*).

Unauthorized use

- ▶ 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 Owner requirements

Safety conscious operation

- ▶ 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.
- ▶ Comply with 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 unit
- ▶ Use only original parts or parts approved by the manufacturer.
- ▶ Keep these operating instructions available at the equipment location.

Personnel qualifications

- ▶ Allow only qualified service technicians to work with and on the device. The qualified service technicians must have received training on the device.
- ▶ Allow personnel in training to work with and on the device only under the supervision of trained qualified service technicians.
- ▶ Make sure that the authorized personnel have read and understood the operating instructions and all other applicable documents (*see Chapter 1.3: "Other applicable documents", page 1*), especially the information regarding safety, maintenance and repairs, before starting work.
- ▶ Define the responsibilities, authorizations and supervision of personnel.

2.3 Operator requirements

- ► Read, observe and follow the information in these operating instructions and the working instructions created by the owner, especially the safety instructions and warnings.
- ► Carry out any work only based on the complete operating instructions.
- ► If you have any questions regarding operation or maintenance that you cannot find answers to in these instructions, then please contact LACO customer service.

2.4 Dangers

The device was built according to recognized state of the art safety regulations. Nevertheless, improper use can result in danger to life and limb of the operator or other persons and damage to the device and other property.

Dangers from electric power

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. Make sure that the electric power supply is reconnected with authorization.

Testing live parts results in danger to life.

- ► Before starting the leak test, disconnect electrically operated test objects from the power supply. Make sure that 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 the restrictions of use (*see Chapter 4.3: "Technical Data", page 10*).
- ► 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 > 5%.
- ► Only use the device outside potentially explosive areas.
- ► No smoking. 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 condensible gases or vapors are measured, there is a risk of pump corrosion and damage.

- ► Do not immediately switch off the device after the measurement. Let the device run in "Background cleanup" mode for at least another 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. Scope of delivery, transport, storage

Scope of delivery

Table 1: Scope of delivery

Item	Quantity
TitanTest™	1
Power-Subcon plug and Cover for D-sub plug	2
Power supply cable (USA version)	1
Filter set	1
Fuse set	1
Centering ring	1
Hexagon key wrench set	1
Plug nipple	1
How to unpack the unit (instruction)	1
Operating instructions	1
USB stick with manuals, instructions, software	1

► Check the scope of delivery of the product for completeness after receipt.

You can order a separate sniffer line for sniff mode (*see Chapter 9.2: "Accessories and consumables", page 100*).

Transport

⚠ CAUTION

Risk of injury when carrying the heavy leak detector

Carrying heavy objects may cause back problems.

The device may slip from your hand.

► Use auxiliary devices for transporting the device.

NOTICE

TitanTest™ Wet Series: 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.

► Don´t change orientation from upright and level for transporting.

► To avoid risks use the plug supplied with the device to close the exhaust line. Remove the plug to be operational again after the transport.

NOTICE

Risk of damage from transporting without original packaging

Transport in unsuitable packaging material can damage the device.

Parts inside the device without transport restraint can be damaged during transport.

- ► Store the original packaging.
- ► Only transport the device in the original packaging or a reusable shipping container that are available for oder, T1106.

There are recessed grips for carrying/transporting the TITANTEST™ (*see Fig. 1, page 7*).

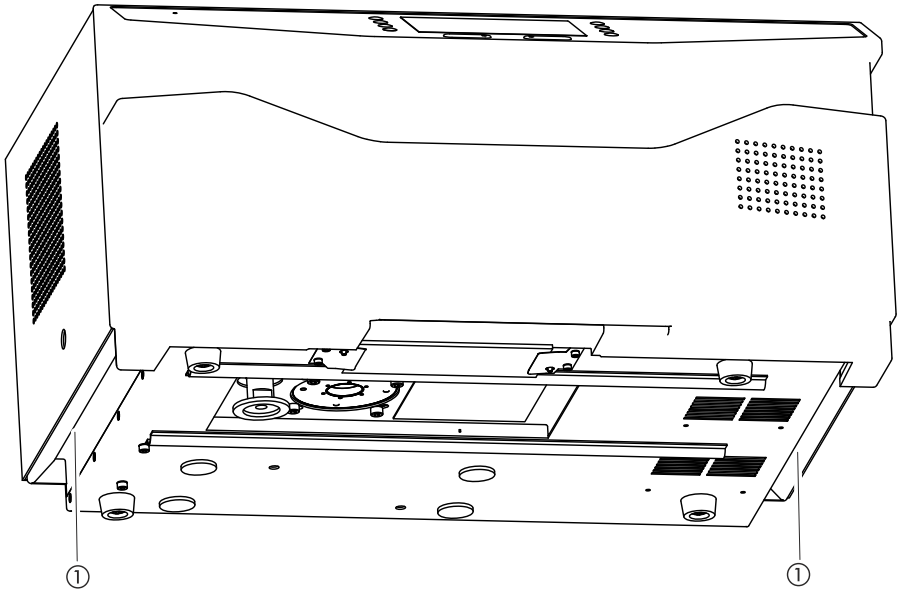


Fig. 1: Recessed grip and holding position

The center of gravity is in the rear part of the device. When carrying the device, position the hands closer to the rear side of the device.

Storage

Always store the device in consideration of ambient conditions (*see Chapter 4.3: "Technical Data", page 10*).

4. Description

4.1 Function

The TITANTEST™ can detect helium and hydrogen tracer gases.

It is suited for leak testing according to the sniffer and vacuum methods.

- When leak testing according to the sniffer method, the test object is pressurized with the 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 procedure has the advantage that leaks can be localized.
  - The test object can be pressurized with tracer gas and tested in a vacuum chamber. To do this, the TITANTEST™ is connected to a vacuum chamber. The device measures the overall leakage rate of the test object.

  The device has three sensitivity levels for vacuum method: "GROSS", "FINE" and "ULTRA". Depending on the pressure in the inlet flange, the TITANTEST™ automatically selects the most sensitive level. For information on pressure ranges and detection limits, *see Chapter 4.3: "Technical Data", page 10*.

4.2 Main unit

In the following, the basic unit will be referred to merely as “device” as long as the meaning remains clear.

Fig. 2: Frontal view

① *Connection flange DN 25 ISO-KF*
② *Display*

Fig. 3: Rear view

① *Mains plug, covered by a label*
② *RoHS label*
③ *Power supply, covered by a label*
④ *Rating plate with information regarding supply voltage, serial number and production date*
⑤ *Connection strip*
⑥ *Oil sight glass*
⑦ *Exhaust line for M-Series with plug, which must be removed before switching on (pictured)*
alternatively
Oil drain for P-Series (not pictured)

Mains plug ①
The mains plug for switching the device on and off.

Power supply ②
Connection for power supply cable. The power supply is conducted via this cable.

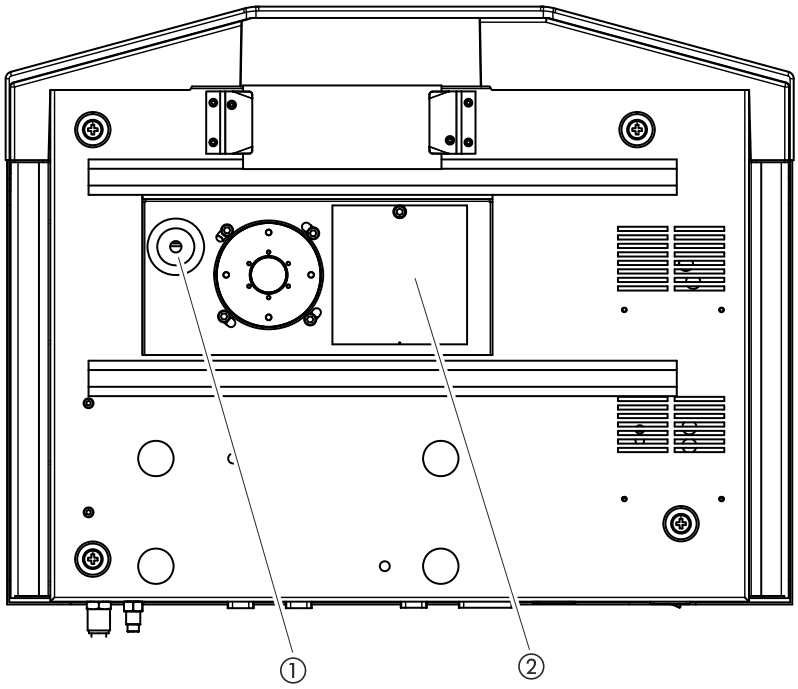
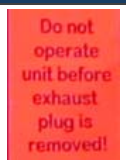


Fig. 4: Bottom view

① *Screw for connection flange DN 25 ISO-KF* ② *Cover plate for ion source*

4.2.1 Markings on the device

Marking	Meaning
	Sticker with note: Do not operate unit before exhaust plug is removed!
	Caution: There may be mains voltage!

4.3 Technical Data

Table 2: Technical data

Mechanical Data	
Basic unit:	
Dimensions (length; width; height)	555 x 425 x 305 mm (21.9 x 16.7 x 12 in.)
Weight	
Wet Series	approx. 44 kg (97 lb.)
Dry Series	approx. 34 kg (75 lb.)
Max. permitted acceleration during operation	1 G (horizontal)
Test port	DN 25 ISO-KF
Cooling air	
Inlet	below, with dust filter
Outlet	on side
Exhaust port M-Series	for hose ø8 mm

Table 2: Technical data (Contin.)

Exhaust port P-Series	DN 25 ISO-KF
External backing vacuum connection	DN 25 ISO-KF
Venting connection (N_2)	Sniffer line connection, for hose ø6/4 mm
Max. pressure on venting connection	1.1 bar
Ambient conditions	
Temperature	
Storage	- 10 °C to 55 °C (14 °F to 131 °F)
Operation	- 10 °C to 35 °C (14 °F to 95 °F)
Max. relative humidity up to 31 °C (88 °F)	80 %
Max. relative humidity from 31 °C (88 °F) to 35 °C (95 °F)	linearly decreasing from 80 % to 50 %
Use	only indoors
Max. altitude above sea level	2000 m a.s.l.
Noise level	< 70 dB(A) (acc. to IEC standard)
Pollution degree	II (According to IEC 61010 / Part 1: "Usually, only non-conducting contamination may occur. However, temporary conductivity caused by condensation is permissible at times.")
Electrical data	
Supply voltages and frequencies	
TTW102 TTW101 TTN150	230 V ± 10% / 50 Hz 120 V ± 10% / 60 Hz 100 V - 230 V ± 10% / 50/60 Hz
Protection class	1
Overvoltage category	II
Current	<10 A
Power consumption	≤ 720 VA (Wet Series) ≤ 150 VA (Dry Series)
Mains fuse	2 pieces, 10.0 AT, 250 V, ø5×20 mm
Physical data	
Measuring	
Operation modes	Vacuum / Sniff / Auto Test
Ready for operation	≤3 minutes (pump run-up time)
Inlet pressure	≤18 mbar (up to 25 mbar allowed for short time)
Filament	2 (iridium yttriated)
Filter stages	none static dynamic
Measuring rate	20 Hz
Display rate	3 Hz
Alarm	
Acoustics / Volume	adjustable
Setpoint / Pre-warning	adjustable
Relay exit	adjustable
Screen displays	Leakage rate vs. time, analog / digital
Vacuum mode	

Table 2: Technical data (Contin.)

Minimum detectable leakage rate	acc. to AVS 2.1
^4He	$<5 \times 10^{-12}$ mbar l/s
^3He	$<5 \times 10^{-10}$ mbar l/s
H_2	$<5 \times 10^{-8}$ mbar l/s
Maximum detectable leakage rate	
^4He	1 mbar l/s
^3He, H_2	1×10^{-2} mbar l/s
Measurement range	10^{-12} … 1 mbar l/s
Units of the display	mbar l/s, Pa m^3/s, sccm, sccs, Torr*l/s, atmcc/s
Detectable gases	^4He, ^3He, H_2
Response time (to 63% of signal)	<0.3 s
Throughput for helium	2.5 l/s if $p_{inlet} < 0.5$ mbar
Throughput at inlet with large backing pump (Wet Series)	depending on external pump
Internal calibration leak	see back of device
Sniff mode	
Minimum detectable leakage rate	
^4He, ^3He, H_2	$>5\times10^{-8}$ mbar l/s
Maximum detectable leakage rate	
^4He	1 mbar l/s
^3He, H_2	1×10^{-2} mbar l/s
Measurement range	10^{-8} … 1 mbar l/s
Units of the display	mbar l/s, Pa m^3/s, ppm, sccm, sccs, g/a, oz/yr,Torr*l/s, atmcc/s
Detectable gases	^4He, ^3He, H_2
Response time	<1 s with 3 m sniffer line
Interfaces	
see Chapter 11.: "Interfaces and Protocols", page 105 for plug arrangements and detailed data.	
Backing pumps	
Wet Series	
Vacuum UNO 06	Single-stage rotary vane pump, oil-sealed
Pumping speed	4.8 m^3/h at 50 Hz, 5.8 m^3/h at 60 Hz
External LACO vacuum pumps	see www.lacotech.com
Turbo pump	
Vacuum SplitFlow 80	Turbo pump, with interstage pumping
Pumping speed for N_2	60 l/s

Factory settings

Table 3: Factory settings

Parameters	Default value	Reset to default value when factory settings are loaded	Included in set of parameters
Contrast	50	no	no
Invert display	off	yes	no
Display automatic	yes	yes	no

Table 3: Factory settings

Parameters	Default value	Reset to default value when factory settings are loaded	Included in set of parameters
Leakage rate unit	mbar l/s	yes	yes
Pressure unit	mbar	yes	yes
Scaling	log	yes	yes
Decades for scaling log	4	yes	yes
Display range	automatic	yes	yes
Time axis	32 seconds	yes	yes
Lower display limit	1E-12 mbarl/s	yes	yes
Menu PIN	0	yes	no
Device PIN	0	yes	no
Access to CAL function	On	yes	yes
Language	English	yes	no
Operating mode	Vacuum	yes	yes
Mass	Mass 4	yes	yes
Leakage rate fact.	Factor (1)	yes	no
Leakage rate filter	dynamic	yes	yes
ZERO	enabled	yes	yes
Time after start for ZERO	10 seconds	yes	yes
MS-BG-Subtraction	On	yes	yes
Alarm operating mode	Trigger alarm	yes	yes
Alarm delay time	30 seconds	yes	yes
LR setpoint	1E-8 mbar l/s	yes	yes
Warning limit	100%	yes	yes
Analog output channel 1	LR mantissa	yes	yes
Analog output channel 2	LR exponent	yes	yes
Analog scaling (upper limit)	-5	yes	no
Analog scaling (V/decade)	1V per decade	yes	no
Control location	All	yes	yes
Mode relay 1	off	yes	no
Mode relay 2	off	yes	no
Interface**	RS232	yes	no

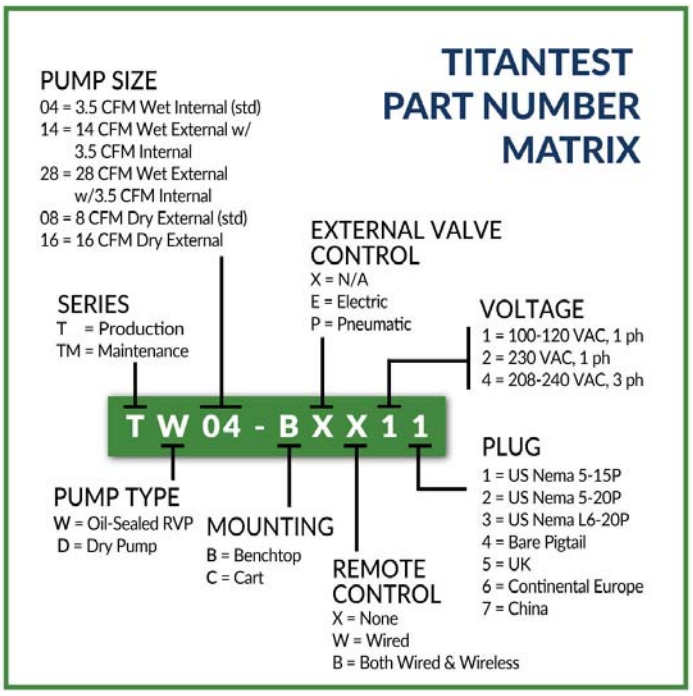
** Feature not available in TitanTest™ Maintenance model

Interface protocol	LD	yes	yes
Ext. Pump Setup Evacuation	Fore pump only	yes	yes
Ext. Pump Setup Measure mode	Fore pump only		
Max. pressure	0.65 mbar	yes	yes
Min. pressure	0.25 mbar	yes	yes
Gross leak protection	off	yes	yes
Limit value, gross leak protection	1E-3 mbar l/s	yes	yes
Minimum volume	0	yes	yes
Volume	2	yes	yes
ULTRA	enabled	yes	yes
Switching threshold ULTRA	0.5 mbar	yes	yes

Table 3: Factory settings

Parameters	Default value	Reset to default value when factory settings are loaded	Included in set of parameters
FINE	enabled	yes	yes
Switching threshold FINE	5 mbar	yes	yes
GROSS	enabled	yes	yes
Switching threshold GROSS	15 mbar	yes	yes
Maximum evacuation time	30 minutes	yes	yes
Venting	with Stop	yes	yes
Calibration request	off	yes	yes
int. calibration leak	see calibration leak	no	no
Ext. Calibration leak (vacuum)	1E-7 mbar l/s	yes	yes
Ext. Calibration leak (sniff)	1E-5 mbar l/s	yes	yes
Calibration mode	int. auto	yes	yes

4.4 TITANTEST™ P/N Matrix**



4.5 Pump Down Times

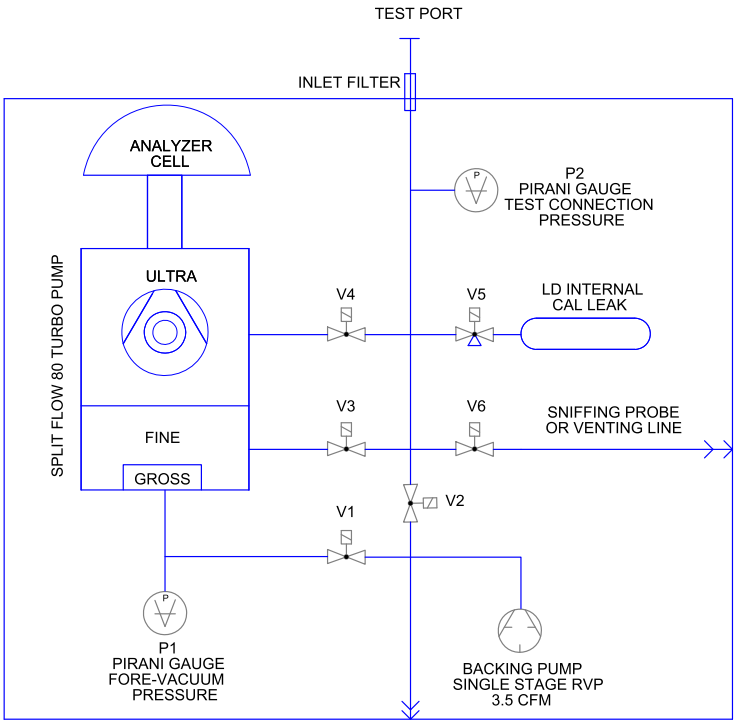
Table 4: Pump Down Times (GROSS, FINE, ULTRA all enabled)

Volume (L)	LD Mode	TW04-BXX11 (sec)	TW14-BXX11 (sec)	TW14-BPX11 (sec)	TD08-BXX11 (sec)	TD08-BPX11 (sec)
2	GROSS	3,9	2,5	2,3	2,9	3
	FINE	4,9	3,7	3	4,9	4
	ULTRA	5,3	4,1	3,5	5,2	4,6
10	GROSS	33,1	18	10,1	18,9	12,2
	FINE	41,9	22,7	12,4	25,5	15,2
	ULTRA	55,7	35,9	17,9	38,7	24
50	GROSS	88,5	77,59	40,5	86,1	52.4
	FINE	135,3	103,7	49,8	112,5	65,5
	ULTRA	258,9	1168,3	75,2	182,9	109,9

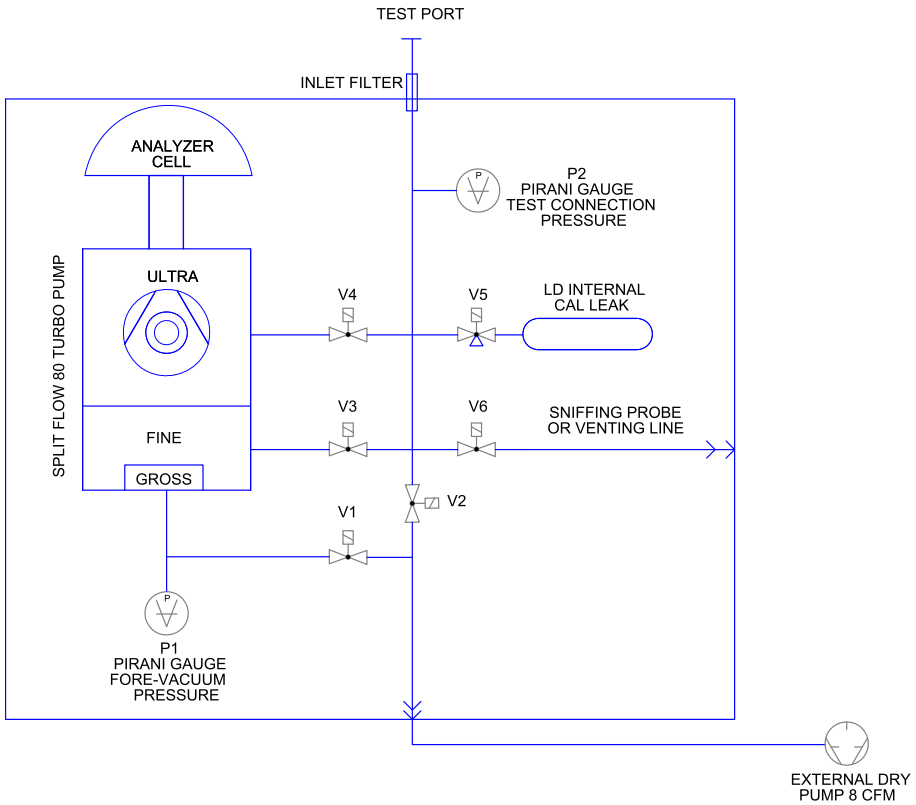
** Feature not available in TITANTEST™ Maintenance model

4.6 Vacuum Diagrams

4.6.1 Vacuum Schematic with Internal Fore Pump



4.6.2 Vacuum Schematic with Dry Scroll Pump



5. Installation

5.1 Setup

⚠ WARNING

Danger from moisture and electricity

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

- ► Only operate the TITANTEST™ in a dry environment.
- ► Operate the TITANTEST™ 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 sufficient ventilation.

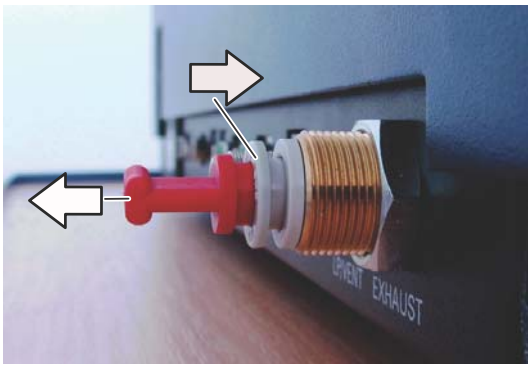
- ► Please note the technical data (*see page 10*).
- ► Ensure sufficient ventilation, especially on the ventilation slots left and right of the device: at least 20 cm of free space on the sides, at least 10 cm in the front and rear.
- ► Keep heat sources away from the device.
- ► Do not expose the device to direct sunlight.

5.2 Removal of the plug (M-Series only)

NOTICE

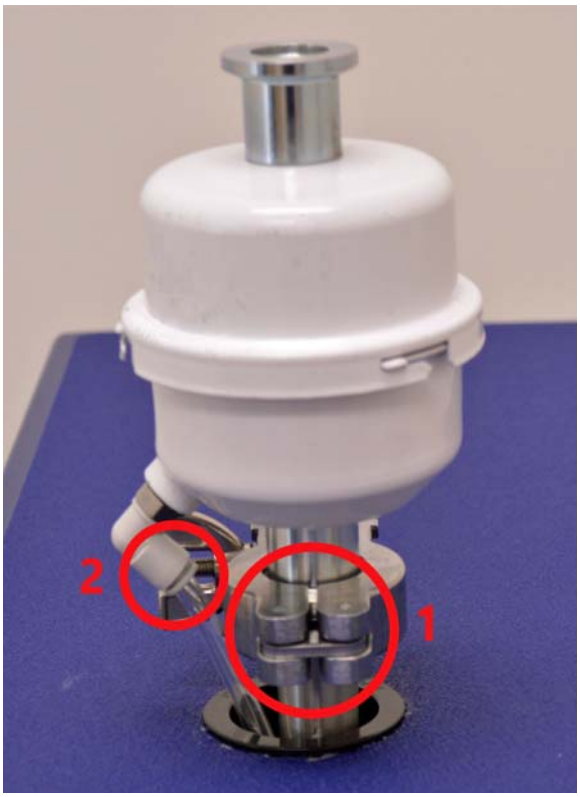
TITANTEST™ Wet Series: Malfunction of the pump system with inserted plug in the exhaust line

- ► Remove the plug from the exhaust line before switching the unit on.
- ► To remove the plug press the release ring in the direction of the device so that the locking device releases. Pull the plug out while release ring is pressed.



5.3 Installing the external oil mist filter (P-Series only)

- ► Attach the mist filter housing to the KF flange (that extends above the cover (1).
- ► Connect the 6 mm drain tube to the mist filter drain fitting (2).



Note: If you want to equip an older device with the oil mist filter conversion kit, you will receive a separate instruction sheet with the kit.

5.4 Accessories for TITANTEST™

A variety of accessories exist for the TITANTEST™ (*see Chapter 9.2: "Accessories and consumables", page 100*). Refer to the Accessory Manual for information on Installation, Operations and Maintenance of these accessories.

5.5 Mounting the accessories

The accessories are connected on the connection strip on the back of the device.

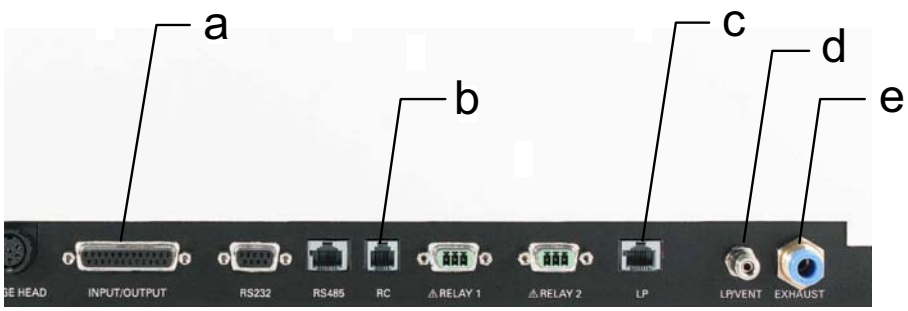


Fig. 5: Connection strip

a Input / Output

b Connection - remote control

c Electrical connection for sniffer probe LP

d Gas connection for the sniffer probe or venting line (hose-nipple ø 6/4 mm)

e Devices M-Series with oil sealed backing pump: Pump exhaust port for 8 mm OD tubing
Devices P-Series with oil sealed backing pump: Oil drain
Devices TD-Series: Connection for external backing pump

5.6 Connecting the sniffer line

For sniff mode, the device is connected to a sniffer line.

Connect the sniffer line before you press the "Start/Stop" button. If you remove the sniffer line 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.

Mounting the sniffer lines

1. Select the right sniffer line.
2. Attach the sniffer line into the LP/Vent connection for the sniffer probe (*see Fig. 5, page 19*).
3. Insert the RJ45 plug of the sniffer line into the LP connection, if using an advanced sniffer.

For information on calibration and measurement, *see Chapter 6.4.10.2: "Calibrate in "Sniff"operating mode", page 51* and *see Chapter 6.5.2: "Measuring in "Sniff" operating mode", page 53*.

Should you later wish to switch to vacuum mode, remove the sniffer probe from the gas connection on the device. The connection is used for venting.

5.7 Remote control

The following remote controls are optionally available for the TITANTEST™:

- Remote control TR100, wired
- Remote control TR101, wireless

Please refer to the separate operating instructions for additional information.

The wired remote control is connected to connection 2 (RC) (*see Fig. 5, page 19*).

5.8 Fore pump exhaust line

If the TITANTEST™ is operated in poorly ventilated spaces, an exhaust gas line is required.

⚠ 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 TITANTEST™.

The 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. Connect on 8 mm OD or 5/16" OD poly tube.

► Connect the exhaust gas line to exhaust port 5 (*see Fig. 5, page 19*).

5.9 Venting or chamber

In vacuum test modes, if the test object is vented with a gas – e.g. argon or dry nitrogen – instead of with air, a gas source is connected to the device. Connect the gas source to connection 4 (*see Fig. 5, page 19*).

The pressure at the venting connection may not exceed 0.1 bar.

5.10 Connecting to the power supply system

NOTICE

Material damage due to incorrect supply voltage

An incorrect supply voltage may damage the device.

1. Check whether the supply voltage specified on the TITANTEST™ rating plate matches the supply voltage available on site.
2. Connect the device to the electric power supply using the supplied power cable.

6. Operation

6.1 Switching on the device

NOTICE

TITANTEST™ Wet Series: Malfunction of the pump system with inserted plug in the exhaust line

1. Make sure the plug is removed of the exhaust line (*see Chapter 5.2: "Removal of the plug (M-Series only)", page 17*).
2. Connect the necessary accessories or equipment before switching on the device.

Operating mode	Connected to device
Sniff mode	Sniffer probe on vacuum chamber flange
Vacuum mode	Test object
Auto Test**	Filling system (if applicable)

3. Switch on the device with the mains plug.
   The TITANTEST™ will start and execute an auto test.
   The start-up time for the turbo pump is about 2 to 3 minutes. The "Run-up" window can be seen on the display. A progress bar on the display shows the process flow.
   In this phase, you can already open the menus "Setup", "Language" and "Information".
   After the run-up, the display shows the window "Standby".
4. Allow the device to warm up for 30 minutes before making exact measurements or executing a calibration.

** Feature not available in TITANTEST™ Maintenance model

6.2 Operating the device

6.2.1 Menu tree

Welcome				
Start-up (*6.1*)	Language (*6.1*)			
	Setup (*6.1*)			
	Information (*6.1*)			
Standby (*6.2.7*)	Mode Select (*6.2.7*)			
	Setup (*6.2.7*)	Global settings (*6.3*)	Display settings (*6.3.1*)	Contrast (*6.3.1*)
				Units (*6.3.1*)
				Date & Time (*6.3.1*)
				Display range (*6.3.1*)
				Lower display limit (*6.3.1*)
				Language (*6.3.1*)
			Access control (*6.3.2*)	Maintenance enabled (*6.3.2*)
				Access to CAL function (*6.3.2*)
				Change device PIN (*6.3.2*)
				Change menu PIN (*6.3.2*)
			Maintenance & Service (*8.; 8.3.2*)	Maintenance device (*8.3.2*)
				Maintenance warning (*8.3.2*)
				Burn-in (*8.3.2*)
				Maintenance components (*8.3.2*)
				View Maintenance interval list (*8.3.2*)
				Service (*8.3.2*)
			Interfaces (*6.3.3*)	Analog output (*6.3.3*)
				Control location (*6.3.3*)
				Relay (*6.3.3*)
				Serial port (*6.3.3*)
				Ext. Pump Setup (*6.3.3*)
			Parameter load / save (*6.3.4*)	Load "PARA SET 1" (*6.3.4*)
				Load "PARA SET 2" (*6.3.4*
				Save as "PARA SET 1" (*6.3.4*
				Save as "PARA SET 2" (*6.3.4*
				Load factory settings (*6.3.4*
			Volume & Beep (*6.3.5*)	
		Auto Test** (*6.3.6*)	Auto test timer (*6.3.6*)	
			Auto test parameter (*6.3.6*)	
		Setpoint & Alarm (*6.4.7*)		
		Information (*6.6*)	Settings (*6.6*)	
			System data (*6.6*)	
			Vacuum diagram (*6.6*)	
			Error list (*6.6*)	
			Calibration history (*6.6*)	
			Paging function (*6.6*)	
		Calibration settings (*6.4.8*)	Calibration request (*6.4.9*)	
			Calibration leak & CAL Mode (*6.4.8*)	
		Test settings (*6.4*)	Mode & Mass (*6.4.1*)	
			Filter & ZERO (*6.4.2*)	
			Vacuum ranges (*6.4.3*)	
			Evacuation time & Vent (*6.4.4*)	
			Gross leak protection (*6.4.5*)	
			Pressure limits for sniff mode (*6.4.6*)	
	Calibration (*6.4.10*)			
	Utilities (*6.2.7*)	Background cleanup (*6.4.4*)		
		Check internal calibr. leak((*6.4.10.3*)		
Pumping down (*6.2.7*)				
M.-mode (Bar-Graph) (*6.2.5*)				
M.-mode (Q(t)-Graph) (*6.2.5*)				
Warning/Error (*7.*)				

** Feature not available in TitanTest™ Maintenance model

6.2.2 Display and buttons

The control unit is the display, operating, and control component for the device.

Fig. 6: Control unit

① *Option buttons*
② *ZERO button*
③ *START/STOP button*
④ *Display*

Option buttons ①
All settings and inputs in the menus are made with the eight buttons to the left and the right of the display. Switch menus, select settings areas or change the settings by pressing the adjacent button. The current assignment is shown next to the respective button.
For information on the symbols next to the buttons, *see Chapter 6.2.3: "Recurring function symbols", page 24*.

ZERO button ②

Activates the background suppression during measurement mode. If you press the button longer than 3 seconds, the background suppression is switched off (*see Chapter 6.4.2: "Set filter & ZERO", page 43*).
If ZERO is activated, the associated LED lights up.

START/STOP button ③

Starts or stops the measuring operation.
The associated LED lights up permanently during measurement mode and flashes during an evacuation.

Display ④
The display shows measured values, device states and settings in different menus.

6.2.3 Recurring function symbols

🔊+	Set the volume for the speaker.
🔊−	Set volume: the current set volume is displayed on the bottom edge of the display. Value range: 0 (off) to 15 (max.) The volume cannot be below the minimum volume set in the menu Volume & Beep.
🔊 2	
	Call up the menu "Setup".
ZERO	ZERO active
Cali-bration	Calling up Calibration.
i	Calling up information about the device.
	Back to measurement display or Standby
	Back to the previous menu
	There is a warning or error message.

6.2.4 Structure of the windows and the menus

After the run-up of the device, the display shows the window "Standby".

The device is ready to measure.

You can change settings for the measurement.

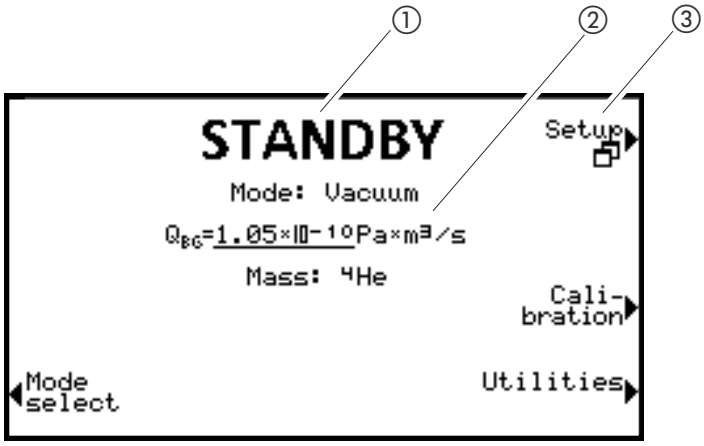


Fig. 7: Window and menu structure

① *Window name*
② *Main display area*
③ *Menu name*

Main display area ②
The main display area shows the current state of the device: operating mode, measuring situation, background, tracer gas

Menu name ③
Select the menus by pressing the adjacent round buttons located to the left or right of the display. For more information on the meaning of the symbols, *see Chapter 6.2.3: "Recurring function symbols", page 24*.

6.2.5 Measurement display

The measured leakage rates are shown numerically with a bar graph or graphically in a diagram as a function of the measuring time.

You can switch between display options using the button located on the lower right. Next to this button is the symbol for the analog display or the graphic display.

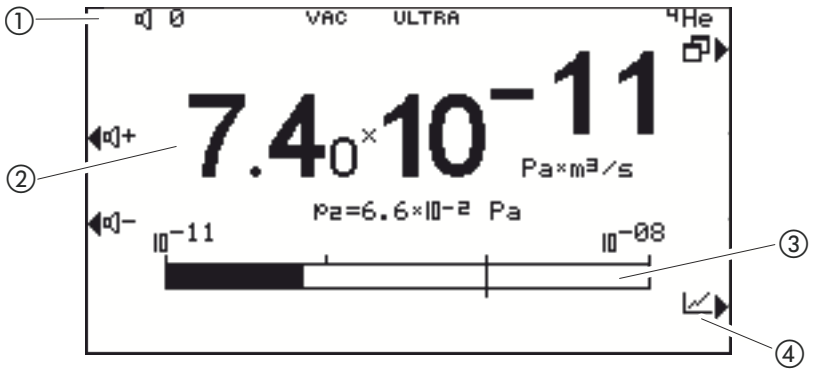


Fig. 8: Numerical measurement display

① *Information area*
② *Current measured value*
③ *Bar graph, logarithmic*
④ *Switch to graphic measurement display*

Information area ①
Shows the current state of the device:
volume, operating mode, measuring situation, ZERO active, tracer gas

Current measured value ②
The current measured value is displayed. Under this the pressure at test port p2 is shown.

Bar graph, logarithmic ③
The current measured value is shown in a bar graph.

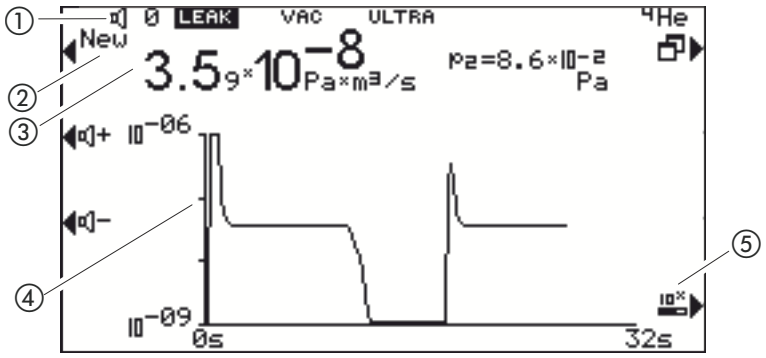


Fig. 9: Graphic measurement display

① *Information area*
② *Graph*
③ *Current measured value*
④ *Measured value displays as function*
⑤ *Switch to analog measurement display*

Information area ①
Shows the current state of the device:
volume, operating mode, measuring situation, ZERO active, tracer gas

The graph is started again by pressing Graph ②.

Current measured value ③
The current measured value is displayed as a logarithm.

Measured value displays as function ④
Shows the progress of the measured values as a function of time.

6.2.6 Setup window display

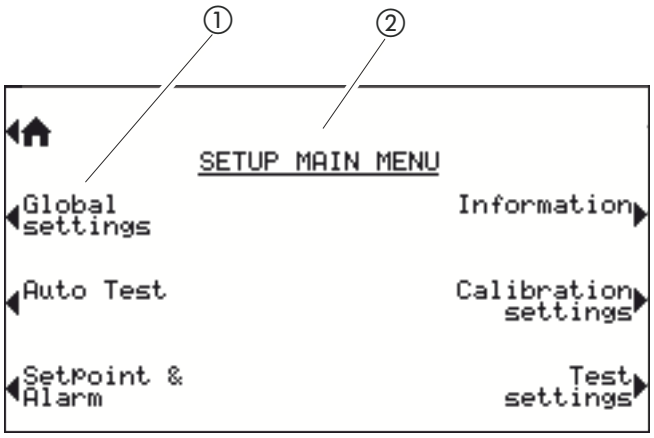


Fig. 10: Structure of the configuration menu

① *Menu name*

② *Window name*

Menu name ①

- Depending on the window, different functions are offered next to the buttons at the left and right edges.
- You can select the menus respectively the functions by pressing the adjacent button.
- You can switch between the windows, select settings areas or change settings when selected.

For more information on the meaning of the buttons, see *see Chapter 6.2.3: "Recurring function symbols", page 24*.

Window name ②

The window name is in upper-case letters and underlined in the top center of the display. If there is a menu previous to the window currently displayed, its name is listed here as a button function.

Working in the windows

- You can switch between the windows using the buttons on the left and right side of the display.
- If a value is selected in the windows for editing values, you can change the selected editing position if necessary using the button on the left side.
- Should there be multiple values in the line, press the button on the left side again.
- You can change selected values at the editing position using the "+" or "-" buttons. If you press and hold the "+" or "-" buttons, the values will change continuously in ascending or descending order.
- Save the changed values to make them effective. To do this, press the button next to "Save".
- Changed values that are not saved will not be effective.
- Press [Return] to go back to the last menu.
- Press [Home] to jump to the "Standby" window.

6.2.7 Standby

After the run-up, the "Standby" window is displayed.

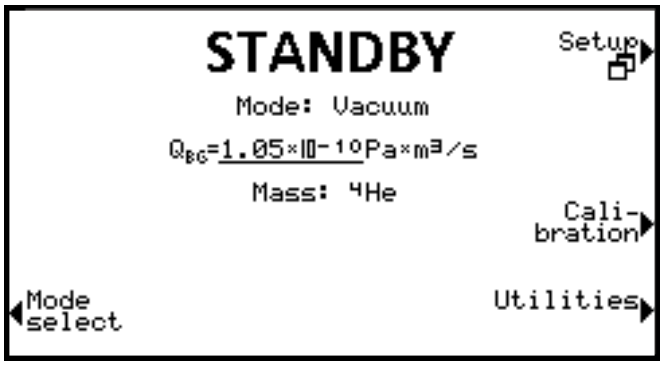


Fig. 11: "Standby" window

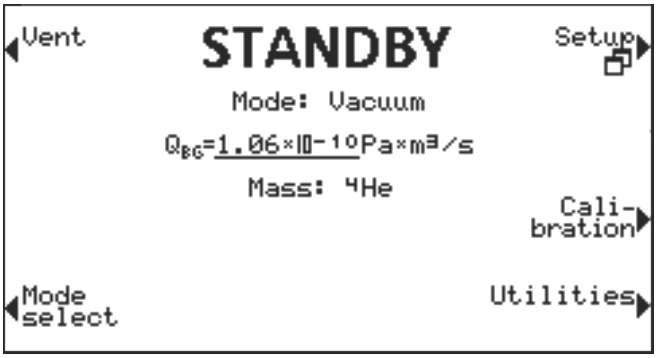
A number of parameters are shown below the name "Standby".

Table 5: Parameters in the "Standby" window

Parameters	Meaning	Comment
Operating mode	Operating mode	Can switch between Vacuum, Sniff, Auto Test**
Q_{BG}	Current background signal	Appears if the corresponding option was selected in the menu "Background ready to start".
Mass	Gas	Can be switched between ^4He, ^3He, H_2

Venting

► Select the entry "manual" for "Venting" in "Setup > Test settings > Evacuation time & Vent" to create an additional "Vent" menu in the "Standby" window.



► In order to start venting, select "Vent" in the "Standby" window.

► Alternatively: If the setting "with STOP" is set for "Venting" in "Setup > Test settings > Evacuation time & Vent", press the "Start/Stop" button to vent.

If the setting "Disabled" is set for "Venting" in "Setup > Test settings > Evacuation time & Vent", you cannot vent.

If the word "Vented" is displayed, the venting process is complete and you can replace the test object.

** Feature not available in TITANTEST™ Maintenance model

Mode select

You can switch between the available operating modes.

1. Select the menu "Mode select" in the window "Standby".
2. Select "Measure mode".
3. Choose from
   - Vacuum
   - Sniff
   - Auto Test**

The current operating mode is displayed in the "Standby" window (*see Chapter 6.2.7: "Standby", page 28*).

Alternatively, you can also switch the operating mode in "Setup > Test settings > Mode & Mass" and also switch between the detectable gases (*see Tab. 19: "Mode & Mass", page 43*).

Setup

Here you can make different settings for the measurement tasks, but also Global settings, such as changing the display or editing authorizations.

► Select the menu "Setup" in the window "Standby".

For information on the setting options, *see Chapter 6.2.1: "Menu tree", page 22*or *see Chapter 6.3: "Global settings", page 30*.

Calibration [CAL]

This function is displayed if calibration is enabled in the "Access control" menu.

► Select the menu "Calibration" in the window "Standby".

Use this function to start the calibration routine (*see Chapter 6.4.10: "Execute calibration", page 49*).

Utilities

This menu allows you to access the functions

- "Background cleanup"
- "Check internal calibration leak"

► Select "Standby > Utilities".

Check internal calibration leak

This function starts the check of the internal calibration leak (*see Chapter 6.4.10.3: "Check calibration with internal calibration leak", page 51*). The function is only available in the operating mode "Vacuum with Mass 4" (*see Tab. 19: "Mode & Mass", page 43*).

► Select "Standby > Utilities > Check internal calibration leak".

Background cleanup

With the background cleanup function, you can start a start-stop cycle for breaking down an increased helium background or for preventing condensates (*see Chapter : "Background cleanup", page 45*).

► Select "Standby > Utilities > Background cleanup".

** Feature not available in TitanTest™ Maintenance model

6.3 Global settings

In order to get an overview of the setting options, please refer to the menu tree representation (*see Chapter 6.2.1: "Menu tree", page 22*).

You can make your own settings or retain the factory settings (*see Tab. 3: "Factory settings", page 12*).

You can save your settings at any time in order to restore an earlier condition when necessary (*see Chapter 6.3.4: "Load/Save parameters", page 37*).

You can access the menus via "Setup > Global settings":

- Display
- Access control
- Maintenance & service (*see Chapter 8.: "Maintenance, Cleaning and Service", page 63*)
- Interfaces
- Load/save parameters
- Volume & Beep

6.3.1 Setting the display

In the "Display" menu, you can modify the type of display by selecting the following buttons:

- Contrast
- Units
- Date & Time
- Display range
- Lower display limit
- Language

► Select "Setup > Global settings > Display settings" and the desired button.

Contrast

Increase or decrease the contrast of the display by pressing the "+" and "-" buttons. If you press and hold down the buttons, the values change continuously.

The settings take immediate effect in the display.

► In order to adjust the contrast automatically to the device temperature, select "Automatic".

► In order to have the background of the display dark and the letters bright, select "Invert Display".

Units

The following options can be selected:

Table 6: Available measurement units

Setting	Measurement unit	Comment
Leakage rate	mbar * l/s	
	Pa*m3/s	
	Torr*l/s	
	sccm	
	sccs	
	atm*cc/s	
	ppm	only available in "Sniff" operating mode
	g/a	only available in "Sniff" operating mode
	oz/yr	only available in "Sniff" operating mode
Pressure	mbar	
	Pa	
	atm	
	Torr	

1. In order to set the units for the leakage rate and the pressure, select "Setup > Global settings >Display settings > Units".
2. In order to define the respective measurement units, press "Leakage Rate" or "Pressure".

Date and Time

You can set the date and time in the menu "DATE & TIME".

- Date in the DD.MM.YYYY format
- Time in the hh:mm format

► Select "Setup > Global settings > Display settings > Date & Time".

Display range

Define how the measured results are to be displayed.

Table 7: Display of measured results

Option	Value range (Min. Max.)	Comment
Scaling	linear	Display linear
	log	Display logarithmic
dec.	2…9	Number of decades for log. display
Range	automatic	Automatic measurement range selection
	manual	Manual measurement range selection via functions in the display
Time axis	16 ... 960	Time axis, time scale in seconds

► Select "Setup > Global settings > Display settings > Display range" and make the desired setting.

Lower display limit

You can apply a lower limit to the display of the leakage rate in measurement mode. The setting is only effective for the operating mode "Vacuum" and "Auto Test**".

Table 8: Available measurement units

Option	Value range (Min. Max.)	Comment
Lower display limit	With unit mbar*l/s: 1E-12 mbar*l/s 1E-11 mbar*l/s 1E-10 mbar*l/s 1E-9 mbar*l/s	The display limit is only effective in the operating modes "Vacuum" and "Auto Test**".

► Select " Setup > Global settings > Display settings > Lower Display Limit".

Language

The following languages are available for the menus:

- English (factory setting)
- German
- French
- Spanish
- Russian

► Select " Setup > Global settings > Display settings > Language".

or

► Alternatively, press "Language" in the "RUN-UP" window.

6.3.2 Access control

In the "Access control" window, you can set access rights for different control areas.

- Maintenance enabled
- Access to CAL function
- Change device PIN
- Change menu PIN

► Select " Setup > Global settings > Access control" and the desired menu.

Maintenance enabled

Define authorization for

– access to the maintenance menu

– venting the turbo molecular pump during the run-up of the device. You require this function for exchanging the lubricant reservoir of the TMP SplitFlow80. For more information, please refer to the separate operating instructions.

** Feature not available in TitanTest™ Maintenance model

Table 9: Maintenance enabled

Option	Value range	Comment
Maintenance enabled	yes	Access to the menu "Maintenance & Service" is enabled. The TMP can be vented during run-up.
	no	Access to the menu "Maintenance & Service" is not enabled. The turbo molecular pump (TMP) cannot be vented during run-up.

► Select " Setup > Global settings > Access control > Enable Maintenance".

Access to CAL function

Define authorization for the execution of the calibration of the device.

Table 10: Enable calibration

Option	Value range	Comment
Enable calibration	yes	The calibration can be started in the "Standby" window.
	no	The device operator cannot start the calibration from the "Standby" window.

► Select " Setup > Global settings > Access control > Access to CAL function".

Change device PIN

The device PIN regulates the use of the device.

If this function was activated, a personal identification number (PIN) must be entered in order to use the device. Only those who know the PIN and enter it correctly can start the device. The device is unusable without entering the correct PIN. The device PIN is requested immediately after switching on the device. If you enter an incorrect PIN, the following message will appear in the display: "Wrong PIN".

Authorization for the device is activated if the current device PIN is not 0000.

If you activate authorization for the device, it is essential to memorize the device PIN.

If you forget the device PIN, contact LACO Technologies.

Table 11: Change device PIN

Option	Value range (Min. Max.)	Comment
New PIN	0000 - 9999	New device PIN
New PIN (Confirmation)	0000 - 9999	New device PIN. Repeat to confirm.

► Select " Setup > Global settings > Access control > Change device PIN".

Change menu PIN

The menu PIN regulates access to the software menu of the device.

If this function was activated, a personal identification number (PIN) must be entered in order to access the menu of the device. Only those who know and correctly enter the PIN can access the device menu.

The menu PIN is requested when accessing the menus. If you enter an incorrect PIN, the message "Wrong PIN" is displayed.

Only the menu "Setup > Information" will remain accessible without restrictions (*see Chapter 6.6: "Calling up information about the device", page 55*).

Authorization for the menu is activated if the current menu PIN is not 0000. After activating the user authorization for the menu, the function is activated after 2 minutes. The setting can be changed in this time. Afterwards, the correct menu PIN must be entered for access to all menus.

If you activate authorization for the menu, it is essential to memorize the menu PIN.

If you forget the menu PIN, contact LACO Technologies.

Table 12: Change menu PIN

Option	Value range (Min. Max.)	Comment
New PIN	0000 - 9999	New menu PIN
New PIN (Confirmation)	0000 - 9999	New menu PIN. Repeat to confirm.

► Select "Setup > Global settings > Access control > Change menu PIN".

6.3.3 Set interfaces

The interfaces are located on the back of the device (*see Chapter Fig. 3: , page 9*).

The menu "Interfaces" allows access to the settings for the following interfaces:

- Analog output
- Control location
- Relay
- Serial port
- Ext. Pump Setup

► Select "Setup > Global settings > Interfaces".

Analog output

Table 13: Analog output settings

Option	Value range (Min. Max.)	Comment
Channel 1	OFF	Channel 1 is switched off (0 V).
	Pressure p2	The inlet pressure p2 is output to Channel 1.
	Pressure p1	The fore-vacuum pressure p1 is output to Channel 1).
	LR mantissa	The leakage rate mantissa is output linearly from 1...10 V (e.g. 5.4 x 10^{-7} mbar l/s corresponds to 5.4V).
	LR exponent	The exponent is output as a step function: U = 1 . . . 10 V in steps from 0.5 V per decade beginning at 1 V = 1x10^{-12} (e.g. 5.4 x 10^{-7} mbar l/s corresponds to 3.5 V).
	LR linear	The leakage rate mantissa is linearly output from 1 ... 10V. The upper limit (=10 V) is specified via the setting "Scaling → upper limit" (see below). For example: 5.4 x 10^{-7} mbar l/s and upper limit 1 x 10^{-6} mbar l/s corresponds to 5.4V.
	LR log.	The output voltages are scaled logarithmically. The upper limit (=10 V) is specified via the setting "Scaling → upper limit". The increase is specified via "Scaling → V/Decade". For example: 10^{-7} mbar l/s, upper limit 10^{-6} mbar l/s and 2V/decade corresponds to an output voltage of 8V.
Channel 2	see Channel 1	analog to Channel 1
Scaling	upper limit 1E-11 . . . 1E+6	upper limit (=10 V) for setting "LR log." and "LR linear".
	V/Decade: 0.5, 1, 2, 2.5, 5, 10	Volt per decade for setting "LR log."

► Select " Setup > Global settings > Interfaces > Analog Output".

Control location**

Define the control location from which the TITANTEST™ is controlled.

Table 14: Control location settings

Option	Value range (Min. Max.)	Comment
Control location**	Local	The TITANTEST™ is controlled with the buttons START, STOP and ZERO.
	Local and RS232 / RS485	The TITANTEST™ is controlled both with the START / STOP and ZERO buttons on the device and via the RS232 / RS485 interface.
	RS232 / RS485	The TITANTEST™ is controlled by an external computer via the RS232 / RS485 interface. The START / STOP and ZERO buttons on the device are deactivated.
	All	The TITANTEST™ is controlled both with the START/STOP and ZERO buttons on the device and via the digital inputs and RS232/RS485 interface.
	PLC	The TITANTEST™ is controlled via the digital input. The START/ STOP and ZERO buttons on the device are deactivated.

► Select " Setup > Global settings > Interfaces > Control Location".

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Relay

Table 15: Relay settings

Option	Value range (Min. Max.)	Comment
Relay 1 and Relay 2	Off [1)]	Relay is always de-energized.
	Start	The relay is energized if Valve V2 opens and de-energized if Valve V2 closes.
	Stop	The relay is energized if Valve V6 opens and de-energized if Valve V6 closes.
	START / STOP	Relay is energized in measurement mode and during evacuation.
	Ready	Relay is energized in measurement mode.
	Setpoint	Relay is energized if the leakage rate exceeds the setpoint and de-energized if it falls 10% below the setpoint.
	On [1)]	Relay is always energized.
	Warning limit LR	Relay is energized if the leakage rate exceeds the warning limit.
	Bypass pump	Relay is energized if the partial flow valve of the bypass pump is switched on.
	Warning	Relay is energized if there is an unconfirmed warning message. Please note: Error messages are not signaled.
	Error	Relay is energized if there is an error message. Please note: Warning messages are not signaled.
	Warning and error	Relay is energized if there is an unconfirmed warning message or an error message.

1. The "Off" and "On" settings are suited well for testing the external relay circuit.

► Select "Setup > Global settings > Interfaces > Relay".

Serial port**

Define

- whether the RS232 or the RS485 interface should be used and which protocol for communication,
- how the RC interface is used.

Table 16: Serial port settings

Option	Value range (Min. Max.)	Comment
Interface	RS232 / RS485	Selection of whether the RS232 or the RS485 interface should be used.
Protocol	LD	LD protocol Baud rate: 19200
	Diagnosis	Interface protocol for device diagnosis. Service purposes only Baud rate: 19200
	ASCII	Interface protocol for device diagnosis. Baud rate: 19200
RC protocol	RC	Remote control protocol. Baud rate: 9600
	LD	LD protocol Baud rate: 19200

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► Select "Setup > Global settings > Interfaces > Serial port". Refer to the document "TITANTEST™ Interface Protocols" for more information about the interface protocols.

Setting the Ext. Pump Setup

You can use the "Ext. Pump Setup" function to employ and additional external partial flow pump via an external partial flow valve. The partial flow valve is controlled via

- a relay output (Option Bypass-Valve activated) or
- pin 21 of the 25-pole D-sub connection.

You can configure the control of the partial flow valve for the evacuation phase and measurement mode separately.

Table 17: Ext. Pump Setup settings

Option	Setting	Comment
Evacuation	Fore pump only	Partial flow pump not active
	Both pumps	Ideal for short evacuation time
	Ext. pump only	Prevents dirt particles from being sucked into the TITANTEST™ as well as a tracer gas contamination of the TITANTEST™ through test objects with gross leaks.)
Measure mode	Fore pump only	Partial flow pump not active
	Both pumps	– Note the pumping speed of the partial flow pump for helium. – Adjust the correction factor of the measurement. – Use an external calibration.

1. Select "Setup > Global settings > Interfaces > Ext. Pump Setup".
2. Configure the "Ext. Pump Setup" according to the table above.

6.3.4 Load/Save parameters

You can save the parameters for a measurement task. In order to set up the device for a measurement task quickly, you can load saved sets of parameters.

► Select "Setup > Global settings > Parameter load / save".

Load Para Set 1 or 2

The save date of the parameter set is displayed.

- The function "Show parameter set" lists all saved settings.
- "Load" activates the the saved parameter set following a confirmation.

Save as Para Set 1 or 2

The current parameters are saved as the indicated set name. Any parameter set saved as this name is overwritten.

Load factory settings

The factory settings are loaded.

For more information, *see Chapter : "Factory settings", page 12*.

6.3.5 Volume & Beep

⚠ WARNING

Hearing damage from excessively loud signal tones

The volume of the signal tones may exceed 85 dB(A).

- ► Keep away from the device when setting high volumes.
- ► Wear ear protection when necessary.

Minimum volume:

You can set the minimum volume. The volume may never be lower than the minimum volume. You can set the volume in the measured value display. The setting applies to the speaker in the device.

Setting range: 0 to 15

Beep Sound:

Activate or deactivate the beep sounds. The sounds signal a state change, for example.

Select "Setup > Global settings > Volume & Beep".

6.3.6 Define the Auto Test settings**

Introduction

The operating mode Auto Test is an automated test sequence with which you can test the test objects using the vacuum method.

Depending on the configuration, you can test components pre-filled with tracer gas or control a gas filling station in order to fill the test part with tracer gas during the test sequence. In addition, you can test components according to the spraying method.

The Auto Test sequence is subdivided into the following steps:

- Evacuation of the vacuum chamber
- Filling of the test object with tracer gas (if necessary) or spraying of test part
- Measurement of the leakage rate
- Venting of the vacuum chamber

If the measured leakage rate exceeds the setpoint, the device will display the message "FAIL" or "PASS" for leakage rates below the setpoint at the end of the test sequence.

Affected areas

In order to use the "Auto Test" function, make the following settings:

- Set the setpoint (*see Chapter 6.4.7: "Set the setpoint and alarm", page 47*)
- Set the "Maximum Evacuation Time" (*see Chapter 6.4.4: "Define evacuation time & vent", page 45*)
- Set the "Delay Timer"
- Set the "Test Timer"
- Set the "Background Limit"

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- Set the "Background Timer"
- Activate/Deactivate the "External Trigger"
- Select the "Rejection Type"

Delay Timer

In order to prevent the evaluation of fluctuations of the leakage rate signal after switching the sensitivity range (e.g. to ULTRA), you can set the "Delay Timer". The "Delay Timer" starts when the most sensitive measurement range is reached (*see Chapter 4.3: "Technical Data", page 10*). The test sequence continues only after the set time elapses.

In addition, you can use the "Delay Timer" to specify a minimum time for the test sequence.

1. Select "Setup > Auto Test > Auto test timer".
2. Define your settings for the "Delay Timer".

Test Timer

The response time of the leakage rate signal depends on the volume in the test chamber as well as the pumping speed of the TITANTEST™.

A partial flow pump can be used to complement the pumping speed of the TITANTEST™ if necessary (see "Setting the Ext. Pump Setup", page *37*).

1. Select "Setup > Auto Test > Auto test timer".
2. Enter the desired measuring time under "Test Timer".
   Select the measuring time in such a way that the leakage rate signal increasing over time differs clearly from the background signal.

Background Limit

In order to prevent incorrect measurements due to a high tracer gas background, set the "Background Limit". The TITANTEST™ will not start the measurement before the background signal falls below the set "Background Limit".

1. Select "Setup > Auto Test > Auto test parameters".
2. Select a "Background Limit".
   The "Background Limit must be lower than the setpoint.
   If you do not require monitoring of the background, set a very high value for the "Background Limit". This may be the case when measuring bombed test objects, for example.

Background Limit Timer

This timer limits the time the TITANTEST™ waits for the background limit. If this timer is excceded, the TITANTEST™ will stop the AutoTest cycle with warning message 163 error message.

1. Select "Setup > Auto Test > Auto test timers".
2. Define your settings for the "Background timer".

External Trigger

If you want to fill the test object with tracer gas, you can trigger a gas filling station via an output of the TITANTEST™ (pin 20 on the D-sub plug). To do this, you must enable the external trigger:

1. Select "Setup > Auto Test > Auto test parameters".
2. Select "External Trigger" and set the value to "enabled".
   After the "Background Limit" is reached, the device activates the PLC output (pin 20 on the D-sub plug).

Once the part is filled, the gas filling station used must trigger the input pin 12 on the D-sub plug of the TitanTest™. The electrical properties of the interface are described more specifically, *see Chapter 11.: "Interfaces and Protocols", page 105*.

► In order to test components already pre-filled with tracer gas, set the External Trigger to "disabled".

Define the Rejection Type

The selection of the rejection type depends on whether you would like to test the test part in a vacuum chamber or according to the spraying method.

► Select "Q last" for tests in a vacuum chamber.
The device determines the test result on the basis of the leakage rate measured at the end of the measuring time.

► Select "Q max" for tests according to the spraying method.
The device determines the test result on the basis of the maximum leakage rate measuring during the measuring time.

Overview Table

Table 18: Auto Test Settings

Option	Value range (Min. Max.)	Comment
Background Limit	Value from - to	Maximum allowed tracer gas background before beginning the measurement.
External Trigger	Disabled	No function
	Enabled	Active
Rejection type	Q last	The device determines the test result on the basis of the leakage rate measured at the end of the measuring time.
	Q max	The device determines the test result on the basis of the maximum leakage rate measuring during the measuring time.

Process diagrams

The following process diagrams show where in the Auto Test process the set values become effective.

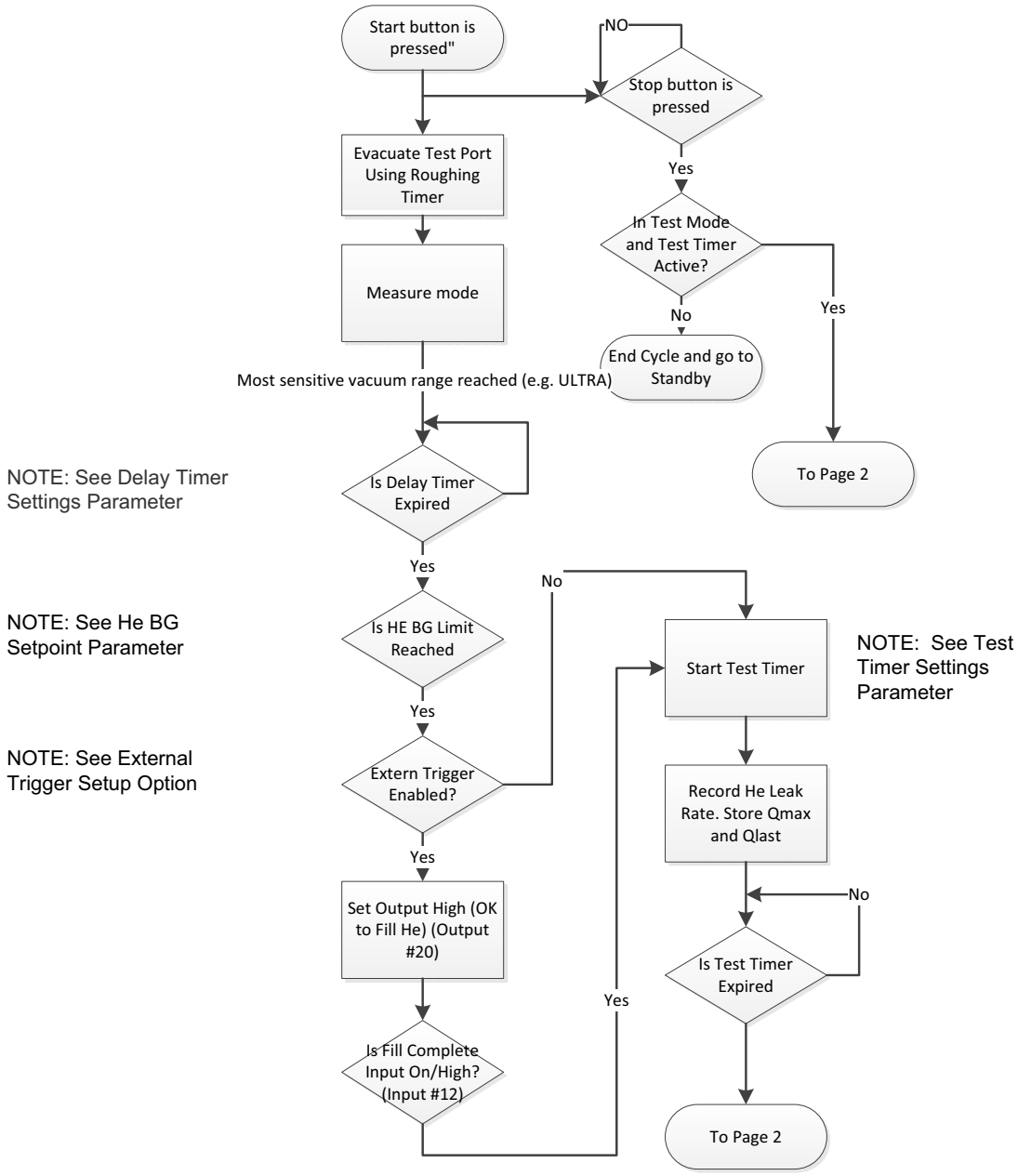


*Fig. 12: Page 1 Auto Test Process Diagram***

** Feature not available in TITANTEST™ Maintenance model

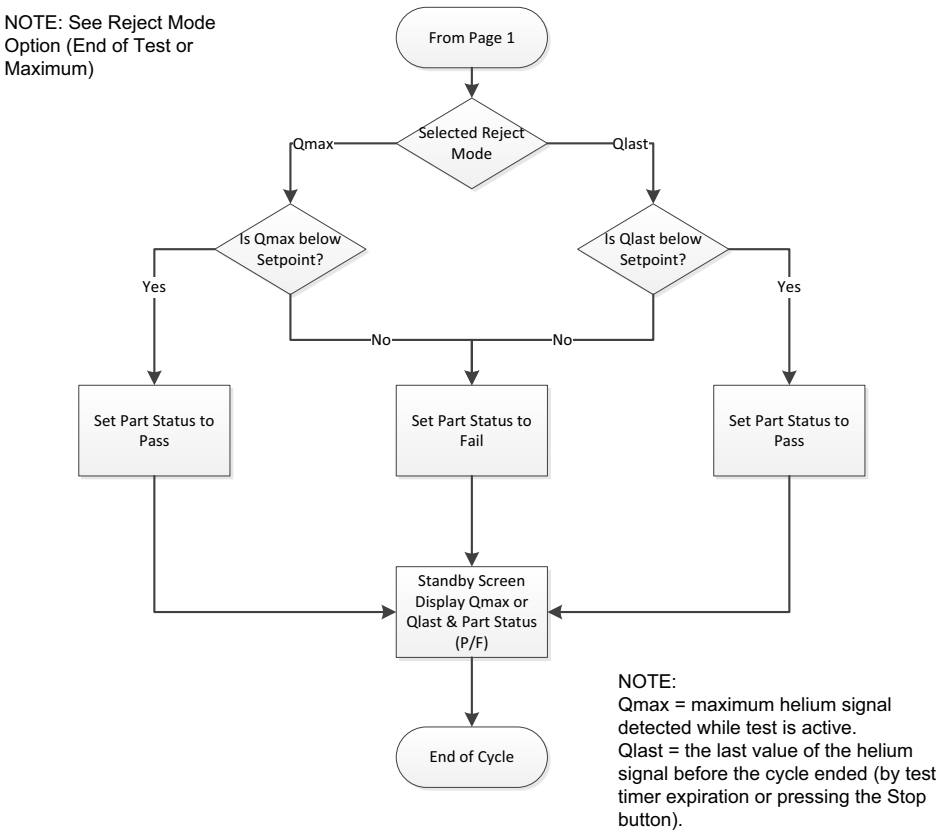


Fig. 13: Page 2 Auto Test Process Diagram

6.4 Settings for the measurements

You must set the following for the measurements:

- Mode & Mass
- Filter & ZERO
- Vacuum ranges
- Evacuation time & Vent
- Gross leak protection
- Pressure limits for sniff mode
- Setpoint and Alarm
- Calibration settings and Calibration

6.4.1 Set operating mode and mass

You can make the following settings:

- Select operating mode
- Select gas (mass)
- Set leakage rate factor

If a menu PIN is required to access the software menu, this function is inaccessible until entered.

** Feature not available in TITANTEST™ Maintenance model

Table 19: Mode & Mass

Option	Value range (Min. Max.)	Comment
Operating mode	Vacuum	Vacuum mode
	Sniff	Sniff mode Connect the sniffer line before pressing START
	Auto Test**	Auto Test mode**
Mass	H_2 (2 amu)	Detectable gas H_2
	^3H (3 amu)	Detectable gas ^3H
	^4He (4 amu)	Detectable gas ^4He
Leakage rate factor	Factor 1E-6 … 1E+6	Leakage rate converted with user-defined factor

If you use a different tracer gas for the leak search than the one used later in normal mode, you can convert the measured leakage rates (^4He, ^3He or H_2) using a leakage rate factor:

- into an equivalent leakage rate of another gas
- into an equivalent leakage rate (4He, 3He or H2) under different flow conditions than molecular flow

Under molecular flow conditions, the leakage rate only depends on the gas mass.

Select " Setup > Test Settings > Mode & Mass" and make your settings according to the table above.
Alternatively, you can switch the operating mode in the "Standby" window via "Mode select".

6.4.2 Set filter & ZERO

- The setting of the leakage rate filter influences the representation of measurement results. The setting recommended here, i.e. "Filter: dynamic", ensures that the signals are averaged in optimized time intervals, and this based on the respective leakage rate range. In addition, the filter eliminates interference peaks that have nothing to do with the leakage rate signals and offers show reaction times even with low leakage rates.
- With "ZERO" you can suppress undesired helium or hydrogen backgrounds. If "ZERO" is activated, the currently measured leakage rate value will be interpreted as a helium or hydrogen background and subtracted from all subsequently measured values.

  If the background in the device is reduced, the background value suppressed by "ZERO" is automatically adjusted.

  In order to activate the "ZERO" function, briefly press the ZERO button on the device or on the sniffer probe (*see Chapter 6.5.2: "Measuring in "Sniff" operating mode", page 53*).

  In order to deactivate the "ZERO" function, press the ZERO button on the device or on the sniffer probe for longer than 3 seconds.

** Feature not available in TITANTEST™ Maintenance model

The mass spectrometer background subtraction is set as a default. Refer to the following table for more details:

Table 20: Filter and ZERO

Option	Value range (Min. Max.)	Comment
Filter	Dynamic	Leakage rate filter with dynamic adjustment of the time constant
	Static	Leakage rate filter with fixed time constant
	None	No leakage rate filter
ZERO	Enabled	Manual background suppression enabled
	Disabled	Manual background suppression disabled
	With Start min:sec 2 s / 5 min	If the most sensitive and enabled measurement range has been reached, "ZERO" is executed after the set time.
MS-BG-Subtraction	on	The internal background is subtracted by pressing "START". The internal background is created from residual gas (e.g. helium) that has not been pumped out yet. The sources for residual gas are the air or gases absorbed from the inner surfaces of the leak detector. This background will never disappear entirely. Very clean systems that have been pumped out for a long time have a background in the range of 10^{-11} mbar l/s. Under normal conditions, a background in the range of 10^{-10} mbar l/s or a low 10^{-9} mbar l/s range can be expected. By activating "START", this currently measured internal background is automatically subtracted from all further measurements. This ensures that only the net leakage rate of the test object is measured. If the leak detector is put back into Standby/STOP mode, a new background is adopted after 25 seconds the earliest.
	off	At START the internal mass spectrometer background (MS-BG) is not subtracted. See description at "on".

► Select " Setup > Test settings > Filter & ZERO".

Information about the active background suppression is shown in the status line of the measuring screen:

Table 21: Display for background suppression

Display	Trigger
ZERO	after briefly pressing the ZERO button in the setting "enabled" or "with Start"
ZERO START	appears after the preset time elapses in the setting "with Start"

6.4.3 Set vacuum ranges

In "Sniff" operating mode, you cannot change the following settings:

Table 22: Vacuum range settings

Option	Value range (Min. Max.)	Comment
ULTRA	Enabled	Enabled
	Disabled	Disabled
	0.01 - 0.5 mbar	Pressure at which valve V4 opens
FINE	Enabled	Enabled
	Disabled	Disabled
	0.1 = 5 mbar	Pressure at which valve V3 opens
GROSS	Enabled	Enabled
	Disabled	Disabled
	0.1 = 25 mbar	Pressure at which valve V1 opens

NOTICE

Damage of turbo pump through permanent gross operation

Gross operation at 15 ... 25 mbar represents a strong load for the turbo pump.

► Avoid permanent operation in this pressure range.

- Changing the default settings may result in a considerable reduction of the performance of the device. Consult with LACO Technologies with any questions.
- Note the default settings.

► To view or change presets, select "Setup > Test settings > Vacuum ranges".

6.4.4 Define evacuation time & vent

Table 23: Evacuation and venting settings

Option	Value range (Min. Max.)	Comment
Maximum evacuation time	1s . . . 30 min, infinite	If the test object has a gross leak, the pump-down time is longer. The maximum evacuation time defines the time allowed for the test object to evacuate to a pressure of 15 mbar. If this time is exceed the pump-down operation stops and an error message is displayed.
Venting	manually	Test connection can be vented in the "Standby" window by pressing "Vent".
	with Stop	The test port is vented automatically after STOP.
	Disabled	Venting of the test port in the window "Standby" is disabled.
Background cleanup		Start-Stop cycles with short intervals for breaking down an increased helium background.

Note the following information for the menu "Evacuation time & Vent".

- In "Sniff" operating mode, you cannot change the settings described here for "Evacuation time & Vent".
- "Venting: Disabled" or "Venting: manual" prevents the unintentional venting of vacuum equipment connected to the test port.
- With the setting "Venting: Disabled", it is only possible to flood the test port by changing the settings in the menu "Evacuation time & Vent".
- With the setting "Venting: manual", you can carry out a targeted venting operation in the "Standby" window by pressing "Vent". For more information, *see Chapter 6.2.7: "Standby", page 28*, "Venting".

► To view or change presets, select "Setup > Test settings > Evacuation time & Vent".

Background cleanup

"Background cleanup" is an automatic start-stop cycle for breaking down an increased helium or hydrogen background or to prevent condensates. The function can only be started with the setting "Venting with STOP".

You can stop the background cleanup by pressing "START/STOP" or pressing "STOP" in the "Background cleanup" menu.

An active background cleanup is indicated on the display.

The background cleanup stops automatically after 60 minutes.

Pressing "Start" starts the following sequence:

- Start, Stop with Venting
- Start, Stop with Venting,
- etc.

► Select " Setup > Test settings > Evacuation time & Vent > Background cleanup".
This menu item is only available in the operating mode "Vacuum".

or

► in the "Standby" window the menu "Utilities > Background cleanup".
This menu item is only available in the operating mode "Vacuum".

With background cleanup, the same steps are carried out as in a burn-in load test without calibration (*see Chapter : "Burn-in", page 64*).

6.4.5 Set gross leak protection

If gross leak protection is activated, the TITANTEST™ closes all inlet valves as soon as the measured leakage rate exceeds the limit value. This way, only a minor amount of helium will enter the mass spectrometer, preventing the device from becoming contaminated by helium.

An external pump can pump down helium that has entered the test object. If there is no external pump available, vent the test object prior to the next measurement.

Table 24: Gross leak protection settings

Option	Value range (Min. Max.)	Comment
Protection	On	Gross leak protection is switched on
	Off	Gross leak protection is switched off
Limit value	1E-9 ... 1E+3 mbar*l/s	Switch-off limit value for the gross leak protection function

Gross leak protection is activated at the earliest once the alarm delay time elapses (*see Chapter 6.4.7: "Set the setpoint and alarm", page 47*).

► To view or change presets, select " Setup > Test settings > Gross leak protection".

6.4.6 Define pressure limits for sniff mode

The pressure limits are only defined for sniff mode (operating mode: "Sniff"). The monitoring unit of the sniffer probe uses the pressure limits.

If you call up the menu during the measurement, the current pressure is also displayed.

Table 25: Settings for pressure limits for sniff mode

Option	Value range (Min. Max.)	Comment
Min. pressure	0.1 5 . . . 0.60 mbar	The warning "Pressure too low" appears if the pressure falls below this value during measurement mode.
Max. pressure	0.25 - 0.65 mbar	The warning "Pressure too high" appears if the pressure exceeds this value during measurement mode.

To view or change presets, select "Setup > Test settings > Pressure limits for sniff mode".

6.4.7 Set the setpoint and alarm

- Define a setpoint and determine how the device is to react to certain measuring values.
- In addition, you can set an alarm delay time under "Trigger Alarm" and "Setpoint".

  In some applications (e.g. during the evacuation of a "test chamber system"), it may be expedient to suppress an alarm for a certain amount of time.

  After pressing START, the acoustic signal can be activated as soon as the leakage rate falls below the warning limit or an alarm delay time elapses or the alarm type "Prop. Leakage Rate"/"Pinpoint" or "Sniff" operating mode is set.

Table 26: Setpoint and Alarm

Option	Value range (Min. Max.)	Comment
Operating mode	Prop.Leakage Rate	The frequency of the audible signal is proportional to the bar graph display. The frequency range is 300 Hz to 3300 Hz.
	Trigger Alarm 0 min, 4.5 min	– If the leakage rate is lower than the warning limit, no tone is output. – If the leakage rate is larger than the warning limit and lower than the setpoint, a continuous tone is output. – If the leakage rate exceeds the setpoint, a multi-frequency signal is generated. The signal remains even if the leakage rate changes. You can set an alarm delay time under the display "Trigger Alarm".
	Setpoint 0 min, 4.5 min	– If the leakage rate is lower than the warning limit, no tone is output. – If the leakage rate is lower than the warning limit, no tone is output. – If the leakage rate exceeds the setpoint, a tone is output with a frequency in proportion to the leakage rate. – If the leakage rate is higher than 100*setpoint, a constant tone is output. You can set an alarm delay time under the display "Setpoint".
	Pinpoint	The frequency of the acoustic signal is proportional to the leakage rate between 0.1*setpoint and 10*setpoint. – If the leakage rate is lower than 0.1*setpoint, a constant deep tone is output. – If the leakage rate is higher than 10*setpoint, a constant high tone is output.
Setpoint	1E-12…9.9E+2mbar l/s	Alarm setpoint
Warning limit	1…100%	Warning limit as percentage of setpoint

► Select " Setup > Setpoint & Alarm" and define your settings according to the table above.

6.4.8 Define calibration settings

In this menu you can define the settings for calibration. Calibration is not introduced here.

► Select " Setup > Calibration settings".

Table 27: Calibration settings

Option	Value range (Min. Max.)	Comment
Unit	e.g. mbar*l/s	The unit for the calibration leak value. The unit for the internal calibration leak is mbar*l/s and cannot be changed.
Calibration leak value (internal/external)		Calibration leak value in the selected unit. Depending on the selected calibration mode, this is either an external or the internal calibration leak.

Table 27: Calibration settings

Option	Value range (Min. Max.)	Comment
Calibration mode	int. auto	Calibration mode internal automatic
	int. man.	Calibration mode internal manual - the signal stability must be confirmed manually.
	external	Calibration mode external.

6.4.9 Set calibration request

Specify whether TITANTEST™ displays a calibration request after the incidence of standard events.

Table 28: Calibration request settings

Option	Comment
Yes	The calibration request is carried out – 30 minutes after switching on the device. – if the temperature in the device changes by more than 5°C since the last calibration.
No	The calibration request is not carried out.

► Select " Setup > Calibration settings > Calibration Request".

6.4.10 Execute calibration

The device should be calibrated daily and after every operator change. Calibration is also required after the following events:

- Switching the operating mode
- Switching the sniffer line
- Switching the sniffer probe
- Switching between gases
- Prompt for calibration by the system

6.4.10.1 Calibrating in "Vacuum" operating mode

NOTICE

Faulty calibration when device cold

► Allow the unit to run for at least 20 minutes before performing the calibration.

► Note the recommended test interval of the calibration leak used! See the associated product description.

In "Vacuum" operating mode, the calibration of the TITANTEST™ is carried out with an internal or an external calibration leak. An internal calibration is only possible for Mass 4 (*see Tab. 19: "Mode & Mass", page 43*). The calibration mode is defined in the menu "Calibration settings" (*see Tab. 27: "Calibration settings", page 48*).

Internal calibration leak

There are two variants for calibration with the internal calibration leak (*see Chapter 6.4.8: "Define calibration settings", page 48*):

- Internal automatic:
  For calibration with the internal calibration leak without volume on the test port. The test port must be blank-flanged.
- Internal manual:
  For calibration with the internal calibration leak with volume on the test port.
  It must be confirmed that there is a stable measuring signal by pressing "Signal stable".

External calibration leak

If "Calibration mode external" is used for the calibration, a request to connect the external calibration leak appears on the display.

1. Check whether the value in the display corresponds to the value on the rating plate of the calibration leak.
   If this is not the case, change the calibration leak value in " Setup > Calibration settings > Calibration Leak & CAL mode" (*see Chapter 6.4.8: "Define calibration settings", page 48*).
2. Connect the calibration leak to the test port.
3. Open the calibration leak while rotating the calibrated leak valve.
4. Press "OK".

The preparations for the calibration with an external calibration leak are complete.

Connection of an external calibration leak for partial flow.

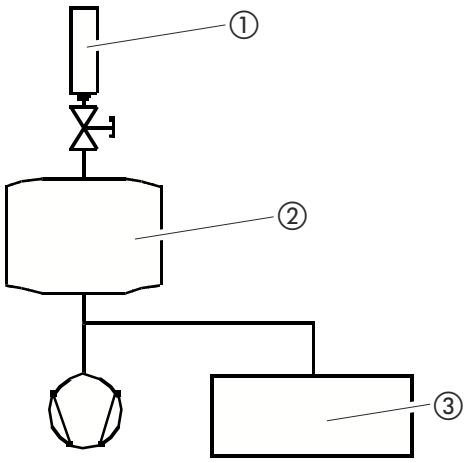


Fig. 14: Connection external calibration leak for partial flow.

① *Calibration leak*
② *Test chamber*
③ *TitanTest™*

► If TitanTest™ is connected to a vacuum system with an integrated vacuum pump, connect the calibration leak to its test container.

Calibration sequence

1. In order to start the calibration, select "Calibration" in the "Standby" window.
   The calibration progresses over multiple steps which are shown in the display. The first step is evacuation.

2. Observe the progress of the calibration routine. An action will be requested on the part of the operator depending on the calibration variant.
   Once the calibration routine is complete, the result is shown in the display.

   Typical values for the calibration factor CF for ^{4}He:

ULTRA Mode	0.1 ... 10
GROSS Mode	0.5 ... 30

   Values ranging between 0.1 and 100 are possible.

   If the overview shows a value in brackets, the calibration leak value for this measurement range is too small. The factor was calculated via an intermediate factor on the next sensitive measuring range.
3. Accept or reject the executed calibration.
   In order to accept the result, select "Save". Otherwise select "Cancel".
   If the typical values are not reached despite multiple attempts, contact your nearest LACO service point.

6.4.10.2 Calibrate in "Sniff"operating mode

Note the recommended test interval of the calibration leak used!
See also the quality test certificate for the calibration leak.

1. For an optimal calibration, allow the unit to warm up for at least 30 minutes.
2. In order to start the calibration, select "Calibration" in the "Standby" window. The display shows the request: Sniff calibration leak
3. Check whether the displayed value corresponds to the value on the rating plate of the calibration leak. If this is not the case, change the calibration leak value in the menu Calibration settings (*see Chapter 6.4.8: "Define calibration settings", page 48*).
4. Hold the sniffer probe to the calibration leak.
5. Confirm this action by pressing "Start".
6. Observe the progress of the calibration routing shown in the display. The first step is evacuation. Execute the operating steps displayed.
   Once the calibration routine is complete, the result is shown in the display.
   A typical value for the calibration factor CF for ^{4}He is: 0.1 ... 10
7. Accept or reject the executed calibration.
   In order to accept the result, press "Save". Otherwise select "Cancel".
8. If the typical values are not reached despite multiple attempts, contact your nearest LACO service point.

6.4.10.3 Check calibration with internal calibration leak

This function is available for the operating modes "Vacuum" and "Auto Test**" with Mass 4.

** Feature not available in TitanTest™ Maintenance model

The test port must be blank-flanged for this measurement.

1. Select "Standby > Utilities > Check internal calibration leak".
   The display shows the question: "Test port blank-flanged?"
2. Check whether the test port is blank-flanged. If the test port is blank-flanged, continue to the next step.
3. Press "Yes".
4. Press "START/STOP" to start the measurement of the internal calibration leak.
   The evacuation is initiated; the measurement of the internal calibration leak begins.
   The display shows the measured calibration leak value.
   The default value for the internal calibration leak (TL value) is also shown.
5. Cancel the measurement of the internal calibration leak with "Cancel".

If the measured value deviates from the target value, calibrate again.

Influences such as temperature or air pressure also have a minor effect on the results of the measurement of the internal calibration leak. Even if the absolute accuracy of the measurement system cannot be guaranteed, you can use the measurement results of the internal calibration leak as a reference.

6.5 Measuring

6.5.1 Measuring in "Vacuum" operating mode

⚠ WARNING

Risk of injury from suction on test port flange.

When in Vacuum mode, TITANTEST™ may suck in parts of the body which block the inlet flange.

- ► Always use an inlet filter.
- ► Keep parts of the body away from the inlet flange.

1. Connect any required accessories or equipment.
   Remove the blank flange on the test port and establish the connection with the test object.
2. Check whether the parameters shown in the "Standby" window apply.
   The device is ready if the display shows the "Standby" window after the run-up of the device.
   Ensure that TITANTEST™ is set to "Vacuum" operating mode.
3. In order to achieve the most precise possible measuring results, allow the device to warm up for approx. 30 minutes (*see Chapter 6.1: "Switching on the device", page 21*).

4. In order to start the measurement operation, press "START/STOP" on the control unit.
   The test object is evacuated and the pressure is displayed during the pump-down operation.
   Once the measuring pressure is reached, the measured value display appears (*see Chapter 6.5.4*).
   If the background leakage rate (< 1E-09 mbarl/s) has been reached, the test object can be pressurized with helium.
   The display shows the leakage rate of the test object.
5. Press the "START/STOP" button to stop the measurement.
   TITANTEST™ will switch back to "Standby" and the test object will be vented.
6. Separate the test object from the device.
7. Connect the next test object.

6.5.2 Measuring in "Sniff" operating mode

⚠ CAUTION

Risk of electric shock

Sucked up liquids can trigger short circuits and cause property damage or personal injury.

► Do not suck up liquids into the device.

1. Connect any required accessories or equipment.
   Ensure that a sniffer line is connected and the test port is blank-flanged.
2. Check whether the parameters shown in the "Standby" window apply.
   The device is ready if the display shows the "Standby" window after the run-up of the device.
   Ensure that TITANTEST™ is set to "Sniff" operating mode.
3. In order to achieve the most precise possible measuring results, allow the device to warm up for approx. 30 minutes (*see Chapter 6.1: "Switching on the device", page 21*).
4. In order to start the measurement operation, press "START/STOP" on the control unit.
   The measurement window is displayed.
5. In order to account for the background concentration of tracer gas and to suppress them during the measurements, hold the sniffer tip away from possible sources of gas and briefly press the "Zero" button on the device or on the button on the handle.
   For more on the "ZERO" function, *see Tab. 20: "Filter and ZERO", page 44*.
6. Hold the sniffer tip close to the possible leak source and sniff the test object.
   The tip may touch the test object.
   If you want to test a weld seam or similar, you must guide the tip along the path at a speed of less than 2.5 cm/s (1 in/s).
   When you check a spot, hold the sniffer line at it for at least 1 second.

If there is a leak, it will be shown in the display and - depending on your settings – also indicated by an acoustic signal.

6.5.3 Executing an Auto Test**

⚠ WARNING

Risk of injury from suction on test port flange

If the Auto Test function of the TITANTEST™ is activated, bodily parts blocking the inlet flange may be sucked in.

- ► Always use an inlet filter.
- ► Keep parts of the body away from the inlet flange.

1. Connect any required accessories or equipment.
   Remove the blank flange on the test port and establish the connection with the test object or test system.
2. Check whether the parameters shown in the "Standby" window apply.
   The device is ready if the display shows the "Standby" window after the run-up of the device.
   Ensure that TITANTEST™ is set to "Auto Test" operating mode.
3. In order to achieve the most precise possible measuring results, allow the device to warm up for approx. 30 minutes (*see Chapter 6.1: "Switching on the device", page 21*).
4. In order to start the measurement operation, press "START/STOP" on the control unit.
   The test object is evacuated and the pressure is displayed during the pump-down operation.
   Once the measuring pressure is reached, the measured value display appears (*see Chapter 6.5.4*).
   TITANTEST™ automatically executes a stored test procedure.
5. Once the "Test timer" elapses, the test sequence ends automatically. By pressing the "START/STOP" button, you can end the test sequence prematurely.
   The display will then show the "Standby" window and the result of the test.
6. Switch the test object.
7. Press the "START/STOP" button to start another Auto Test.

6.5.4 Measured value display

Once the measurement pressure is reached, the measured value display appears with the last used display type:

- Analog/digital with bar graph and large-format numbers or
- Graphically as a function of measuring time

** Feature not available in TITANTEST™ Maintenance model

► You can switch between the analog/digital display and the graphic display using the lower right button. This button alternately shows the analog display symbol and the graphic display symbol.

For more information, *see Chapter 6.2: "Operating the device", page 22*.

6.6 Calling up information about the device

Various information about the state of the device can be called up. The information is shown on the display in the form of lists or graphs.

► Select "Setup > Information".

The menu allows you to access the following information:

- Settings
- System data
- Vacuum diagram
- Error list
- Calibration history

You can also locate the installed remote control by means of an audible signal via "Setup > Information > Paging function".

Settings

The current settings of the device are listed in this menu.

The settings cannot be changed here.

► Select "Setup > Information > Settings".

System data

The menu lists the current system data. The information is subdivided according to subject on the following pages:

- PUMPS
- MASS SPECTRO.
- TEMP.& PRESSURES
- MISC.
- SERIAL COMM.
- DIGITAL INPUTS
- DIGITAL OUTPUTS

► Select "Setup > Information > System data".

Vacuum diagram

The graphic representation of the measurement system shows

- the current switching status of the valves
- the background value
- the backing pump pressure at the input of the backing pump (p1) and at the test port (p2) measured by the gages

► Select "Setup > Information > Vacuum diagram".

Error list

The error list shows the last 12 reported errors.

For each error, the data and time, the error message number, and part of a comment are displayed. One of the error messages is always selected. You can move the selection up or down using buttons next to the arrow sym-

bols. You can call up the complete message for the selected error message by pressing 🔍. This contains both the error description and information as to possible causes and remedies.

► Select "Setup > Information > Error list".

Calibration history

The calibration history shows the date, time, tracer gas, and the calibration factor for the last 12 calibrations. Additional details are stored for the calibrations.

In order to view details about a calibration, proceed as follows:

1. Select "Setup > Information > Calibration history".
2. In order to select a certain calibration, use the buttons next to the symbols ↑ or ↓ to move the selection to the respective calibration.
3. In order to display the complete message, select 🔍.

Paging function

You can use the paging function to locate an activated wireless remote control. An acoustic signal will assist you in finding the remote control.

1. Select "Setup > Information > Paging function".
2. Switch the paging function on or off. If the paging function is switched on, the remote control will issue an acoustic signal.

6.7 Switching off the device

You can switch off the TITANTEST™ at any time with the mains plug.

The parameters set in the TITANTEST™ are saved.

A controlled vent valve connected to the exhaust of the turbo pump allows the turbo pump to spin down quickly after shut down by letting a specific amount of air entering the pump. If need be, the TITANTEST™ leak detector can then be moved around within a minute after shut down.

The tradeoff of this feature is the helium background after start-up.

During the vent, the high vacuum side of the unit (turbo pump and analyzer cell) will in-gas from the air flow getting into the unit creating a high helium background (10^{-9} atm.cc/sec range).

For demanding applications where the leak rate requirements is below 10^{-9} atm.cc/sec, we recommend to have the vent valve disconnected.

7. Warning and error messages

Malfunctions are displayed by warnings and error messages.

Warnings indicate problems, but measurements generally remain possible. In the case of error messages, measurements can no longer be made.

Warnings and error messages signal an alarm tone whose frequency switches between 500Hz and 1200Hz every 400ms. In addition, a message is displayed. A warning or error message consists of a number and a descriptive text.

If you press the "OK" button on the lower right in the window with the message, the device is restarted.

The following tables display all the warning and error messages. It lists possible causes for the malfunction and instructions on how to eliminate these.

7.1 Warning messages

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

Table 29: Warning messages

No.	Message	Possible error sources
W69	TMP fault	– - Untreated error message of the turbo molecular pump. More information about the error number can be found in the instructions for the turbo molecular pump.
W101	Real-time clock was reset! Please enter date and time.	– Battery on the MC 68 control board discharged / defective – MC 68 changed
W102	Please recalibrate!	– The automatic calibration prompt is activated and one of the following conditions is fulfilled: – 30 minutes have expired since switching on the leak detector – The pre-amplifier temperature has changed by more than 5 °C since the last calibration – The mass setting has changed – The filament was switched – After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected.
W103	Flow through capillary is too low!	– Filter in filter tip clogged – Sinter filter in filter tip soiled – Capillary clogged by dirt – Lower flow limit set incorrectly – After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected. "Standby".
W104	Capillary broken	– Capillary broken or torn – Upper flow limit set incorrectly – After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected.
W105	Global Reset	– A global reset has been performed.

Table 29: Warning messages (Contin.)

No.	Message	Possible error sources
W106	Default settings loaded!	– The factory settings have been loaded by the instrument software.
W107	Service interval expired!	– Service interval 5000 hrs. reached – Service the fore pump – Service the TMP
		– After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. When maintenance is complete, the service interval can be reset under ”maintenance & service“ ’ (device - maintenance interval)
W108	ZERO function is disabled.	– The "ZERO" function has been disabled in the setting menu, but was activated via the PLC input.
W109	Pre-amplifier signal too high (>10V)	– The pre-amplifier signal is overmodulated in the least sensitive measurement range. – Pre-amplifier defective – Mass spectrometer heavily soiled
W120	Time-out during calibration	– Pressure threshold for following measuring range is not reached within the set time limit. The time limit is specified by the set maximum evacuation time in the setup menu.
W121	The calibration leak signal is too small!	– The calibration leak used for the calibration is too small. – The external calibration leak valve is not open or defective. – Internal calibration leak defective
W122	Signal not steady during calibration!	– Leakage rate signal too small and noisy – Internal calibration leak defective – Fore pump with heavily unstable end pressure
W123	Peak out of tuning range!	– Leakage rate signal was unstable during the mass adjustment. Re-calibrate. – Check internal calibration leak and repeat the calibration with an external calibration leak.
W124	Signal difference between opened and closed calibration leak is too small.	– Internal calibration leak defective. – The external calibration leak valve is defective or not closed. – The calibration leak used for the calibration is too small.
W125	Calibration factor too low	– The calculated calibration factor is outside the permissible range (< 0.1). The old factor is retained. – The calibration leak is defective. – The leakage rate value entered for the calibration leak is much too small. – The conditions necessary for calibration have not been satisfied.
W126	Calibration factor too high!	– The calculated calibration factor is outside the permissible range (> 100). The old factor is retained. – The calibration leak is defective or empty. – The calibration leak value entered for the calibration leak is too great. – Mass spectrometer soiled and non-sensitive. – The conditions necessary for calibration have not been satisfied.
W130	Pre-amplifier temperature is too low. (<2 °C)	– The ambient temperature is too low. – The temperature sensor in the pre-amplifier is defective. – Pre-amplifier cable is defective. – After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected.

Table 29: Warning messages (Contin.)

No.	Message	Possible error sources
W131	Pre-amplifier temperature is too high. (>60 °C)	– The ambient temperature is too high. – The air filter is soiled. – Heat build-up due to unfavorable position – Temperature sensor in the pre-amplifier defective.
		– After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected.
W132	Temperature at electronic unit is too low (<2 °C).	– Ambient temperature too low – Temperature sensor is defective.
		– After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected.
W133	Temperature at electronic unit is too high! (>55 °C)	– The ambient temperature is too high. – Unfavorable position of the leak detector. (heat build-up) – Fan failed. – Air filter too heavily contaminated. – Temperature sensor defective. – After the confirmation of this warning a warning triangle remains in the "Standby" menu, which signals the existence of this interruption. The warning triangle disappears as soon as this interruption has been corrected.
W135	Emission for filament 1 cannot be switched on.	– Filament 1 defective – Defective ion source connector or cable. – MSV board defective.
W136	Emission for filament 2 cannot be switched on.	– Filament 2 defective – Defective ion source connector or cable. – MSV board defective.
W140	EEPROM write timeout	– The write command from the MC 68 to the EEPROM was not acknowledged. – E-EPROM defective. – Error on wiring board – MC 68 defective.
W141	EEPROM parameter queue overflow	– Software problem. Please contact LACO service department!
W142	All EEPROM parameters lost! Please check your settings!	– EEPROM on wiring board is empty and was initialized with default values. All parameters must be re-entered or determined. – If the warning occurs again after switching back the leak detector, the EEPROM on the wiring board is probably defective. – Wrong EEPROM type used. – New EEPROM is used.
W143	x EEPROM parameters lost! Please check the settings!	– Missing or invalid parameter value in the EEPROM after switching on the leak detector. – EEPROM cannot be described. EEPROM defective. – MC 68 control board defective – Line connection to EEPROM broken – Wrong EEPROM type used
W145	x EEPROM parameters initialized! Please check the settings!	– Missing or changed parameter in the EEPROM and new software version number determined. – A software update has been performed and one or more new parameters determined. The message can be acknowledged in this case. The parameter(s) is (are) automatically initialized.

Table 29: Warning messages (Contin.)

No.	Message	Possible error sources
W160	Leakage rate too high! Switch made to Standby to prevent contamination!	– The monitor function "Gross leak protection" is activated and a leakage rate above the set limit value has been detected. – Gross leak. – Switch-off limit value too low. – Alarm delay set too short.
W161	Maximum evacuation time exceeded!	– Within the set evacuation time the "measure" mode has not been reached. – Evacuation time is adapted incorrectly to the volume of the test object. – The test object has a gross leak. – Switching pressures set incorrectly.
W162	Excessive increase in inlet pressure p2 during AUTO-TEST!**	– Gross leak – AUTO TEST** delay time is too short

7.2 Error messages

Errors are events that the device cannot correct itself. Errors force an interruption in operation.

Table 30: Error messages

No.	Message	Possible error sources
E21	Suppressor voltage reference value too high.	– The suppressor voltage has been affected by a short circuit. – MSV is defective.
E22	Setpoint of anode potential too high!	– Brief increase in pressure in the mass spectrometer. – Valve contaminations cause high mass spectrometer pressure. – The anode voltage is short-circuited. – The nominal value for the anode voltage is too high. The anode voltage is limited to 1,200 V.
E24	24V voltage at MSV board is too low!	– Fuse F1 on the MSV board is blown. – MSV board defective – 24 V supply voltage from power supply unit too heavily stressed or faulty.
E25	Filament current is too high!	– MSV board defective.
E26	Filament current is too low!	– MSV board defective – Defective ion source connector or cable.
E27	Emission fail	– Inrush of air – Valves contaminated – Failure of a filament during measurement
E28	Emission for both filaments cannot be switched on!	– Both filaments defective. Replace ion source. – Defective ion source connector. – MSV board defective
E29	The anode potential has risen above the set-point by over 10%.	– MSV is defective. – MC 68 defective
E30	The anode potential has dropped below its nominal value by over 10%.	– Brief increase in pressure in the mass spectrometer. – MSV is defective. – MC 68 defective

** Feature not available in TitanTest™ Maintenance model

Table 30: Error messages

No.	Message	Possible error sources
E31	Anode/cathode voltage is too high!	– Anode/cathode voltage is greater than U > 130 V. – MSV is defective..
E32	Anode/cathode voltage is too low!	– Anode/cathode voltage is less than U < 30 V. – Fuse F4 on MSV board defective – MSV is defective.
E33	Suppressor potential too high.	– Suppressor potential is greater than 363V. – MSV is defective
E34	Suppressor potential too low.	– Suppressor potential is less than U < 297 V. – Short circuit in the suppressor line. – MSV is defective. – High ohmic short circuit in the ion collector.
E35	24V on OPTION output is too high	– The 24 V voltage for the external outputs I/O; RS 485 is too high. (U> 30 V) – Check the external feed of the 24 V outputs. – Power supply unit defective
E36	24V on OPTION output is too low	– The 24 V voltage for the external outputs I/O; RS 485 is too low. (U< 20 V) – Fuse F1 on I/O board defective. – Power supply unit defective
E37	24V voltage on the remote control is too low (<20V)	– The 24 V voltage for the external outputs RC and fans 1+2 is too low. (U< 20 V) – Fuse F2 on I/O board defective. – Power supply unit defective
E39	Temperature at electronic unit is too high! (>60°C)	– The ambient temperature is too high. – Unfavorable position of the leak detector. (heat build-up) – Fan failed. – Air filter too heavily contaminated. – Temperature sensor defective.
E41	TMP frequency is too low!	– The target speed (1,450 Hz) of the turbo molecular pump (TMP) was not reached within 5 min. – The foreline pressure is too high. – Turbo molecular pump is defective. – Electronic drive unit TC 110 is defective.
E42	Emission off (p1 too high)	– Inrush of air – Valve V1 leaking.
E43	Emission off (p2 too high)	– Emission is switched off during normal operation of the leak detector when the pressure – in GROSS with p2 > (pressure limit GROSS + 5mbar) or – in FINE with p2 > (pressure limit FINE + 1mbar) or – in ULTRA with p2 > (pressure limit ULTRA + 0.1mbar).
E52	Inlet pressure p2 too low!	– The output voltage of pressure measuring point P2 is too low – Check cable to Pirani sensor – Pirani sensor defective – Sensor electronics I/O board defective
E54	Foreline pressure p1 too low!	– The output voltage of pressure measuring point p1 is too low – Check cable to Pirani sensor – Pirani sensor defective – Sensor electronics I/O board defective

Table 30: Error messages

No.	Message	Possible error sources
E56	p1 > 10 mbar after run-up	– The fore-vacuum pressure p1 after 5 min. in run up is > 10 mbar – Fore pump defective – Leaks in the vacuum system – Valve V1 does not open
E60	TMP frequency too high (E001)!	– Rated speed of 1,500 Hz exceeded by 5 %. – Check connecting cable, restart leak detector – TC 110 defective
E61	TMP power supply faulty (E002)!	– Error detected in the power supply unit TC 110. – Power supply unit defective (electronic drive unit TMP)
E62	TMP start-up time error (E006)!	– Speed of the TMP is below the speed switching point < 1,200 Hz 15 min. after starting. – Turbo pump bearing damage – TC 110 defective
E63	TMP connection TC to pump faulty (E008)!	– TMP connection between TC 110 and TMP defective – Check proper assembly of TC 110 on TMP – TC 110 defective
E64	TMP controller TC faulty (E015)!	– TMP controller TC 110 detected as defective. – Exchange TC 110
E65	TMP wrong resistor (E021)!	– TMP controller detects wrong pump rated resistance – Exchange TMP
E66	TMP motor control defective (E037)!	– The control of the TMP motor is defective. – Exchange TMP – Exchange TC 110
E68	No communication with turbo pump.	– No communication via the RS 485 between TC 110 and MC 68 control board – Connection faulty or not plugged TC 110 – wiring board – TC 110 defective – MC 68 defective
E70	The offset voltage of the pre-amplifier is too high. (>5 mV)	– The pre-amplifier is defective. – Defective supply voltage pre-amplifier
E71	TMP temperature control faulty	– Short circuit in the temperature sensor
E72	TMP temperature sensor faulty	– Temperature sensor broken

8. Maintenance, Cleaning and Service

8.1 Important instructions

⚠ CAUTION

Risk of injury from improper maintenance work

► Maintenance work on the TITANTEST™ may only be performed by personnel who have been authorized by LACO Technologies to execute these tasks.

- When handling the gases used, comply with the applicable regulations and safety measures.
- The inert gas, helium, has an asphyxiating effect in large concentrations.
- The test objects and the gas fittings must be capable of withstanding the existing pressure differential.
- For repair, sent-in products must be free of pollutants, (e.g. radioactive, toxic, or caustic or biological substances). Otherwise the type of contamination must be declared.
- The mains filter, the power supply unit, the wiring board and the backing pump contain parts that are supplied with a voltage of 50 V. During servicing, therefore, it is necessary to always pull the mains plug before opening the device.
- Prevent the contamination of the vacuum area.
- 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 protective measures, warranty claims may no longer be applicable.
- LACO Technologies does not accept responsibility and warranty claims
  - if the device is converted,
  - if the device is operated with accessories that are not listed in the associated product documentation.

8.2 Cleaning the housing

⚠ 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. Make sure that the electric power supply is reconnected with authorization.

► Wipe the housing with a soft damp cloth.

► Use only water to moisten. Avoid cleaners that contain alcohol, fat or oil.

8.3 Information sources

8.3.1 List of documents

For additional information on the below items see TITANTEST™ USB drive.

- Operating instructions UNO 006 A
- Operating instructions SplitFlow 80
- TITANTEST™ accessories

8.3.2 Calling up maintenance information

The device provides information for maintenance.

You can find an overview of the stored information in "Maintenance & Service".

► Select "Setup > Maintenance & Service".
In case the menus described in the following are not visible, maintenance is not enabled. See "'Setup > Access control > Maintenance enabled".

Maintenance device

The operating hours of the device and the operating hours since the last maintenance work are displayed.

► Select "Setup > Global settings > Maintenance & Service > Maintenance device".

► In order to count the hours of operation after completion of maintenance starting with "0", set the device maintenance interval counter to "0" by pressing the "Device" button.

The specification "Operating hours device" cannot be changed.

Maintenance warning

If you wish to allow or disable the display of maintenance messages, proceed as follows:

1. Select "Setup > Global settings > Maintenance & Service > Maintenance message".
2. In order to allow the display of maintenance messages, select "Yes", otherwise "No".
3. Save your setting.

Burn-in

You can carry out a load test which starts an automatic start-stop cycle.

In the menu "Setup > Test settings > Evacuation time & Vent", the option "with Stop" must be set for "Venting" (*see Chapter 6.4.4: "Define evacuation time & vent", page 45*).

1. Select "Setup > Global settings > Maintenance & Service > Burn-in".
2. Make sure the test port is blank-flanged.

3. Start the load test either with the function "Start without calibration" or "Start with calibration".
   The active burn-in process is reported in the display.
4. To stop the process, press the button "Start/Stop".

Table 31: Burn-in process

Option	Comment
Start with calibration	Start of following sequence: – Calibration, Stop, Start – Venting, Start, Stop – Venting, Start, Stop – Venting, Start, Stop – Venting, Start, Stop – Calibration, Start, Stop etc.
Start without calibration	Start of following sequence: Venting, Start, Stop, etc.

Maintenance components

The hours of operation since the last maintenance are listed for the components fore pump, turbo pump, and ion source.

► Select "Setup > Global settings > Maintenance & Service > Maintenance components".

► In order to reset the interval counter for the respective component after maintenance, press the desired button, i.e. "Fore pump", "Turbo pump", or "Ion source".
A new entry is written in the maintenance interval list.

Maintenance interval list

The maintenance interval list shows the date/time of the last maintenance for the individual components. It also lists the operating hours of the components since their last maintenance.

► Select "Setup > Global settings > Maintenance & Service > View maintenance interval list".

Service

The Service menu is intended exclusively for service technicians. Access to it is protected by a service PIN. The service PIN cannot be changed.

After entering the correct service PIN, the Service menu may be accessed.

► Select "Setup > Global settings > Maintenance & Service > Service".

8.3.3 Maintenance and service schedule

Table 32: Maintenance and service schedule

ITEM	TASK	OPERATING HOURS/WEEKS				PART(S) REQUIRED	PART NUMBER(S)	Ref. Chapter
		160	8600	17200	34400			
		1	52	104	208			
Rouging Pump	Check oil level	x				Vacuum Pump Oil	LVOEZ1QT	*8.4.3.1* *8.4.3.2* *8.4.3.3*
(Oil Units, Wet Series)	Rebuild				x	Maintenance Kit	T10065	
Oil Mist Filter (M-Series) Oil Mist Filter (P-Series)	Check	x				Oil Mist Filter	T10025-M T10025-P	*8.4.4.1*
Oil Mist Filter (M-Series) Oil Mist Filter (P-Series) (Devices with oil sealed backing pump)	Replace		x			Oil Mist Filter	T10025-M	*8.4.4.2*
Turbo Pump Split Flow 80	Replace Oil Wick SplitFlow 80			x		Turbo Pump Maint. Kit	T10004	*8.6.1.1*
Valve Block	Clean/Rebuild			x		LD Seals Kit	T10040	*8.6.2.1*
						Valves Rebuild Kit	T10052	
Cooling Fan Filter	Clean/Replace		x			Cooling Fan Filter	T10023	*8.6.3.1*

8.4 Maintenance work (M-Series only)

⚠ 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 prior to any maintenance work. Make sure that the electric power supply is reconnected with authorization.

⚠ CAUTION

Danger from improper maintenance work

- ► Maintenance work on the device may only be performed by personnel who have been authorized by LACO Technologies to execute these tasks.

NOTICE

Contamination of the vacuum area

- ► For all tasks in this area, wear clean, lint-free gloves.
- ► Use clean tools.

8.4.1 The system at a glance (M-Series only)

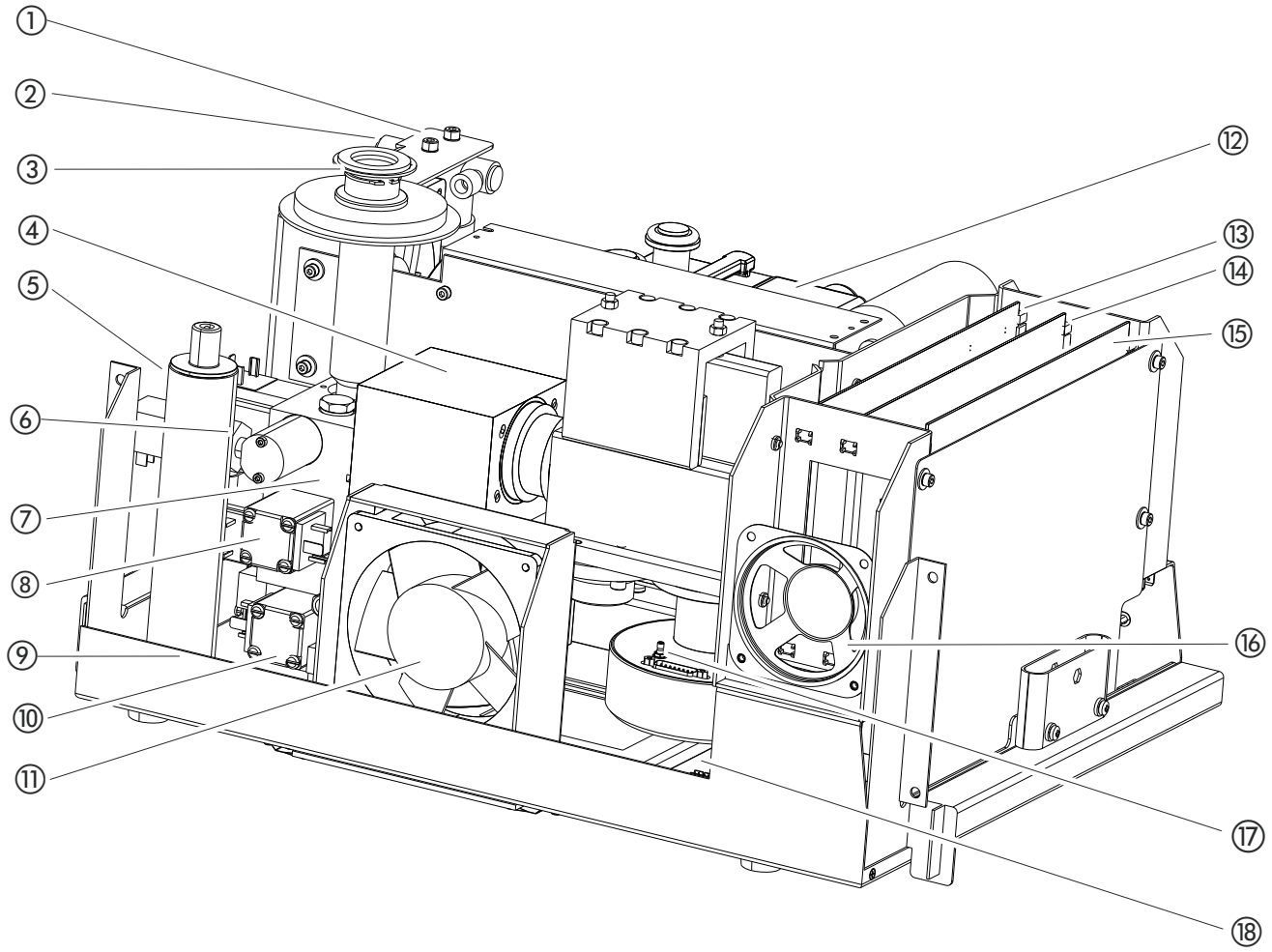


Fig. 15: TitanTest™

Table 33: The system at a glance

Pos.	description	Pos.	description
1	Holder - fan 2	10	Valve V1
2	Oil mist filter (M-Series)	11	Fan 1
3	Test port	12	Backing pump UNO 006A
4	Turbo pump SplitFlow 80	13	I/O printed circuit board
5	Calibrated leak	14	MC 68 printed circuit board
6	Calibrated leak valve V5	15	MSV printed circuit board
7	Valve block	16	Speaker
8	Valve V2	17	Electrometer amplifier
9	Valve V3	18	Wiring board

8.4.2 Removing the cover (M-Series only)

For a variety of purposes you have to remove the cover of the device.

► Loosen the cover on the left and right side using an 8 mm Allen wrench.
Note to open the lock on both sides twist towards the back of the device.

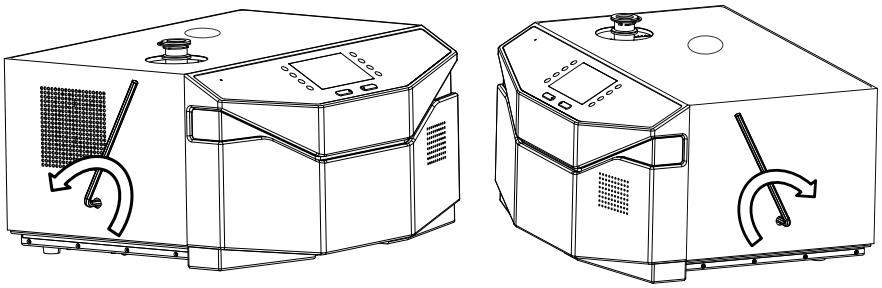


Fig. 16: How to remove the cover

After the maintenance replace the cover and secure it with an 8 mm Allen wrench by turning it in the other direction.

8.4.3 Backing pump (M-Series only)

Maintenance work for devices with oil-sealed backing pump:

- TITANTEST™ Wet Series

8.4.3.1 Check oil level from outside

► Check oil level every week.

1. Look at the oil sight glass (back) to check the oil level and discoloration of the oil in the UNO 006A.
   The oil level must be at least 2 mm over the lower edge of the oil sight glass.

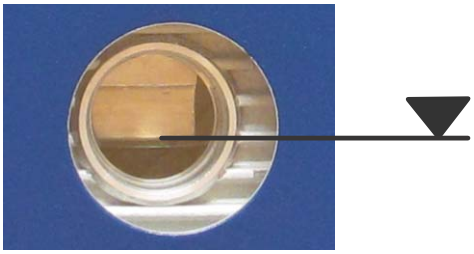


Fig. 17: Oil sight glass on the back of TitanTest™

2. If the oil level is lower, replenish the oil (see below).
3. If the oil is discolored, change the oil (*see Chapter 8.4.3.3: "Change the oil (M-Series only)", page 70*).

8.4.3.2 Replenish the oil (M-Series only)

Required material: Pump Oil, 1 qt. Ordering no. LVOEZ1QT

1. Switch the device off at the mains plug.
2. Pull out the mains plug.

3. Loosen the cover on the left and right side using an 8 mm Allen wrench, *see Chapter 8.4.2: "Removing the cover (M-Series only)", page 69*.
4. Lift off the cover.
5. Loosen the grounding cable.
6. Perform a visual inspection of the oil level and discoloration of the oil in the UNO 006A.
7. If the oil level is below the minimum mark, remove the oil drain plug using a screwdriver, fill the oil to the max. mark and screw in the oil drain plug again.
8. Should the oil be strongly discolored, change the oil (see below).
9. Connect the grounding cable.
10. Replace the cover and secure it with an 8 mm Allen wrench on the left and right side.
11. Insert the mains plug again.

8.4.3.3 Change the oil (M-Series only)

► Change the oil annually.

Required material: Pump Oil P3, 0.5 l Ordering no. T10067

1. Switch the device off at the mains plug.
2. Pull out the mains plug.
3. Loosen the cover on the left and right side using an 8 mm Allen wrench, *see Chapter 8.4.2: "Removing the cover (M-Series only)", page 69*.
4. Lift off the cover.
5. Loosen the grounding cable.
6. Remove the oil drain plug with a screwdriver.
7. Keep an oil collection container ready and point the oil drain hose to the container.
8. Use a 13 mm open-ended wrench and 5 mm Allen wrench to loosen the lock screw at the oil drain hose and drain the oil.
9. Screw in the oil drain plug slightly, insert the mains plug again, and allow the pump to run for 5 to 10 s to drain the remaining oil.
10. Disconnect the mains plug again.
11. Use a 13 mm open-ended wrench and 5 mm Allen wrench to replace the lock screw at the oil drain hose.
12. Remove the oil drain plug again and fill in 0.4 l (13.5 fl oz) of fresh oil using a funnel.
13. Replace the oil drain plug.
14. Connect the grounding cable.
15. Replace the cover and secure it with an 8 mm Allen wrench on the left and right side.

16. Insert the mains plug again.
17. Dispose of old oil as stipulated by local regulations.

8.4.4 Oil mist filter (M-Series only)

Maintenance work for devices with oil-sealed fore pump UNO 006A:

- TITANTEST™ TW Series

8.4.4.1 Check and empty the oil mist filter and clean the oil pan (M-Series only)

You may combine the work steps described here with refilling or changing oil for the UNO 006 A (*see Chapter 8.4.3.2: "Replenish the oil (M-Series only)", page 69* or *see Chapter 8.4.3.3: "Change the oil (M-Series only)", page 70*).

1. Switch the device off at the mains plug.
2. Pull out the mains plug.
3. Loosen the cover on the left and right side using an 8 mm Allen wrench (*see Chapter 8.4.2: "Removing the cover (M-Series only)", page 69*).
4. Lift off the cover.
5. Loosen the grounding cable.
6. Perform a visual inspection of the transparent plastic cylinder.
7. If there is oil in the plastic cylinder, unscrew the plastic cylinder by hand in a counter-clockwise motion. Dispose of the collected oil as stipulated by local regulations.
8. Screw the plastic cylinder back in.
9. Clean the oil pan with a lightly alcohol-soaked cloth.
10. Connect the grounding cable.
11. Replace the cover and secure it with an 8 mm Allen wrench on the left and right side.
12. Insert the mains plug again.

8.4.4.2 Replace the filter of the oil mist filter (M-Series only)

► Replace the filter annually.

Required material: Oil Mist Filter Cartridge Ordering no. T10025

1. Switch the device off at the mains plug.
2. Pull out the mains plug.
3. Loosen the cover on the left and right side using an 8 mm Allen wrench (*see Chapter 8.4.2: "Removing the cover (M-Series only)", page 69*).
4. Lift off the cover.
5. Loosen the grounding cable.
6. Unscrew the plastic cylinder by hand in a counter-clockwise motion. Dispose of the collected oil as stipulated by local regulations.
7. First wipe the filter retaining screw with a dry cloth, then loosen the filter retaining screw by hand and remove the filter.
8. Attach the spare filter to the retaining screw and replace the retaining screw with the filter.

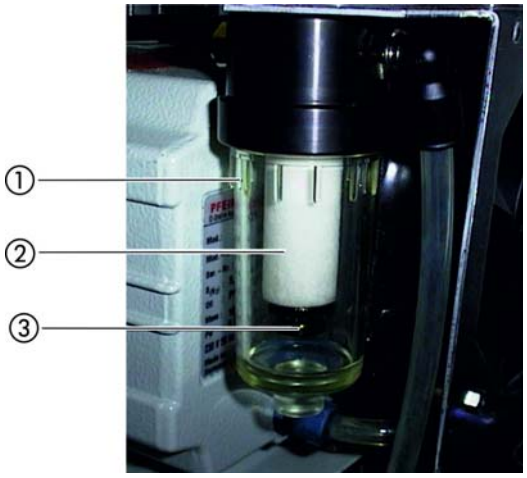


Fig. 18: Replacing the filter for the oil mist filter

① *Plastic cylinder*
② *Filter*
③ *Filter retaining screw*

9. Screw the plastic cylinder back in.
10. Re-connect the grounding cable.
11. Replace the cover and secure it with an 8 mm Allen wrench on the left and right side.
12. Insert the mains plug again.

For further maintenance steps *see Chapter 8.6: "Maintenance work further steps (All Series)", page 78*.

8.5 Maintenance work (P-Series only)

⚠ 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 prior to any maintenance work. Make sure that the electric power supply is reconnected with authorization.

⚠ CAUTION

Danger from improper maintenance work

- ► Maintenance work on the device may only be performed by personnel who have been authorized by LACO Technologies to execute these tasks.

NOTICE

Contamination of the vacuum area

- ► For all tasks in this area, wear clean, lint-free gloves.
- ► Use clean tools.

8.5.1 The system at a glance (P-Series only)

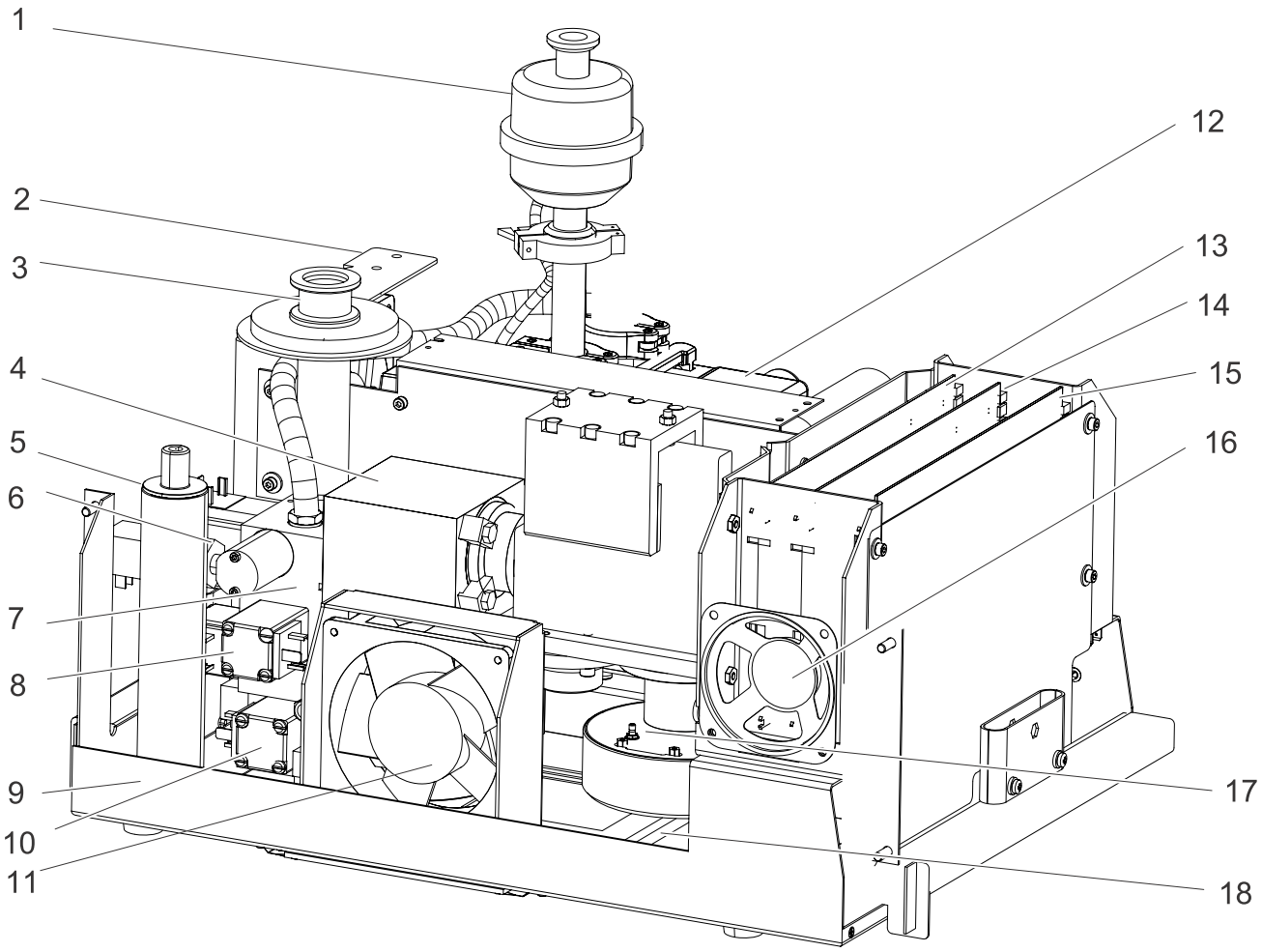


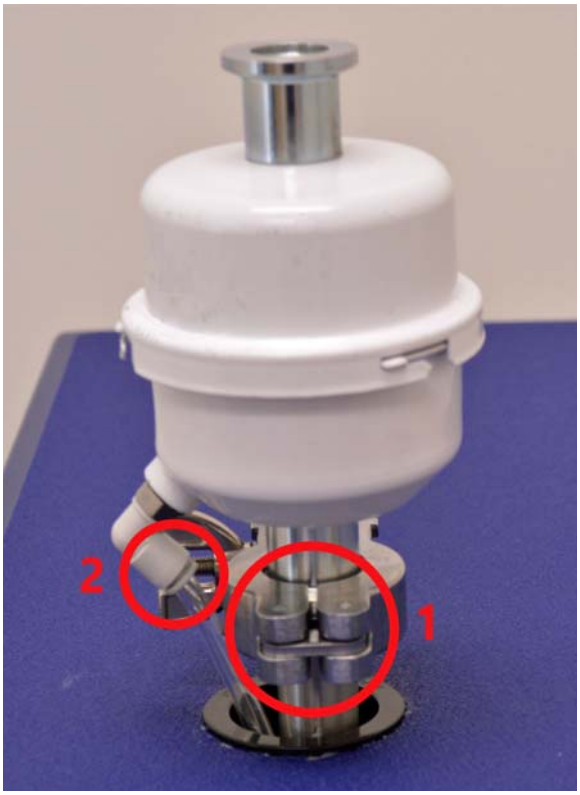
Fig. 19: TITANTEST™

Table 34: The system at a glance

Pos.	description	Pos.	description
1	Oil mist filter (P-Series)	10	Valve V1
2	Holder - fan 2	11	Fan 1
3	Test port	12	Backing pump UNO 006A
4	Turbo pump SplitFlow 80	13	I/O printed circuit board
5	Calibrated leak	14	MC 68 printed circuit board
6	Calibrated leak valve V5	15	MSV printed circuit board
7	Valve block	16	Speaker
8	Valve V2	17	Electrometer amplifier
9	Valve V3	18	Wiring board

8.5.2 Removing the cover (P-Series only)

For P-Series devices, the external oil mist filter must be removed before removing the cover.



- ► Disassemble the oil mist filter housing from the KF flange (1).
- ► Disconnect the 6 mm drain tube from the mist filter drain fitting (2).
- ► Loosen the cover on the left and right side using an 8 mm Allen wrench. Note to open the lock on both sides twist towards the back of the device.

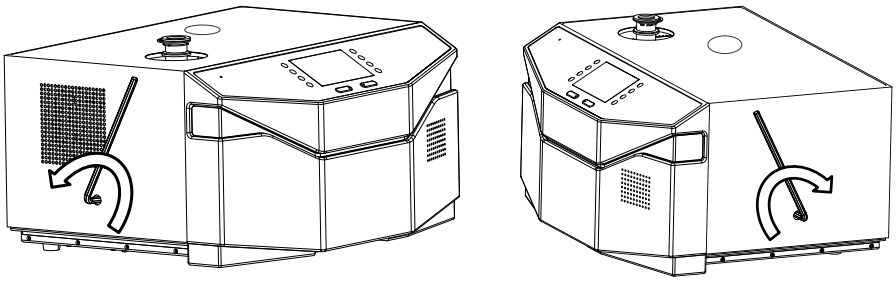


Fig. 20: How to remove the cover

After the maintenance replace the cover and secure it with an 8 mm Allen wrench by turning it in the other direction.

8.5.3 Backing pump (P-Series only)

8.5.3.1 Check oil level from outside

It is the same procedure as the M-Series, *see Chapter 8.4.2, page 69*.

8.5.3.2 Replenish the oil (P-Series only)

New oil can be filled through the oil mist filter extension tube.

8.5.3.3 Replenish or Change the oil (P-Series only)

For P-Series units, it is not necessary to remove the cover to change the oil.

The oil can be drained through the oil drain port and filled through the oil mist filter extension tube.

- ► Remove the external oil mist filter, *see Chapter 8.5.2: "Removing the cover (P-Series only)", page 75*.
- ► To replenish the oil, fill in new oil in the mist filter extension tube.
- ► To remove the oil, first remove the drain plug with a 6 mm Allen wrench and pass the oil through a hose.

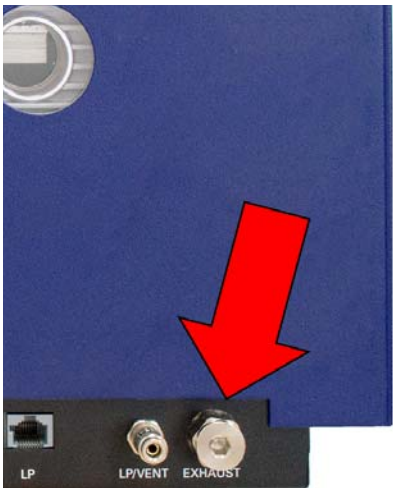


Fig. 21: Drain plug (P-Series)

8.5.4 Oil mist filter (P-Series only)

8.5.4.1 Check and empty the oil mist filter and clean the oil pan. (P-Series only)

- ► To change the mist filter on the P-Series, twist the upper mist filter housing clock-wise to remove.
- ► Then, remove the retaining thumb screw to remove the filter cartridge.

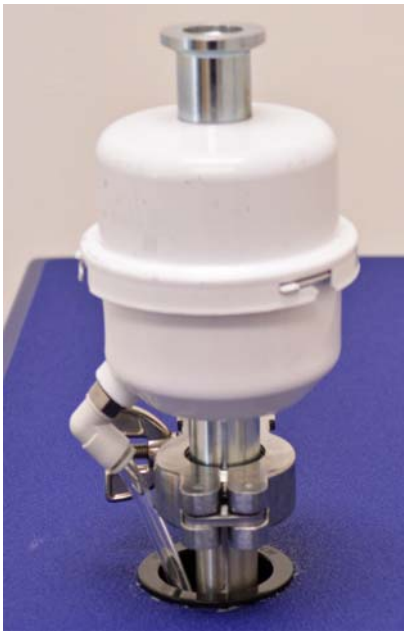


Fig. 22: How to open the oil mist filter

8.5.4.2 Replace the filter of the oil mist filter (P-Series only)

- ► To change the mist filter on the P-Series, twist the upper mist filter housing clock-wise to remove.
- ► Remove the retaining thumb screw to remove the filter cartridge, for pictures see the previous chapter.
- ► Replace the filter of the oil mist filter.

8.6 Maintenance work further steps (All Series)

8.6.1 Turbo molecular pump

Maintenance work for devices with turbo molecular pump:

- TITANTEST™ Wet Series
- TITANTEST™ Dry Series

8.6.1.1 Replace the oil wick cartridge.

► Replace the oil wick cartridge every 2 years.

Required material: Oil Wick SplitFlow 80 T10034

The turbo pump is filled with operating fluid upon the delivery of the SplitFlow 80. The oil wick cartridge should be replaced every 2 years (in shorter intervals accordingly in case of extreme loading or impure processes).

⚠ 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

► Before starting maintenance work, it must be ensured that the mass spectrometer and the turbo pump are completely vented. Only when in a vented state can the cover for the oil wick cartridge be removed.

► With the TITANTEST™, the mass spectrometer is vented via the software (see step 2).

1. Switch on the mains plug.
2. Select "Start-up > ℹ Information > Vent TMP".
3. Wait for the message "TMP is vented. Please switch off leak detector".
4. Switch off the mains plug.
5. Pull out the mains plug.
6. In case an external backing pump is used, detach the KF 25 connection to the external backing pump.
7. Carefully place the device on its back or left side (as seen from the front).
8. Use the special tool T10071 to unscrew the cover on the back.

9. Pry the oil wick cartridge with 2 screwdrivers and dispose of it according to local regulations.
10. Remove the Porex rods (8x) from the guides using tweezers.

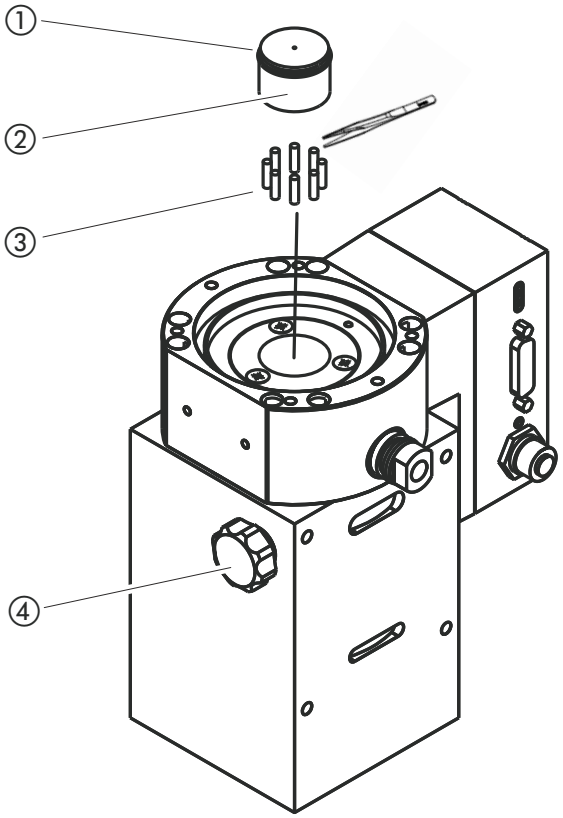


Fig. 23: TitanTest™: Replace with new image of oil wick cartridge

① *O-ring*
② *Operating fluid reservoir*
③ *Porex rod*
④ *Ventilating screw*

11. Remove the contamination on the turbo molecular pump and cover with a clean, lint-free cloth. Do not use cleaning liquids.
12. Insert the new Porex rods (8x) using tweezers.
13. 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.

14. Screw in the cover with a new O-ring. Note the tightening torque for the cover of 13 Nm +/-10%.
    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. Set up the device again.

16. If use use an external backing pump, re-establish the KF 25 connection to the external backing pump.
17. Re-connect the power supply.
18. Enter your maintenance work on the TMP in "Setup > Maintenance & Service > Maintenance components".
    This is only possible if maintenance is enabled in "Setup > Access control > Maintenance enabled".

8.6.1.2 Replace SplitFlow 80 for bearing change

Recommended bearing change at least every 4 years, with high loading earlier where necessary. A bearing change can only be carried out by LACO employees.

8.6.2 Valve block

Maintenance work for:

- TITANTEST™ Wet Series
- TITANTEST™ Dry Series

8.6.2.1 Cleaning the venting connection filter

Required material: Exhaust Fittings T10019

1. Switch the device off at the mains plug.
2. Pull out the mains plug.

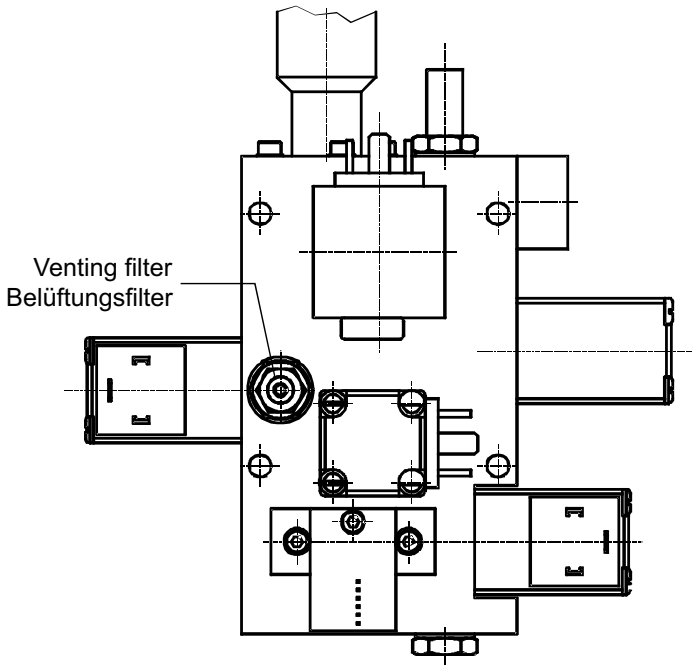


Fig. 24: Venting filter

① *Venting connection*

3. Loosen the cover on the left and right side using an 8 mm Allen wrench (*see Chapter 8.4.2: "Removing the cover (M-Series only)", page 69*).

4. Lift off the cover.
5. Loosen the grounding cable.
6. Loosen the hose connection on the valve clock using a 12 mm open-ended wrench and remove the hose from the nipple.
7. Use a 17 mm tubular box wrench to remove the fitting with the filter.
8. Clean the filter and mount it on the valve block.
9. Attach the hose to the fitting and tighten the fitting.
10. Connect the grounding cable.
11. Replace the cover and lock the cover with the bolt locks.
12. Insert the mains plug again.

8.6.3 Fan 1

8.6.3.1 Clean / replace filter mat

Required material: Cooling Fan Filter T10023

Clean or replace the filter mat on the bottom of the device if dirty.

8.6.4 Sniffer probe/capillary filter/sinter filter

See the operating instructions for the sniffer probe, Doc. no. ltna01e1

8.7 Replace the ion source

Required material: Ion Source T10059
Required tools: 4 mm Allen Wrench

You can replace the ion source through the inspection opening in the chassis bottom of the device without the need to remove the detection system.

1. Switch off the device and pull out the mains plug.

NOTICE

Damage to the turbo pump from rotating rotor

- The rotor may no longer rotate.
- After switching it off, do not move the TITANTEST™ for at least 4 minutes.

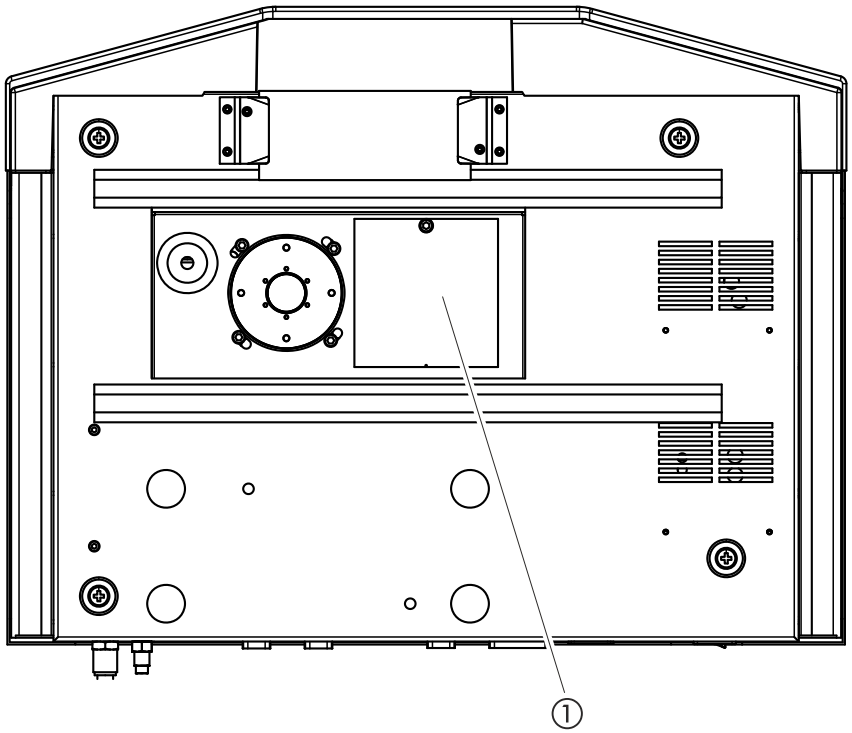


Fig. 25: Chassis bottom with inspection opening

① *Cover plate for ion source*

2. Set the unit on its side so that you can access the inspection opening.
3. Loosen the cap nut of the ion source connector and pull the ion source cable off the ion source.
   Not the high insertion forces of the ion source connector!
4. Loosen the 4 hexagon socket screws of the ion source and remove the compression ring.
5. In order to force away the ion source from the mass spectrometer, use one of the hexagon socket screws and screw it into the threaded hole in the ion source flange.
6. Pull the ion source out of the mass spectrometer.

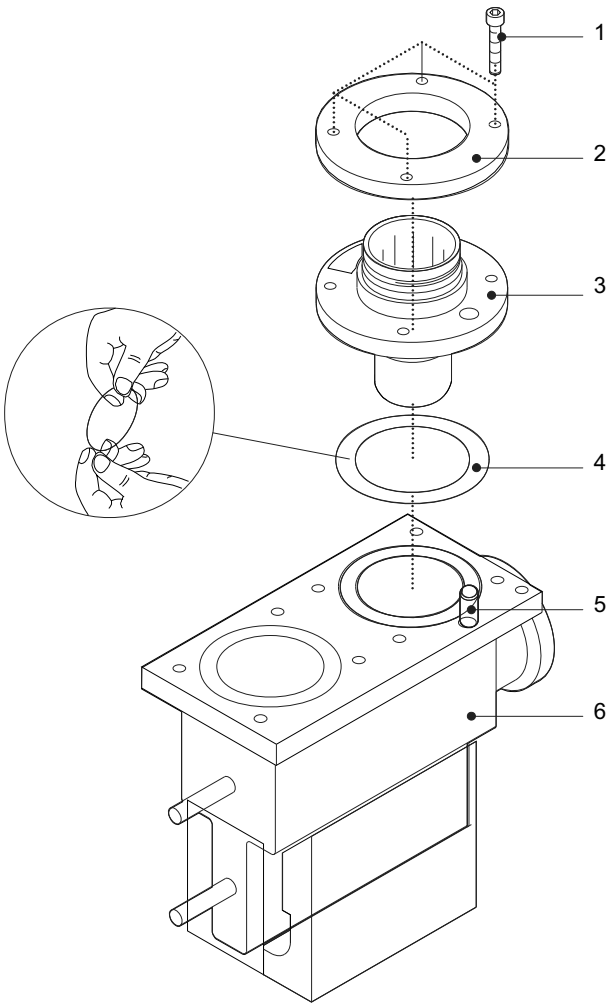


Fig. 26: Installation - ion source

Item	Description	Item	Description
1	4 x screw M5 x 20	4	Flat seal 41,5 x 55 0,5
2	Compression ring - ion source	5	Guide pin
3	Ion source	6	Mass spectrometer housing

7. Insert the ion source with a new flat gasket (*see Fig. 8.7, page 81*). The flat gasket must be cleaned with an alcohol-soaked, lint-free cloth prior to insertion.
8. Fix the flat seal in place on the ion source and insert the ion source into the mass spectrometer. The ion source can only be inserted at the position designated by the guide pin in the mass spectrometer.
9. Proceed by refitting the compression ring and tighten the mounting screws applying 8.5 Nm of torque. The elevated groove inside the compression ring needs to be fitted on the ion source flange.
10. Slip the ion source connector back on and lock the connector using the cap nut.

8.8 Fuses

8.8.1 Replacing the fuses

DANGER

Life threatening hazard from electric shock

Incorrectly secured products may be life threatening.

► Only use fuses with the prescribed values.

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

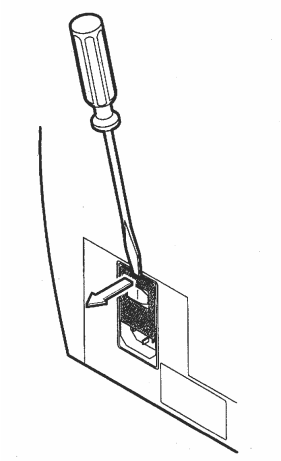


Fig. 27: Replace the mains fuses (1)

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

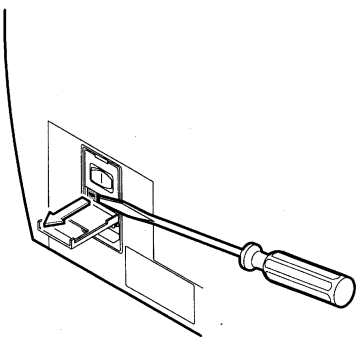


Fig. 28: Replace the mains fuses (2)

5. Lock the fuse holders back into place.
6. Close the cover.
7. Re-connect the mains plug.

8.8.2 Fuses used

Table 35: Fuses used

Designation	Fuse rating	Dimensions	Function
Main fuse			
F	T10 A	5 x 20	Mains fuses
Wiring board			
F3	T4 A	5 x 20	24 V (main fuse except for TC Power)
I/O Board			
F1	T0.8 A	5 x 20	24 V_I Sniffer connection LP and total pressure and I/O port
F2	T0.8 A	5 x 20	24 V_{III} plug XS4 RC and fan
F3	T0.315 A	5 x 20	not used for TITANTEST™
MSV			
F1	T4 A	5 x 20	24 V of MSV
F2	T4 A	5 x 20	Anode heating
F3	T1 A	5 x 20	24 V DC/DC converter for +5 V/±15 V
F4	M0.032 A	5 x 20	Anode/cathode potential

Table 36: Included fuse set

Designation	Value	Quantity
G fuse link	T 3.15	10
G fuse link	T 8.0 G	10
G fuse link	M 0.032 C	10
G fuse link	T 4.0	10
G fuse link	T 0.315 A	10
G fuse link	T 0.5	10
G fuse link	T 1.0 A	10
G fuse link	T 1.6 A	10
G fuse link	T 2.0 A	10
G fuse link	T 0.8 A	10
G fuse link	T 6.3 A	10
G fuse link	T 10.0 G	10
G fuse link	T 0.2 A	10
G fuse link	T 2.5 A	10

8.9 Sending in the TITANTEST™ for repairs

You can send in your device to LACO Technologies for maintenance or repairs. For further information on this topic, *see Chapter 10.2: "Sending in the TitanTest™", page 103*.

9. Spare parts list

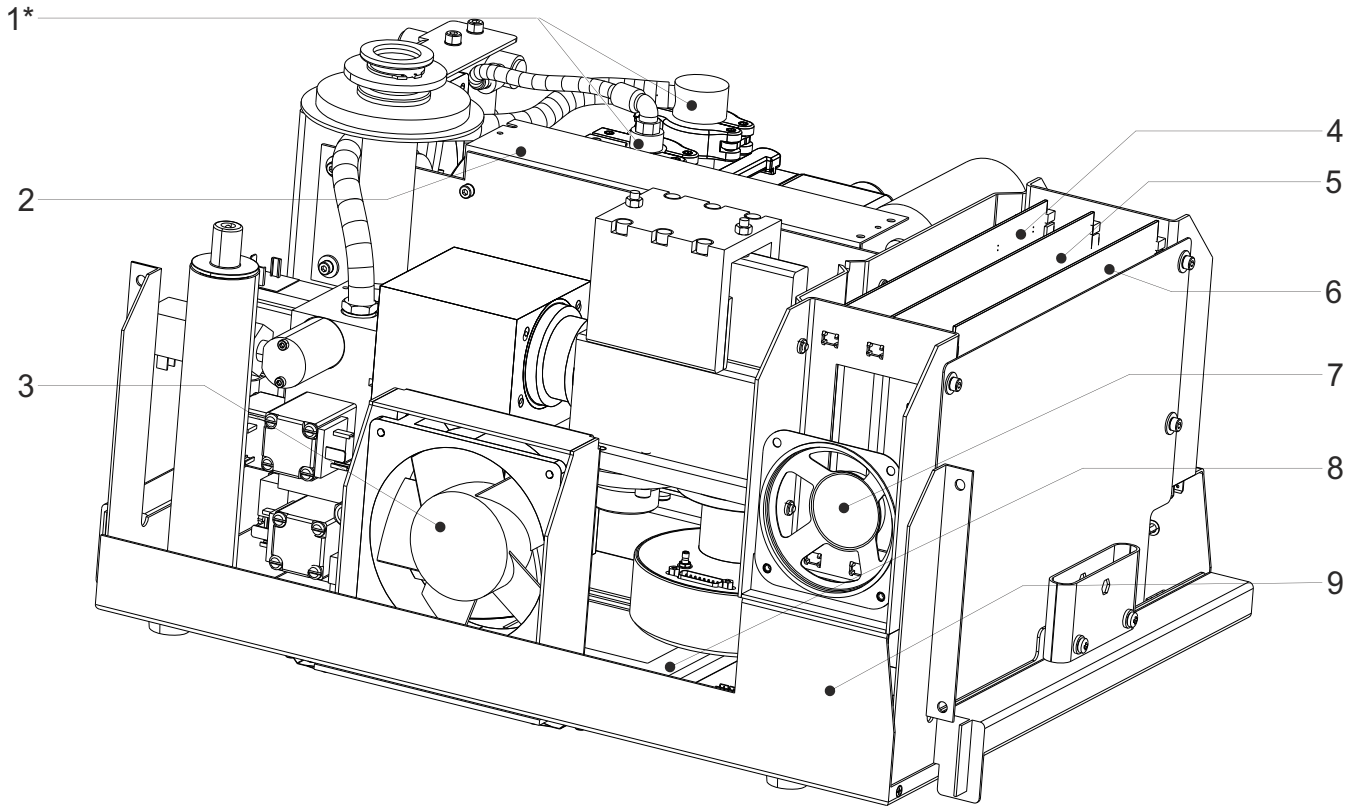


Fig. 29: TitanTest™ M-Series, Chassis Front View ** Wet Series Only / ** Dry Series Only*

Pos.	Description	Quantity	Specifications	Order No.
1*	Fore Pump Intake & Exhaust Flange Assemblies	1		T10020
	– Fore Pump Flange	1	DN16 - G 1/4"	
	– Exhaust Flange	1	DN16 - G1/8 "	
	– Clamping Ring	2	DN 10/16KF	
	– Hose Clamp	2	10-16/8	
2	Power Supply	1	24 V / 250 W	T10010
3	Cooling Fan	1	24 V	T10011
4	PCB I/O Board	1		T10012
5	PCB MC68 Micro Controller Board (without Firmware)	1		T10013
--	Firmware Titan Test (actual version)	1		T10014
6	PCB MSV Board	1		T10015
7	Loud Speaker complete	1		T10016
	– Mounting Hardware			
8	PCB Wiring Board	1		T10017
9	Chassis complete	1		T10018
	– Rubber Feet	4	D=20; H=12; M6	
	– Handgrip	2		
	– Latches	2		

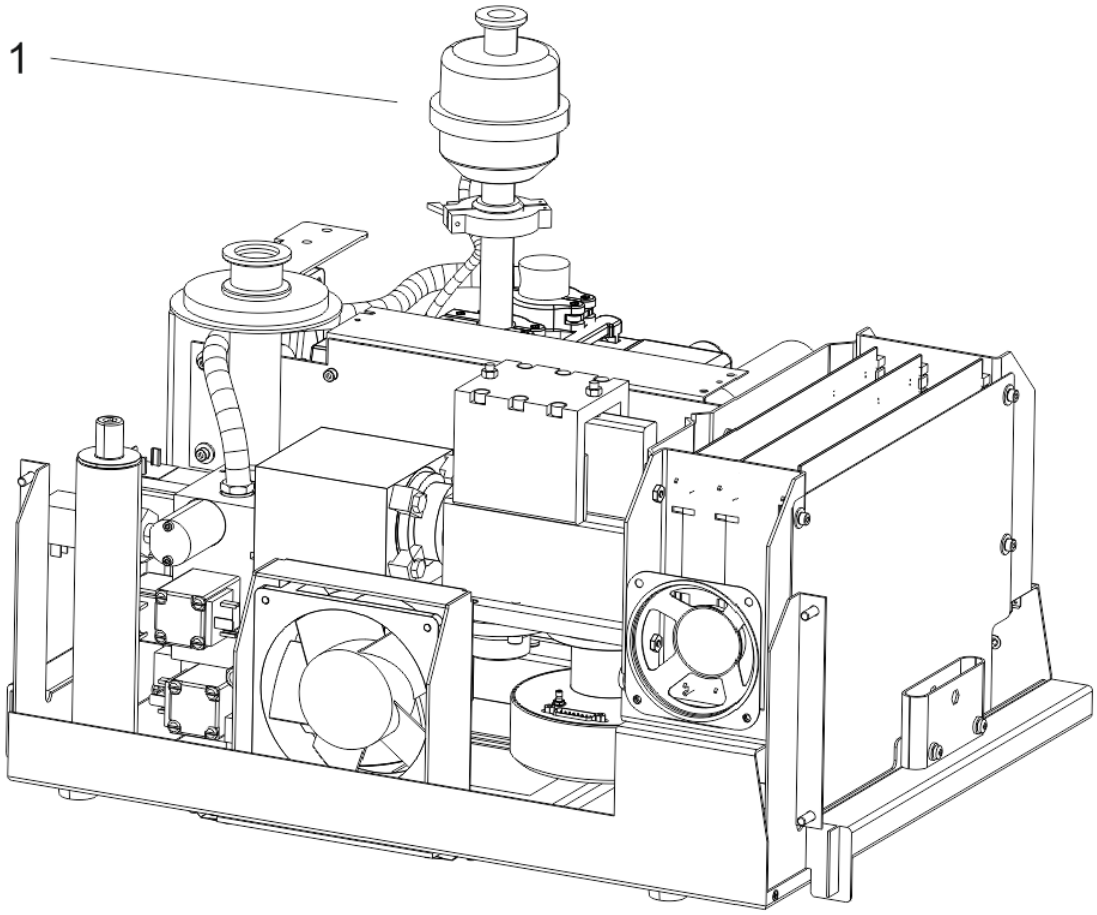


Fig. 30: TITANTEST™ P-Series specific, Chassis Front View ** Wet Series Only*

Pos.	Description	Quantity	Specifications	Order No.
1*	P-Series external oil mist filter kit with external oil drain	1		T109514

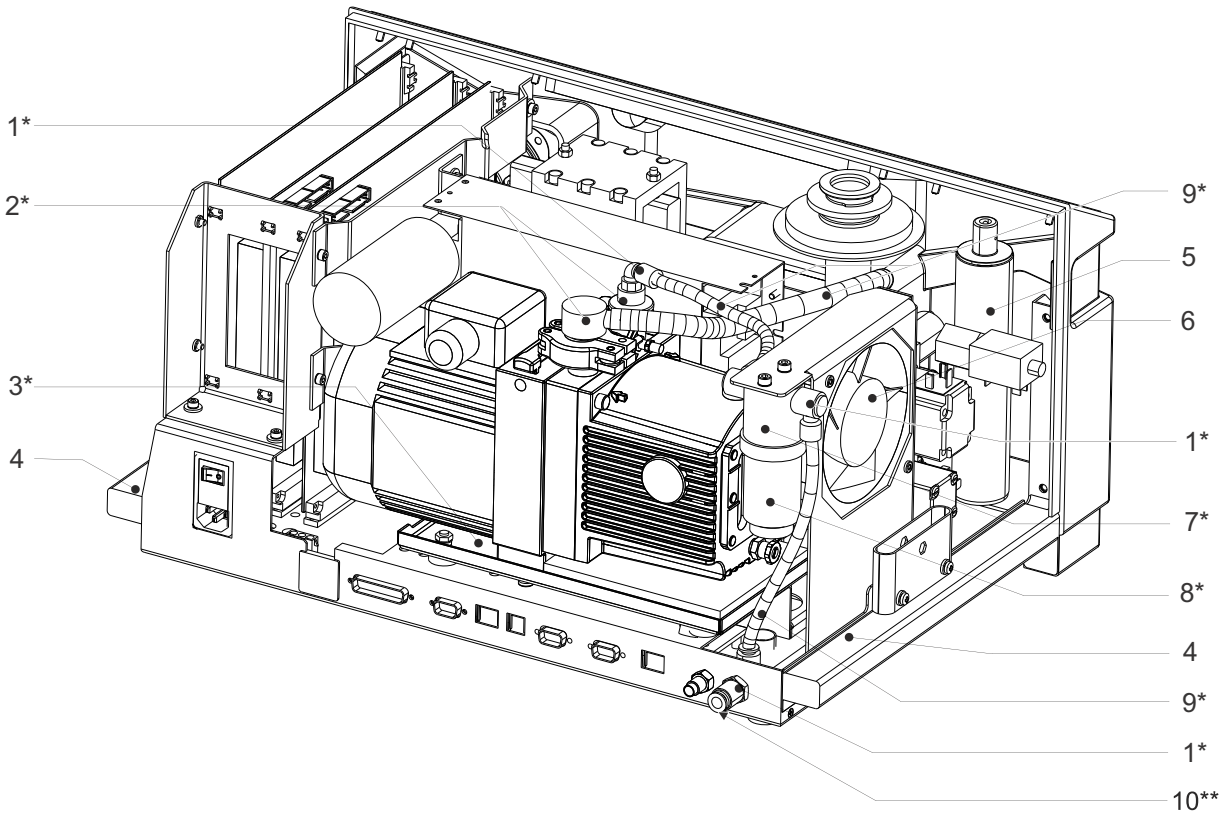


Fig. 31: TitanTest™ M-Series, Back View ** Wet Series Only / ** Dry Series Only*

Pos.	Description	Quantity	Specifications	Order No.
1*	Exhaust Fittings	1		T10019
	– Elbow Fitting	3	1/8“ - 8 mm	
	– Straight Fitting	1	8 mm	
	– Straight Fitting with filter and gasket	1	EV13/06N	
2*	Fore Pump Intake & Exhaust Flange Assemblies	1		T10020
	– Fore Pump Flange	1	DN16 - G 1/4"	
	– Exhaust Flange	1	DN16 - G1/8 "	
	– Clamping Ring	2	DN 10/16KF	
	– Hose Clamp	2	10-16/8	
3*	Oil Tray	1		T10021
4	Handle right and left	2		T10022
5	Calibrated Leak Assembly with Valve	1		CM102492
6	Cooling Fan	1	24 V	T10011
7*	Oil Mist Filter without Fittings	1		T10024-M for M-series T10024-P for P-series
8*	Oil Mist Filter Cartridge	1		T10025-M for M-series T10025-P for P-series
9*	Set of Hoses	1		T10026
	– Hose 4 mm x 1 mm	1	L=500 mm	
	– Hose 5 mm x 1,5 mm	1	L=500 mm	
	– Hose 10 mm x 3 mm	1	L=500 mm	
10**	External Pump Connection Kit	1		T10076

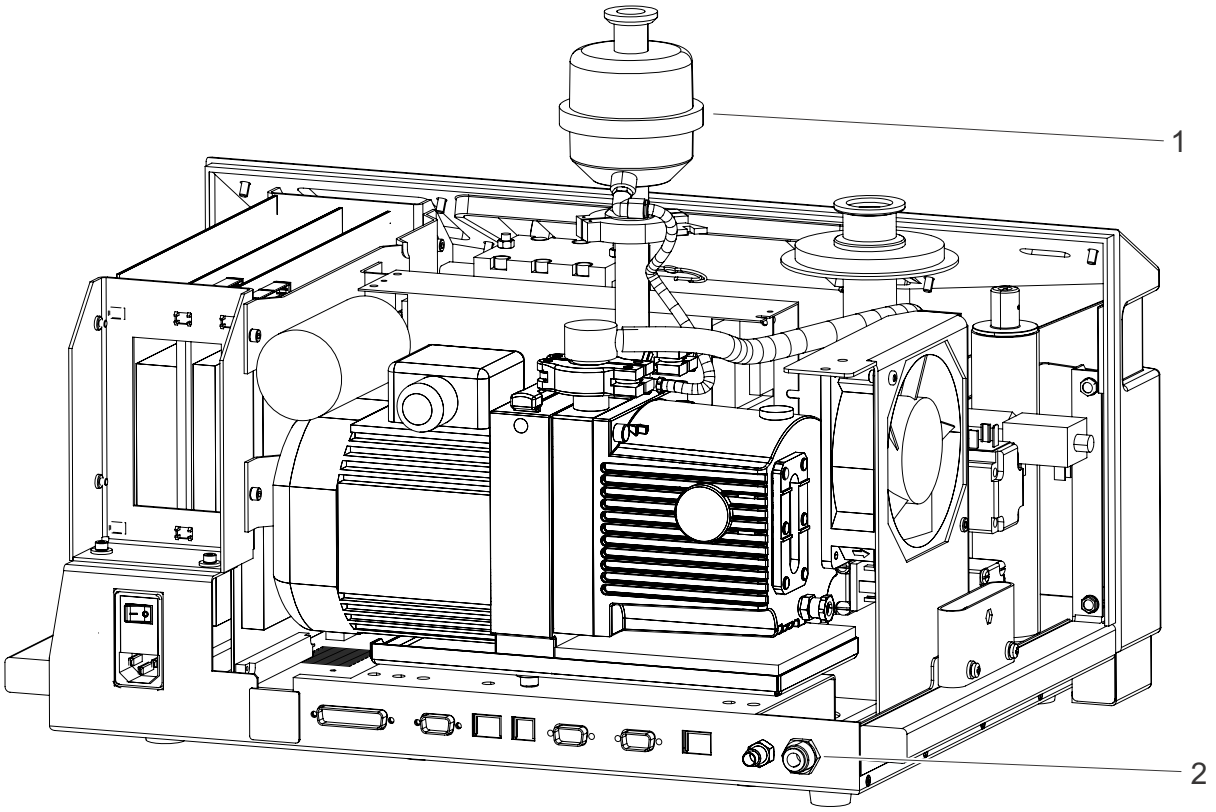


Fig. 32: TITANTEST™ P-Series specific, Back View **1 and 2 Wet Series Only*

Pos.	Description	Quantity	Specifications	Order No.
1 and 2*	P-Series external oil mist filter kit with external oil drain	1		T109514

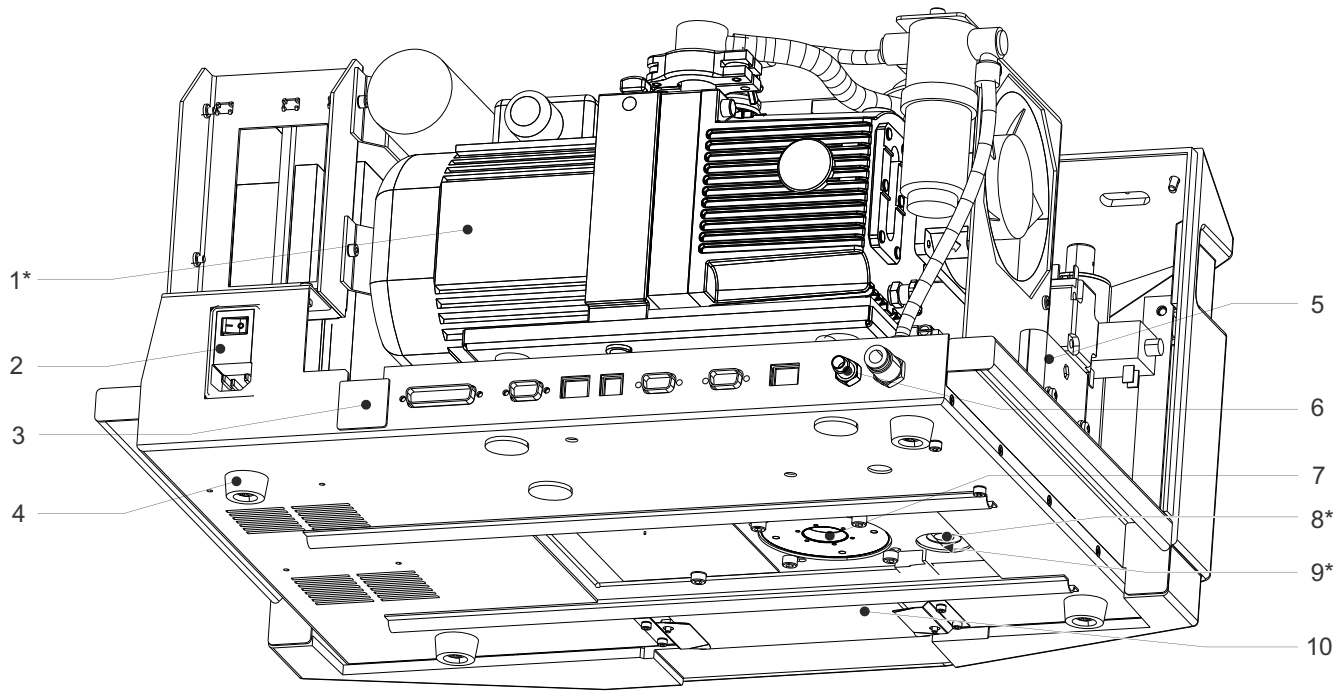


Fig. 33: TitanTest™ M-Series, Chassis bottom view ** Wet Series Only / ** Dry Series Only*

Fig. 34: TitanTest™ Chassis bottom view

Pos.	Description	Quantity	Specifications	Order No.
1*	UNO 006 120 V / 60 Hz	1		T10027
1*	UNO 006 230 V / 50 Hz	1		T10028
2	Mains Switch Assembly	1		T10029
--	Power Cord 120 V	1	3 x 1,5; l = 2,5 m	T10080
--	Set of Power Cords (Europe)	2	3 x 1,5; l = 2,5 m	T10081
3	Cover Cap	1		T10030
4	Rubber Feet	4	D=20; H=12; M6	T10031
5	Set of Latches for Cover Hood	2		T10032
6	Quick Coupling	1		T10033
7	Oil Wick SplitFlow 80	1		T10034
7	Oil Wick Cap SplitFlow 80	1		T10070
--	Oil Wick Cap Removal Tool	1		T10071
8*	Valve Block Inlet Plug & Gasket	1	G 1/4 "	T10077
9**	Valve Block Inlet Flange & Gasket	1	DN 25 - G1/4"	T10078
10	Cooling Fan Filter	1	Pore Size 500µ	T10023

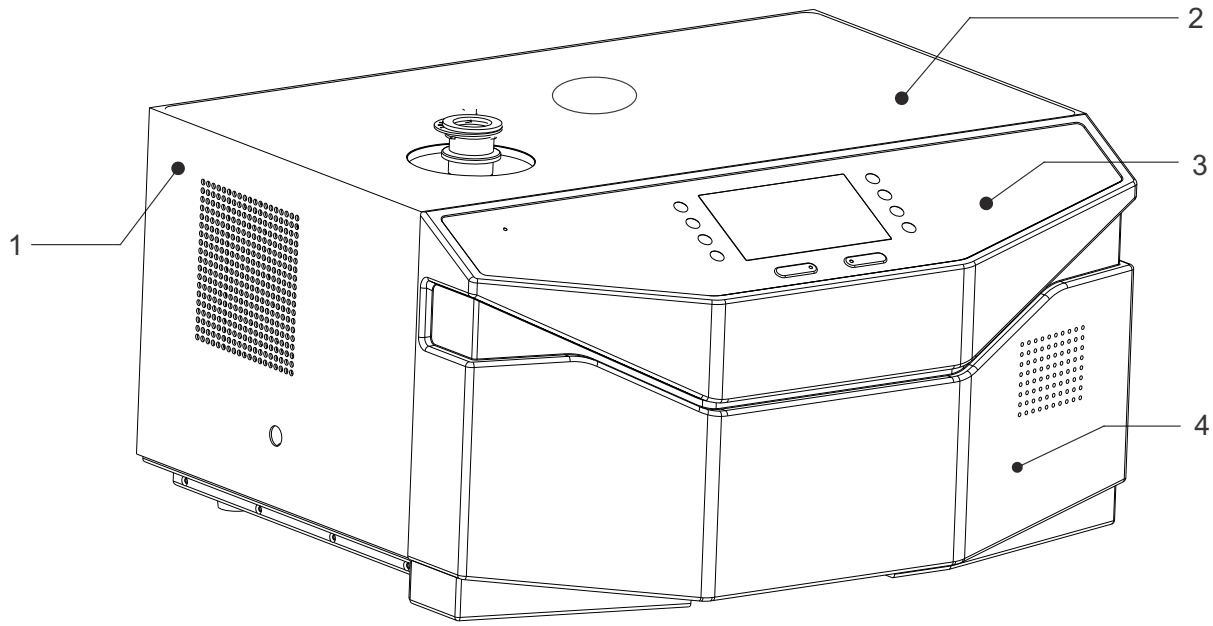


Fig. 35: TitTitanTest™ M-Series, Housing View

Pos.	Description	Quantity	Specifications	Order No.
1	Cover Hood complete	1		T10035
2	Screen Mat Cover Hood	1		T10036
3	Display panel	1		T10037
4	Front Cover without Display	1		T10038

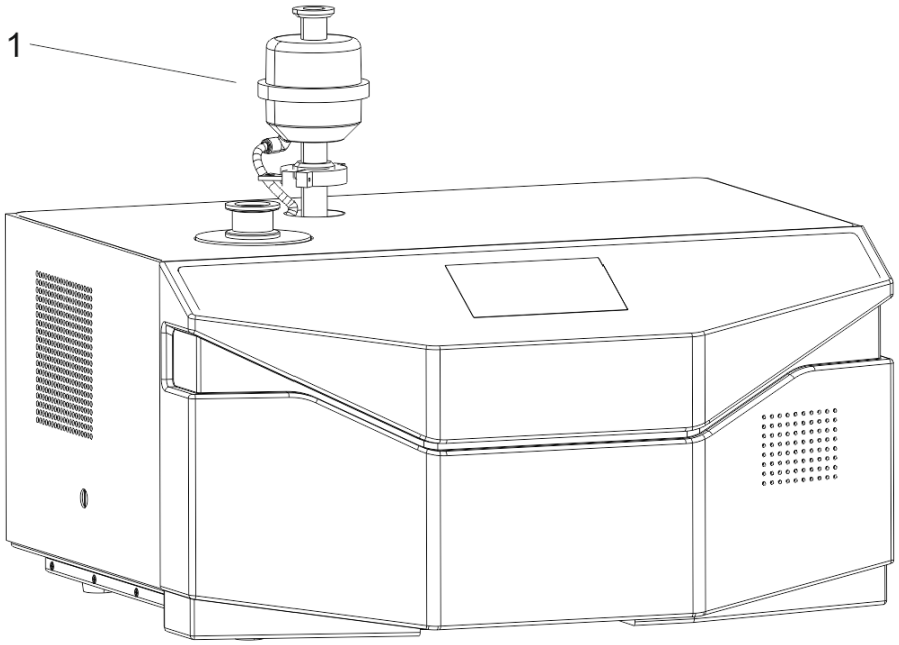


Fig. 36: TitTITANTEST™ P-Series specific, Housing View

Pos.	Description	Quantity	Specifications	Order No.
1	– P-Series external oil mist filter kit with external oil drain	1		T109514

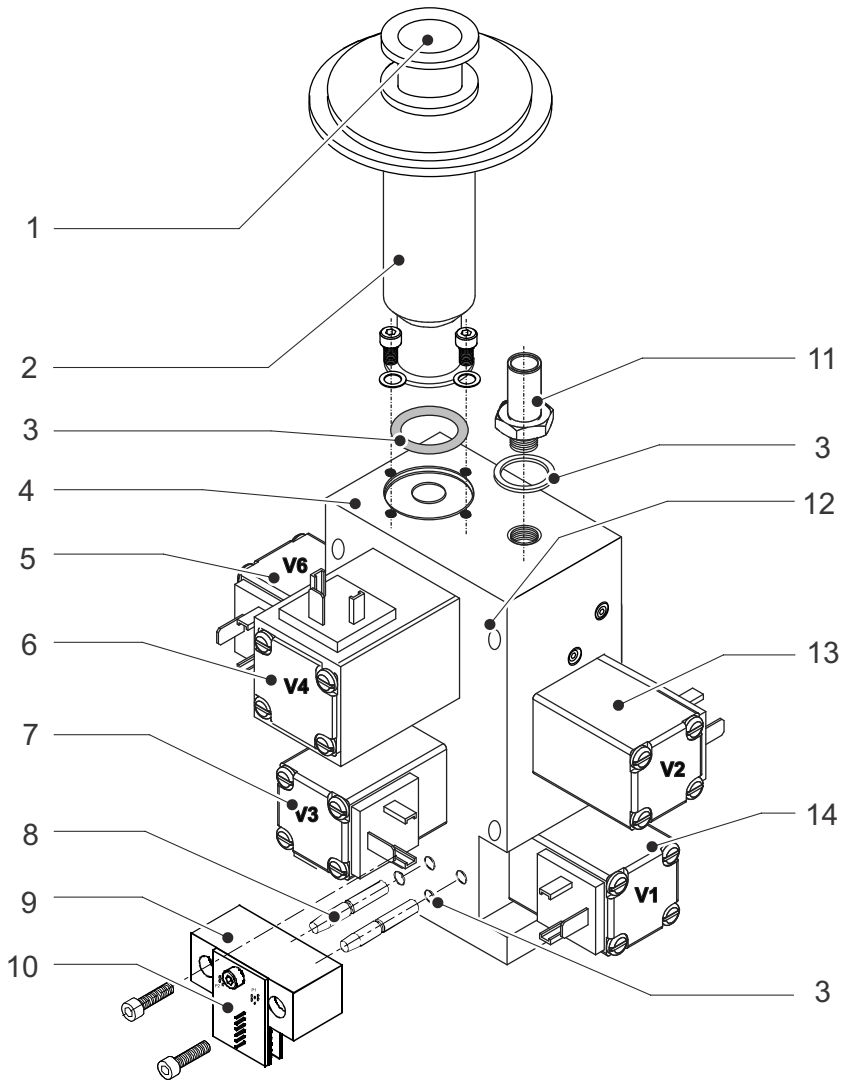


Fig. 37: TitanTest™ Valve Block

Pos.	Description	Quantity	Specifications	Order No.
1	Mesh Inlet Screen	1		T10079
2	Inlet Flange complete	1		T10039
3	Leak Detector Seal Kit	1		T10040
	– O-Ring (Inlet Flange- Valve Block)	5	19 x 3 mm	
	– O-Ring (Pirani elements)	5	3,69 x 1,78 mm	
	– O-Ring (TMP - Valve Block)	5	30 x 3,5 mm	
	– O-Ring (TMP - Fore vacuum)	5	13,94 x 2,62 mm	
	– O-Ring (Adapter flange reference leak)	5	12 x 1,5 mm	
	– Sealing Ring	5	R 1/4 IN	
	– Flat Gasket	5	41,5 x 55 x 0,5	
4	Valve Block complete with valves (without calibrated leak assembly)	1		T10041
5	Valve V6 2/2 way valve	1	24 V	T10042
6	Valve V4 2/2 way valve	1	24 V	T10043
7	Valve V3 2/2 way valve	1	24 V	T10044
8	Pirani Gauge (each)	1		T10045

Pos.	Description	Quantity	Specifications	Order No.
9	Holder Pirani Gauges	1		T10046
10	PCB-Pirani Gauges	1		T10047
11	Hose Barb (Fore vacuum connection)	1	G 1/4“- DN12	T10048
12	Stud Bolts SplitFlow 80	4	M6 x 60	T10049
13	Valve V2 2/2 way valve	1	24 V	T10050
14	Valve V1 2/2 way valve	1	24 V	T10051
--	Maintenance Kit for Valves V1 to V6	1		T10052
--	Maintenance Kit for Valve V5 (Calibrated Leak)	1		T10067
--	Maintenance Kit for Valves V1, V2, V3, V6	1		T10068
--	Maintenance Kit for Valve V4	1		T10069

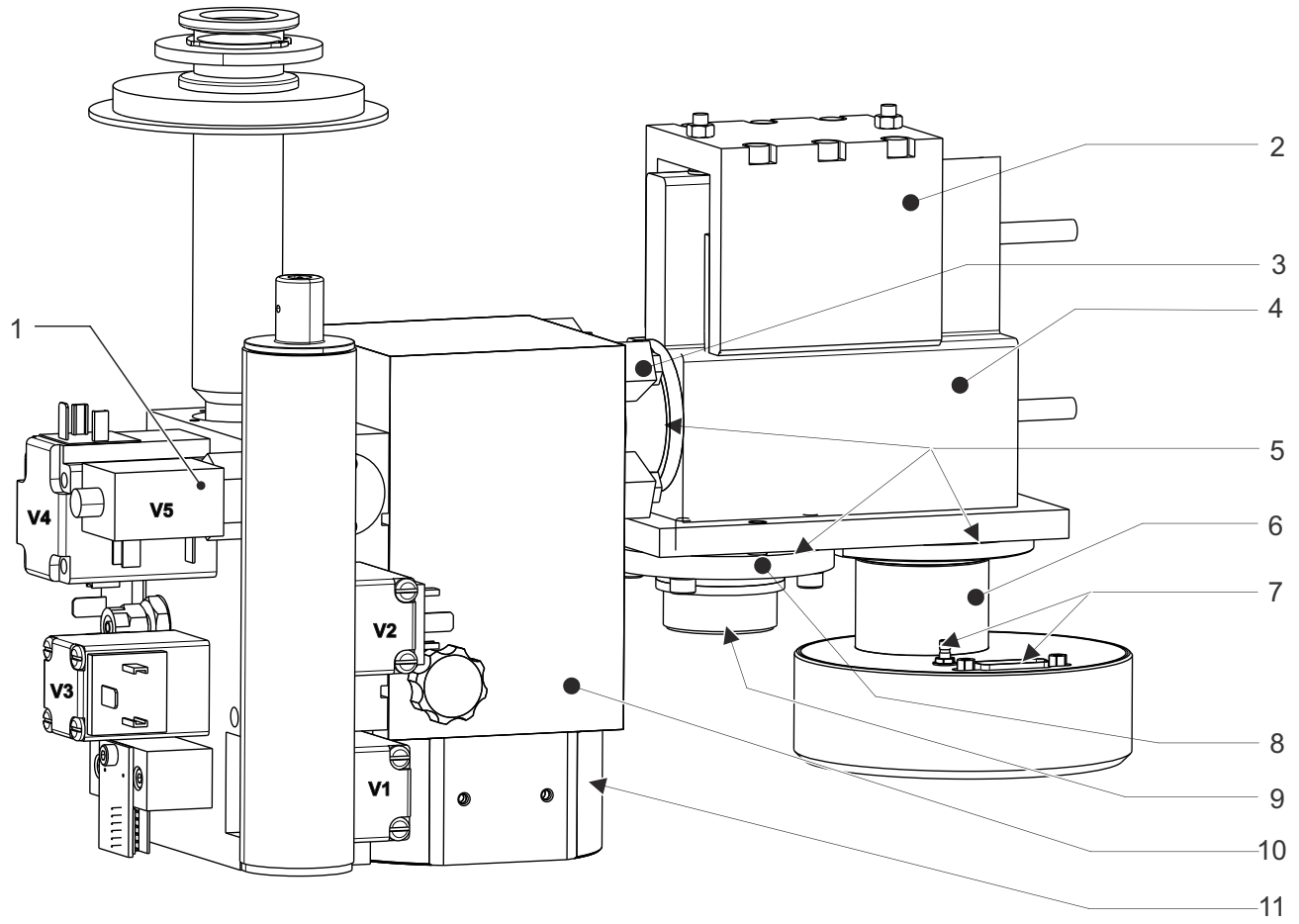


Fig. 38: TitanTest™ Detection System complete

Pos.	Description	Quantity	Specifications	Order No.
1	Valve V5 Calibration Valve (Maintenance Kit only)	1		T10067
2	Magnet System	1		T10053
3	Clamps (Set of 4)	4		T10054
4	Mass Spectrometer Housing	1		T10055
5	Flat Gaskets (Set of 20)	20	41,5 x 55 x 0,5	T10056
6	Pre-Amplifier / Ion Collector	1		T10057
7	Cable Harness Titan Test complete – Pre-Amplifier / Power Supply – Valves / Gauges – Cooling Fan / Speaker – Ion Source / TMP	1 1 / 1 1 / 1 1 / 1 1 / 1		T10058
8	Ion Source	1		T10059
9	Ion Source Cable	1		T10060
10	TMP SplitFlow 80 with TC110	1		T10061
10	TMP SplitFlow 80 with TC110 (Refurbished Exchange)	1		T10073
11	Cable TMP SplitFlow 80	1		T10062

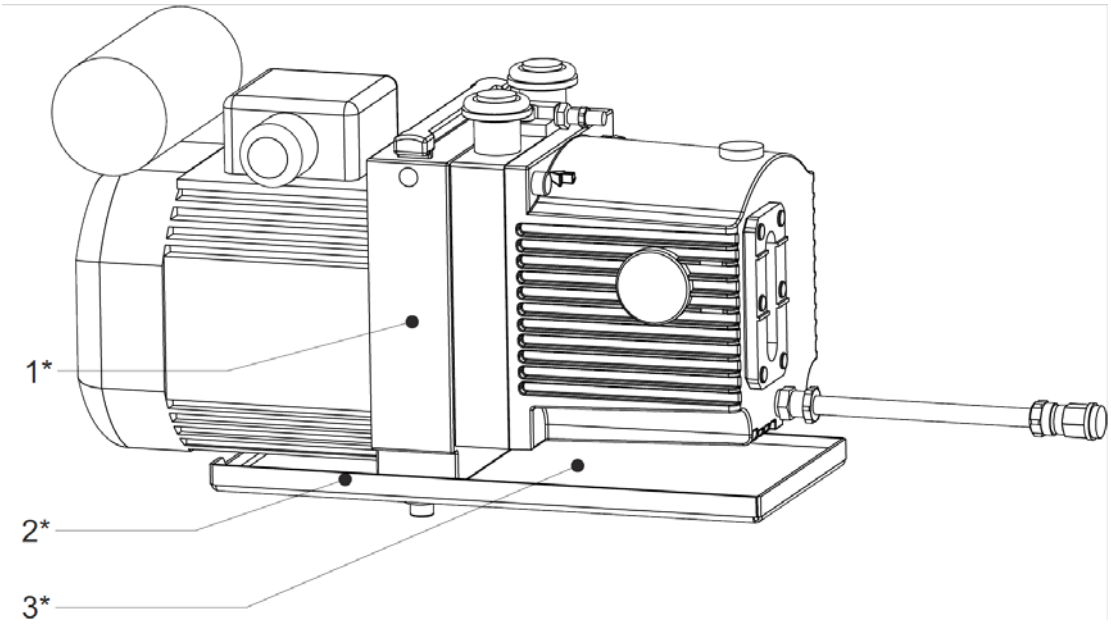


Fig. 39: TITANTEST™ Backing Pump UNO 006 ** Wet Series Only / ** Dry Series Only*

Pos.	Description	Quantity	Specifications	Order No.
1*	UNO 006 120 V / 60 Hz	1		T10027
1*	UNO 006 230 V / 50 Hz	1		T10028
2*	Oil Tray	1		T10021
3*	Felt Sheet for Oil Tray	1		T10063
--*	Set of O-Rings for UNO 006	1		T10064
--*	Maintenance Kit & Set of O-Rings UNO 006	1		T10065
--*	Overhaul Kit & Set of O-Rings UNO 006	1		T10066
--*	Pump Oil 19 Grade, replace with Pump Oil Elite Z Synthetic	1	1 Qt.	LVOEZ1QT

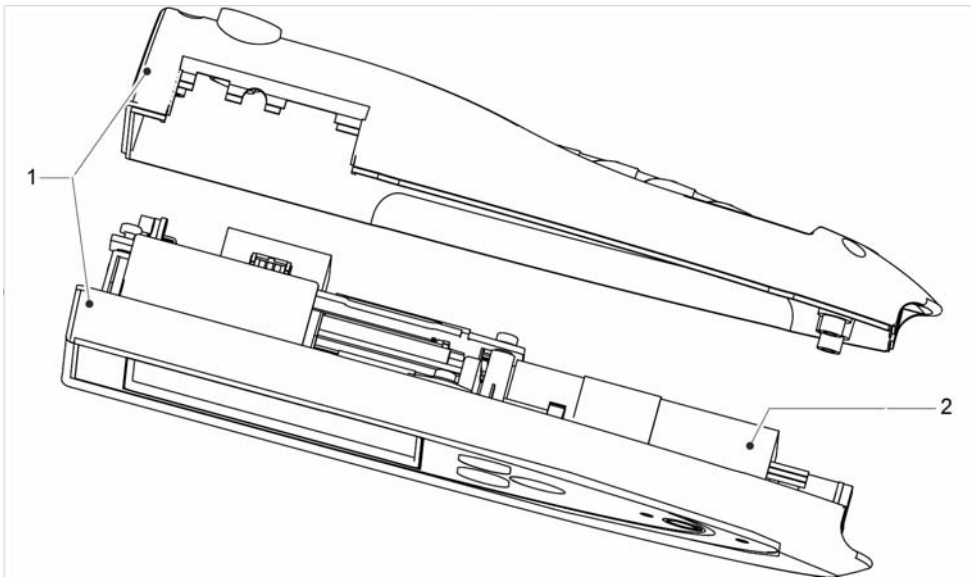


Fig. 40: RC1000WL/RC1000C

Pos.	Description	Quantity	Specificatons	Order No.
1	Set of Housings RC1000WL / WL – Keypad Foil – Display gasket	1 1 1		200003315
2	Replacement battery	1		200003316
--	Remote Control RC1000WL refurbished	1		551-015R
--	Remote Control RC1000C refurbished	1		551-010R
--	Coiled Cable	1		20099027
--	Radio Transmitter	1		551-020
--	Wall Power Supply for Remote Control	1		200003317

9.1 Maintenance/Repair Kits

Table 37: LD MAINTENANCE KIT FOR OIL UNITS, P/N: T10000

Item	P/N	Quantity
Oil Wick SplitFlow 80	T10034	1
Oil Mist Filter Cartridge	T10025	2
Vacuum Pump Oil (1qt.)	LVOEZ1QT	2
Cooling Fan Filter	T10023	1

Table 38: LD OVERHAUL KIT FOR OIL UNITS, P/N: T10001

Item	P/N	Quantity
Maintenance Kit for Wet	T10000	1
Leak Detector Seals Kit	T10040	1
Maintenance Kit Valves V1-V6	T10052	1

Table 39: LD MAINTENANCE KIT FOR DRY UNITS, P/N: T10002

Item	P/N	Quantity
Oil Wick SplitFlow 80	T10034	1
Cooling Fan Filter	T10023	1

Table 40: LD OVERHAUL KIT FOR DRY UNITS, P/N: T10003

Item	P/N	Quantity
Maintenance Kit for Dry	T10002	1
Leak Detector Seals Kit	T10040	1
Maintenance Kit Valves V1-V6	T10052	1

Table 41: LEAK DETECTOR SEALS KIT, P/N: T10040

Item	Quantity
Sealing Ring, ¼ IN.	5
Flat Seal, 55x41.5x0.5	5
O-ring, 12x1.5	5
O-ring, 13.94x2.62	5
O-ring, 19x3	5
O-ring, 3.69x1.78	5
O-ring, 30x3.5	5

Table 42: MAINTENANCE KIT FOR VALVES V1-V6, P/N: T10052

Item	P/N	Quantity
Maintenance Kit V5 (Cal. Leak)	T10067	1
Maintenance Kit (V1, V2, V3, V6)	T10068	4
Maintenance Kit (V4)	T10069	1

Table 43: MAINTENANCE KIT FOR V5 (CAL. LEAK VALVE), P/N: T10067

Item	Quantity
Gasket	1
Plunger/Spring	1

Table 44: MAINTENANCE KIT FOR VALVES V1, V2, V3, V6, P/N: T10068

Item	Quantity
Sealing Cap	1
Spring	1
O-ring, 25x1.5	1

Table 45: MAINTENANCE KIT FOR VALVE V4, P/N: T10069

Item	Quantity
Seal B SPE	1
Spring	1
O-ring, 26.7x1.78	1

Table 46: TMP SPLITFLOW 80 MAINTENANCE KIT, P/N: T10004

Item	P/N	Quantity
Oil Wick SplitFlow 80	T10034	1
Oil Wick Cap SplitFlow 80	T10070	1
Oil Wick Cap Removal Tool	T10071	1

9.2 Accessories and consumables

Table 47: Accessories and order no.

Category	Description	Model (Order number)
External Vacuum Pump Kits		
	Rotary Vane Pump, 14 CFM, NW25, Oil Mist Eliminator, Cart Vibration Mount	T102599-14C
	Rotary Vane Pump, 14 CFM, NW25, Oil Mist Eliminator, Benchtop	T102599-14B
	Rotary Vane Pump, 28 CFM, NW25, Oil Mist Eliminator, Cart Vibration Mount	T102599-28C
	Rotary Vane Pump, 28 CFM, NW25, Oil Mist Eliminator, Benchtop	T102599-28B
	Dry Scroll Pump, 8 CFM, NW25, Cart Vibration Mount	T102599-08C
	Dry Scroll Pump, 8 CFM, NW25, Benchtop	T102599-08B
	Dry Scroll Pump, 16 CFM, NW25, Cart Vibration Mount	T102599-16C
	Dry Scroll Pump, 16 CFM, NW25, Benchtop	T102599-16B
Cart option		
	Cart with Power Module	T102378-PC
	Power Module	T102166
	Shelf for TitanTest™ Communication Module	T102745
	Shelf for Helium Charge System	T102746
	Stainless Steel Work Surface	T102607
External Pump Valve Kits		Order number
	Vacuum Operated Valve	
	Kit for Cart Configuration	T102587-EC
	Kit for Benchtop Configuration	T102587-EB
	Pneumatic Operated Valve	
	Kit for Cart Configuration	T102587-PC
	Kit for Benchtop Configuration	T102587-PB
Communication Module		
	TitanTest™ Communication Module with Data Logging / Ethernet	TCM50
	TitanTest™ Communication Module with Data Logging / Ethernet / Printer	TCM50-PT
	Ticket printer for TCM50	TCM-PT
	Barcode Reader for TitanTest™ Communication Module	TCM-PC
	WiFi Adapter for TitanTest™ Communication Module	TCM-WIFI
Leak Test Accessories		Order number
	Sniffer probe	
	Sniffer Probe - 10 ft (3 m)	LSP-01N-10
	Sniffer Probe - 33 ft (10 m)	LSP-01N-33

Table 47: Accessories and order no. (Contin.)

Category	Description	Model (Order number)
	Enhanced Sniffer Probe - 10 ft (3 m), Pass/Fail + Zero Function, Rigid Tip	T2003
	Enhanced Sniffer Probe - 33 ft (10 m), Pass/Fail + Zero Function, Rigid Tip	T2010
	Helium Spray Probe - 10 ft (3 m) Poly tube	LHSP-01
	Helium Spray Probe - 10 ft (3 m) Poly tube with Regulator	LHSP-04
	Helium Spray Probe - 10 ft (3 m) Poly tube with Regulator and 620cc Reservoir Bottle	LHSP-07
Remote Control		
	Wired Remote Control RC 800, 13 ft (4 m) Cable Included	TR100
	Wireless Remote Control RC 800 WL, Up to 330 ft (100 m)	TR101
	Radio transmitter (to operate another leak detector)	TR-RC800-TM
Leak standard		Order number
	10-7 atm*cc/sec helium reservoir leak standard for TitanTest™, unlimited warranty	CM102492
	10-4 atm*cc/sec standard helium reservoir leak standard, 300 cc Res, Sniffer	CM515.0-4102DAG/4
	10-4 atm*cc/sec standard helium reservoir leak standard	CM51X-41161V0/1
	10-5 atm*cc/sec standard helium reservoir leak standard	CM51L-51121V0/1
	10-6 atm*cc/sec standard helium reservoir leak standard	CM51X-61141V0/1
	10-7 atm*cc/sec standard helium reservoir leak standard	CM51X-71111V0/1
	10-8 atm*cc/sec standard helium reservoir leak standard	CM51X-81111V0/1
	10-9 atm*cc/sec standard helium reservoir leak standard	CM51X-91111V0/1
	See www.lacotech.com for more options	
Filters		Order number
	Internal sintered bronze filter	LVF-B-2075-40-NW25
	External filter (high flow)	LVF-E-NW25-40-10
Accessories		Order number
	Large chamber vent valve assembly	T102752
	Pass/fail light assembly	T103181
	Helium fill module assembly	T104545
Chambers		Order number

Table 47: Accessories and order no. (Contin.)

Category	Description	Model (Order number)
	Leak detection chambers	
	4" x 4" x 2" LD Vacuum Chamber	LVC040402-2222-LD
	4" x 4" LD Vacuum Chamber	LVC0404-3321-LD
	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
	8" x 3" Leak Test ASME Pressure Bombing Chamber (60 PSI)	LBC083-60
	9" x 15" Leak Test ASME Pressure Bombing Chamber (60 PSI)	LBC0915-60
	9" x 15" Leak Test ASME Pressure Bombing Chamber (100 PSI	LBC0915-100
	Standard vacuum chambers	
	See www.lacotech.com	

9.3 External vacuum pumps (optional)

Table 48:

Wet14-xxxx	W2V40 Two-stage rotary vane pump, oil sealed
	Pumping speeds 20 m3 /hr at 50 Hz, 24 m3 /h at 60 Hz
Wet28-xxxx	W2V80 Two-stage rotary vane pump, oil sealed
	Pumping speeds 40 m3 /hr at 50 Hz, 48 m3 /h at 60 Hz
Dry08-xxxx	TriScroll 300 Two-stage dry (oil-less) scroll pump
	Pumping speeds 12.6 m3 /hr at 50 Hz, 15 m3 /h at 60 Hz
Dry16-xxxx	TriScroll 600 Two-stage dry (oil-less) scroll pump
	Pumping speeds 25.2 m3 /hr at 50 Hz, 30 m3 /h at 60 Hz
	See www.lacotech.com

10.Decommissioning the device

10.1 Disposal of the TITANTEST™

The device can be disposed of by the operator or sent to LACO Technologies.

The device is made of recyclable materials. You should 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.

10.2 Sending in the TITANTEST™

⚠ 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 in.

Prior to each shipment, contact LACO Technologies at:

Phone: +1-801-486-1004

11.Interfaces and Protocols

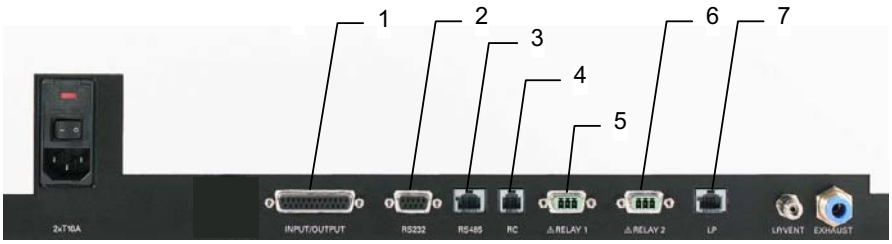


Fig. 41: Interface connections at the back of the device

① *INPUT/OUTPUT: Control and output signals*
② *RS232**: Connection for computer*
③ *RS485**: Connection for computer*
④ *RC: Remote control or wireless transmitter*
⑤ *RELAY 1: Relay output*
⑥ *RELAY 2: Relay output*
⑦ *LP: Connection for sniffer probe*

11.1 INPUT/OUTPUT interface

Input and output signals, 25-pin, D-sub, sockets

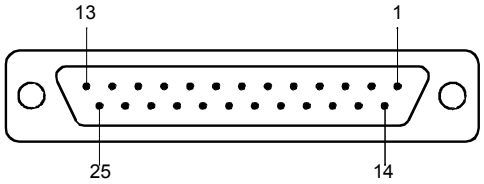


Fig. 42: INPUT/OUTPUT: Control and output signals

Table 49: INPUT/OUTPUT: Control and output signals

Pin	Assignment	Explanation
1	Canal 1	Analog output 0 … 10 V, Ri 3 Ω. (*see table 13, page 35*)
2	Channel 2	Analog output, data as above (*see table 13, page 35*)
3	AGND	Reference potential of analog outputs, galv. insulated
4		Audio output (headphones or active speakers)
5		Reference potential to audio output
6 … 13	DI 1 … 8**	Digital inputs, +18 … 30 V (approx. 5 mA). The functions are triggered by the positive flank. Same level as the control unit.**
6	Start/Stop**	Starts the measurement in Ready-to-start state and stops the measurement in Measuring state.**
7	Vent**	Venting with setting "Venting manual" (*see chapter 6.4.4: "Define evacuation time & vent", page 45*)**
8	ZERO**	Function of the ZERO key.** If pressed longer than 3s, ZERO is canceled.**
9	Calibrate**	Starts the calibration or for confirmation of "Calibrate Acknowledge" (PIN 19)**
10	PARA 2**	Upon activation: "Loading parameter set 2."** Upon deactivation: "Loading parameter set 1."**
11	Not used	

** Feature not available in TitanTest™ Maintenance model

Table 49: INPUT/OUTPUT: Control and output signals (Contin.)

Pin	Assignment	Explanation
12	Fill complete**	Fill complete**
14	DGND	Reference potential of the digital inputs, galvanically insulated
15 … … 22	DO1 … 8	Digital outputs, not galvanically insulated, active 24 V ± 10%, passive on DGND (0 V) Maximum allowed current: 800 mA for all outputs together Upon switching on, all outputs are active for approx. 1 s.
15	Ready to start	Enabled when the device is ready to evacuate the test volume.
16	Ready to measure	Enabled when the device measures, i.e. in either ULTRA, FINE, or GROSS state
17	Leak	Enabled when the alarm limit is activated and exceeded, disabled below 90% of this value
18	Error	Enabled in error state
19	Calibrate Acknowledge	Enabled if the device is waiting for a confirmation during calibration: internal calibration: - Apply factors? external calibration: - Calibration leak opened and signal stable? - Calibration leak closed and signal stable? - Apply factors?
20	Start Fill	If in Auto Test mode, this outpout is enabled once background is achieved.
21	Bypass Valve	Enabled if bypass valve is open (control bypass option)
22	No Leak	Active if the alarm setpoint was exceeded.
23	DGND (0 V)	Reference potential of the digital outputs, not galvanically insulated
25	+24 V	+24 V e.g. for actuating the digital inputs 0.8 A slow fuse

** Feature not available in TitanTest™ Maintenance model

Example of digital inputs:

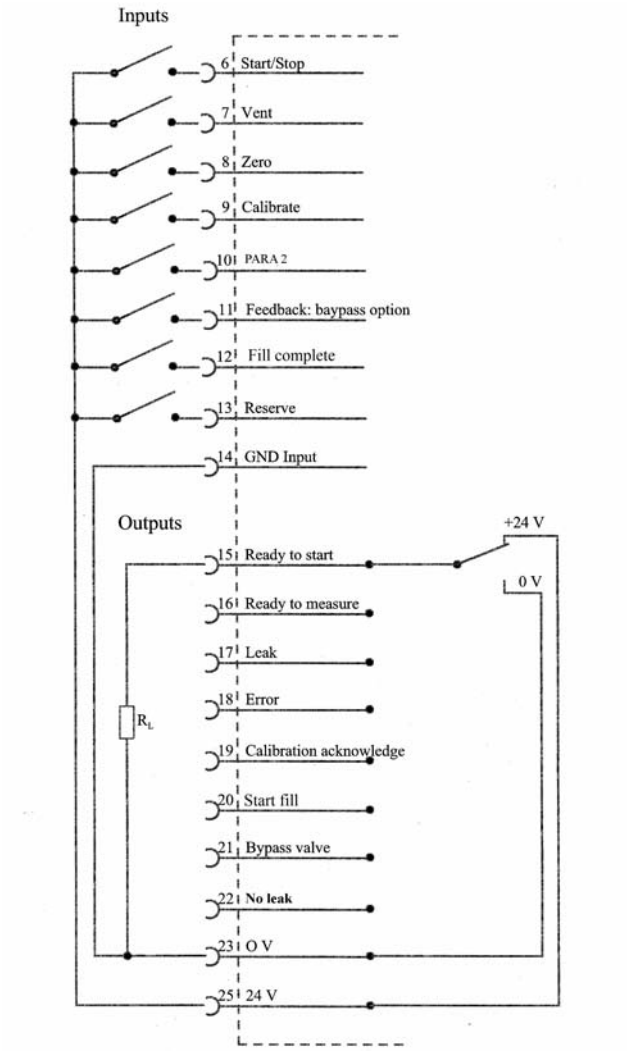


Fig. 43: Example of digital inputs

When controlling via the +24V of the leak detector, there must be a connection between PIN 14 and PIN 23.

11.2 RS232 interface**

The RS232 interface enables communications between the TitanTest™ and a computer. A terminal can also be connected for test purposes.

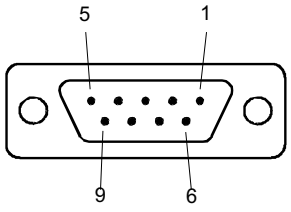


Fig. 44: TitanTest RS232 Connector

** Feature not available in TITANTEST™ Maintenance model

Table 50: RS-232 pin assignment**

Pin	Signal	Comment
1	not used	
2	TXD	Transmission data (galvanically insulated)
3	RXD	Received data (galvanically insulated)
4	free	
5	GND	Reference potential (galvanically insulated)
6	not used	
7	not used	
8	not used	
9	not used	

11.3 Serial interface RS485**

The connection of the TITANTEST™ to a computer can be made through the serial interface RS485.

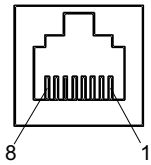


Fig. 45: RS485 Connector

Plug: RS485 (8pin)

PIN 1 not used
PIN 2 +24 V (for supplying the field bus converter;
PIN 3 not used
PIN 4 not used
PIN 5 D+ (galvanically isolated)
PIN 6 GND (0 V)
PIN 7 D- (galvanically isolated)
PIN 8 not used

** Feature not available in TITANTEST™ Maintenance model

The TitanTest may adopt the position of cases A, B or C in a bus. See *Fig. 46:*

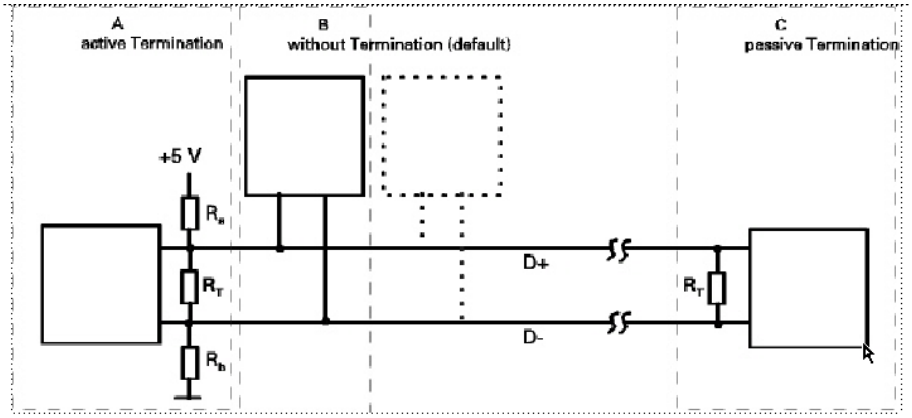


Fig. 46: RS485 cable connection

A: TITANTEST™: with active termination

B: TITANTEST™: without termination (default setting).

C: TITANTEST™: with passive termination

The choice of TITANTEST™ connection can be made with the

DIP switch 1-3, *Fig. 47:* , according to Table *51*.

DIP switch 4 has no function.

Table 51: bus termination, terminating resistors

	DIP 1 (RT = 121Ω)	DIP 2 (Rb = 562Ω)	DIP 3 (Ra = 562Ω)
A	closed	closed	closed
B	open	open	open
C	closed	open	open

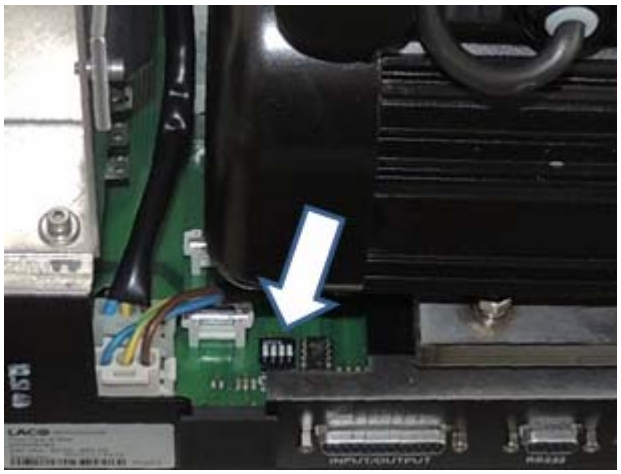


Fig. 47: RS485 DIP switches

A twisted, screened two-wire cable is recommended for the connection!

After receiving a command it takes about 5 to 10 ms until the TITANTEST™ sends a reply.

► Do not confuse the "RS485" connector with the "LP" connector. Otherwise the device will not function.

11.4 Remote control

This remote control interface is designed as a serial port for controlling the TITANTEST™ via the remote control when the wired version is used. The remote control can be connected via a connection cable with an RJ45 plug. The remote control is not included in the scope of delivery of the TITANTEST™.

Table 52: RC pin assignment

Pin	Signal
1	not used
2	+24 V (0.8 A slow fuse)
3	0 V DGND (0 V)
4	RxD (intern. RS232)
5	TxD (intern. RS232)
6	not used
7	not used
8	not used

11.5 Relay 1, Relay 2

Relay contact, 230 V~, 3 A.,

Plug TITANTEST™ Power Subcon, 3-pin

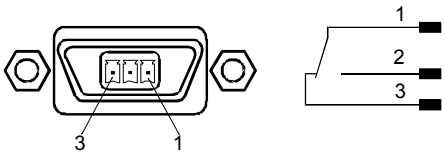


Fig. 48: Relay 1, Relay 2

11.6 LP

Connection for sniffer probe LP 503, LP 505, LP 510

RJ-45, 8-pin

- Do not confuse the connectors!
  The connector is similar to the "RS485" connector.

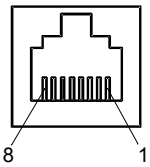


Fig. 49: Connector: RJ-45 (8-pin)

Table 53: Sniffer probe pin assignment

Pin	Signal
1	not used
2	not used
3	ZERO
4	(LED red)
5	(LED green)
6	+24 V (0.8 A slow fuse)
7	not used
8	not used

LED green: Leak detector is ready for measurement.

LED red: Setpoint is exceeded.

11.7 Serial Interface Protocols**

You can communicate with the TITANTEST™ via the following serial interface protocols:

- LD Protocol
- ASCII Protocol
- Diagnostic Protocol (Only for internal use.)

The serial interface protocol can be selected at the menu of the TITANTEST™. Refer to TITANTEST™ operating instructions.

ASCII and LD protocol have nearly the same functional range, but each of them have some advantages and disadvantages:

ASCII protocol

Advantages:

- human readable
- easy to use with simple terminal program

Disadvantages:

- No checksum, therefor lower data security
- PC/ PLC software must convert numerical values from ASCII string to binary
- Lower efficiency (for example: 8 data bytes for one float value)

LD protocol

Advantages:

- Leak detector status always transmitted in each slave telegram
- High data security due to CRC checksum
- Binary transmission of numerical values – no conversion needed in PC/ PLC software
- High efficiency (for example: 4 Byte data bytes for one float value)

** Feature not available in TITANTEST™ Maintenance model

Disadvantages:

- Not human readable
- Not useable with simple terminal program

12.LD Protocol**

12.1 Communication Parameters

Data format	
Baudrate	19.200, 8 data bits, 1 stop bit, no parity

12.2 Command format

12.2.1 Telegram structure

Master sends

ENQ	LEN	ADR	CmdH	CmdL	DATA (n bytes)	CRC
0	1	2	3	4	5	5 + n

Slave answers

STX	LEN	StwH	StwL	CmdH	CmdL	DATA (n bytes)	CRC
0	1	2	3	4	5	6	6 + n

Command	Meaning	
ENQ	0x05	Start of master request
STX	0x02	Start of slave response
LEN	Number of telegram bytes	without ENQ(STX)/LEN, however with CRC max. 253, so the total slave telegram length is max. 255
ADR	Slave address	Slave address = 1: non-addressed bus. Address byte is ignored.
Stw H/L	Status word	Info from slave to master (Seite 117)
Cmd H/L	Command	Bit 15 ... 13: Command-specifier Read/Write etc. (see table "*Cmd H/L: Command: Command-specifier*") Bit 12: free Bit 11 ... 0: Command numberSeite 117)
DATA	Data belonging to master request (Slave reply to write command is sent without data)	0 ≤ n ≤ 248 If I/O module (7-byte additional header) is used, then limit maximum data length to 241.
CRC	Checksum	Calculate CRC for all bytes (except CRC byte) Polynomial: 0x98, Name: DOWCRC, Maxim/Dallas, $X^8+X^5+X^4+1$ Info: CRC calculation see document "CRC_calculation.c" (C souce code)

** Feature not available in TITANTEST™ Maintenance model

Cmd H/L: Command: Command-specifier

Bit 15 ... 13	Meaning	High Nibble (Hex)
000	Read value	0
001	Write value	2
010	Read lower limit	4
011	Read upper limit	6
100	Read default value	8
101	Read command name in plain text	A
110	Read command info	C
111	not used	E

Command info

1. Byte	Data type (see table “Data types”)
2. Byte	Number of array elements: 0 = no data, no array 1 = data, no array
3. Byte	Bit 0: 1 = Reading allowed, 0 = Reading not allowed Bit 1: 1 = Writing allowed, 0 = Writing not allowed Bit 2 ... 7: not used (always 0)

Data types

Value	Meaning	Acronym	Comments
0	Boolean		
1	Signed 8 bit integer	SINT8	
2	Signed 16 bit integer	SINT16	
3	Signed 32 bit integer	SINT32	
4	Unsigned 8 bit integer	UINT8	
5	Unsigned 16 bit integer	UINT16	
6	Unsigned 32 bit integer	UINT32	
7	Character	CHAR	ISO 8859-1; printable characters
16	Signed 64 bit integer	SINT64	
17	Unsigned 64 bit integer	UINT64	
18	Floating point/real number	FLOAT	IEEE 754
20	no data	NO_DATA	For commands without data, such as Start

All data types are used in Big Endian format (Motorola format), i.e. the byte with the highest-order bits is transferred first.

Arrays

- Read single elements: Array index in first DATA-byte
- Write single elements: Array index in first DATA byte and values in following DATA bytes
- Read all elements: Pseudo array index 255 in first DATA byte

- Write all elements: Pseudo array index 255 in first DATA byte and values in following DATA bytes
- Response from slave (in case data are sent): Array index or pseudo array index in first DATA byte and values in following DATA bytes

All elements of an array have the same Min/Def/Max value.

Array parameters in commands table (see chapter *12.4*): The number of array elements is set in brackets behind the data type.

12.3 Status Word

Status word bit no.	Meaning
Bit 0	Device state Bit 0
Bit 1	Device state Bit 1
Bit 2	Device state Bit 2
Bit 3	Device state Bit 3
Bit 4	ZERO
Bit 5	Still warning
Bit 6	Measure range 0
Bit 7	Measure range 1
Bit 8	Measure range 2
Bit 9	Setpoint exceeded
Bit 10	Warnpoint exceeded
Bit 11	not used
Bit 12	Paging
Bit 13	Device warning
Bit 14	Device error
Bit 15	Syntax/Command error

Value	Bit 3..0	Device state
0	0000	INIT
1	0001	RUNUP
2	0010	STANDBY
3	0011	VENT
4	0100	EVACUATION
5	0101	MEASURE
6	0110	CALIBRATION
7	0111	DISPLAY CAL
8	1000	ERROR
9	1001	WAIT EVACUATION
10	1010	not used
11	1011	not used
12	1100	not used
13	1101	not used

Value	Bit 3..0	Device state
14	1110	not used
15	1111	not used

Value	Bit 8..6	Meaning
0	000	NO RANGE
1	001	GROSS
2	010	FINE
3	011	ULTRA
4	100	EVACUATION
5	101	not used
6	110	not used
7	111	not used

12.4 Commands**

Command		Name	Data type	R/W	Meaning
dez	hex				
0	0000	NOP	NO_DATA	R	No operation, replies without data
1	0001	Start	NO_DATA	W	Switch to measure
2	0002	Stop	NO_DATA	W	Switch to standby
3	0003	Vent	NO_DATA	W	Switch to vent
4	0004	Calibration	NO_DATA	W	Start, acknowledge calibration
5	0005	Clear error	NO_DATA	W	Clear Error or Warning
6	0006	Zero	UINT8	R/W	0 = Zero "Off" 1 = Zero "On" "Update" without data = toggle Zero state
9	0009	Emission nominal status	UINT8	R/W	Emission nominal status 0 = OFF 1 = STANDBY 2 = ON
10	000A	TMP nominal status	UINT8	R/W	TMP nominal status 0 = OFF 1 = ON
26	001A	Interface protocol	UINT8[2]	R/W	Interface protocol Index 0: Remote Control Index 1: RS232 / RS485 see table / enumerations
27	001B	Used interface	UINT8	R	Used interface 0 = Remote Control 1 = RS232 / RS485
128	0080	Leak rate [sel. unit]	FLOAT	R	Leak rate [sel. unit], limited to lower display limit
129	0081	Leak rate [mbar*l/s]	FLOAT	R	Leak rate [mbar*l/s], unlimited
130	0082	Internal pressure 1 [sel. unit]	FLOAT	R	Internal pressure 1 [sel. unit]
131	0083	Internal pressure 1 [mbar]	FLOAT	R	Internal pressure 1 [mbar]
132	0084	Internal pressure 2 [sel. unit]	FLOAT	R	Internal pressure 2 [sel. unit]
133	0085	Internal pressure 2 [mbar]	FLOAT	R	Internal pressure 2 [mbar]
138	008A	TMP actual rotation speed [Hz]	UINT16	R	TMP actual rotation speed [Hz]
139	008B	TMP power [W]	FLOAT	R	TMP power [W]
140	008C	TMP operation hours [h]	UINT32	R	TMP operation hours [h]
141	008D	Frequency converter operation hours [h]	UINT32	R	Frequency converter operation hours [h]
142	008E	Leak detector operation hours [h]	UINT32	R	Leak detector operation hours [h]
143	008F	TMP temperature bottom [deg. C]	FLOAT	R	TMP temperature bottom [deg. C]
144	0090	TMP temperature electronic [deg. C]	FLOAT	R	TMP temperature electronic [deg. C]
145	0091	TMP temperature bearing [deg. C]	FLOAT	R	TMP temperature bearing [deg. C]
146	0092	TMP temperature motor [deg. C]	FLOAT	R	TMP temperature motor [deg. C]

** Feature not available in TITANTEST™ Maintenance model

Command		Name	Data type	R/W	Meaning
dez	hex				
147	0093	Time since power on [min]	UINT32	R	Time since power on [min]
150	0096	TMP voltage [V]	FLOAT	R	TMP voltage as reported by TMP controller [V]
151	0097	TMP current [A]	FLOAT	R	TMP current as reported by TMP controller [A]
158	009E	TMP runup time [s]	UINT16	R	TMP runup time [s]
159	009F	Time in measure [s]	UINT16	R	Time in measure [s]
160	00A0	Time in evacuation [s]	UINT16	R	Time in evacuation [s]
161	00A1	Time in standby [s]	UINT16	R	Time in standby [s]
165	00A5	Electronic temperature [deg. C]	FLOAT	R	Electronic temperature [deg. C]
166	00A6	Preamplifier temperature [deg. C]	FLOAT	R	Preamplifier temperature [deg. C]
167	00A7	Anode voltage [V]	FLOAT	R	Anode voltage [V]
168	00A8	Cathode voltage [V]	FLOAT	R	Cathode voltage [V]
169	00A9	Suppressor voltage [V]	FLOAT	R	Suppressor voltage [V]
170	00AA	Anode-cathode voltage [V]	FLOAT	R	Anode-cathode voltage [V]
188	00BC	Maximum leak rate [sel. unit]	FLOAT	R	Maximum leak rate since last inquiry via interface [selected unit]
189	00BD	Maximum leak rate [mbar*l/s]	FLOAT	R	Maximum leak rate since last inquiry via interface [mbar*l/s]
202	00CA	Pre amplifier voltage [V]	FLOAT	R	Pre amplifier voltage [V]
212	00D4	24 V power out RC [V]	FLOAT	R	24 V power out RC [V]
213	00D5	24 V power out IO [V]	FLOAT	R	24 V power out IO [V]
221	00DD	Analog outputs [V]	FLOAT[2]	R	Analog outputs [V] Index 0: Channel 1 Index 1: Channel 2
222	00DE	Analog output configuration	UINT8[2]	R/W	Function of analog output Index 0: Channel 1 Index 1: Channel 2 see table / enumerations
223	00DF	Analog output leak rate scale (log. only	UINT8	R/W	Leak rate scaling of analog output in logarithmic mode see table / enumerations
224	00E0	Analog output upper exponent	SINT8	R/W	Upper limit for the analog out at the I/O modul. Value is exponent of the mbar*l/s value. Example: -5 = 1E-5 mbar*l/s
260	0104	Calibration status	UINT8	R	Status of calibration see table / enumerations
261	0105	PLC input state	UINT16	R	Get PLC input state see table / enumerations
262	0106	PLC output state	UINT16	R	Get PLC output state see table / enumerations

Command		Name	Data type	R/W	Meaning
dez	hex				
264	0108	Emission actual status	UINT8	R	Emission actual status 0 = OFF 1 = STANDBY 2 = ON
265	0109	Relais configuration	UINT8[2]	R/W	Relais configuration Index 0: Relais 1 Index 1: Relais 2 see table / enumerations
266	010A	TMP actual status	UINT8	R	TMP actual status 0 = OFF 1 = ON 2 = RUNNING_UP 3 = RUNNING_DOWN 4 = FAIL
275	0113	Calibration history	UINT8[*]	R	Calibration history To read send after the array index 255 the UINT8 history list index (0...11). Without history list index you will get the last (newest) entry. see table / enumerations
280	0118	Used entries in cal history	UINT8	R	Used entries in cal history
281	0119	Used entries in error history	UINT8	R	Used entries in error history
282	011A	Used entries in TMP error history	UINT8	R	Used entries in TMP error history
287	011F	Error history	UINT8[*]	R	Error history To read send after the array index 255 the UINT8 history list index (0...11). Without history list index you will get the last (newest) entry. see table / enumerations
288	0120	TMP error history	CHAR[8]	R	TMP error history To read send after the array index 255 the UINT8 history list index: (0...9) see table / enumerations
290	0122	Number of actual error	UINT16	R	Error number of the actual error or warning
297	0129	Present warnings	UINT8	R	Present warnings Each bit represents a warning see table / enumerations
299		HW-version	UINT8[4]	R	HW-version Index 1: IO board Index 2: display Index 3: backplane Index 4: MC68

Command		Name	Data type	R/W	Meaning
dez	hex				
300	012C	Device identification	UINT8[2]	R	Device identification Index 0, Manufacturer ID: 5 - Laco Index 1, Device ID: 1
301	012D	Device name	CHAR[*]	R	Get device name as ASCII string, "Titan-Test"
310	0136	SW-version MC68	UINT8[3]	R	Software-version MC68 Index 0: Main version Index 1: Sub version Index 2: Debug version
315	013B	SW-version TMP controller	CHAR[6]	R	SW version TMP controller (character string from TMP controller)
317	013D	TMP controller name	CHAR[6]	R	TMP controller name (character string from TMP controller)
320	0140	CRC-code MC68	UINT16	R	Checksum MC68
321	0141	DIP switch MC68	UINT8	R	DIP switch setting of the MC68: Bit7: S2, switch 4 Bit6: S2, switch 3 Bit5: S2, switch 2 Bit4: S2, switch 1 Bit3..2: not used,always 0 Bit1: S1, switch 3 Bit0: S1, switch 2
385	0181	Setpoint [mbar*l/s]	FLOAT[3]	R/W	Setpoint [mbar*l/s] Index 0: Vacuum Index 1: Sniff Index 2: AutoTest
386	0182	Warning limit [%]	UNIT8[3]	R/W	Warning limit [%] Index 0: Vacuum Index 1: Sniff Index 2: AutoTest
390	0186	Test leak extern vacuum [mbar*l/s]	FLOAT[3]	R/W	Test leak extern vacuum [mbar*l/s] Index 0: Mass 2 Index 1: Mass 3 Index 2: Mass 4 Helium
392	0188	Test leak extern sniff [mbar*l/s]	FLOAT[3]	R/W	Test leak extern sniff [mbar*l/s] Index 0: Mass 2 Index 1: Mass 3 Index 2: Mass 4 Helium
394	018A	Test leak intern [mbar*l/s]	FLOAT	R/W	Test leak intern in mbar*l/s
401	0191	Operation mode	UINT8	R/W	Operation mode 0 = Vacuum 1 = Sniff 2 = Auto Test

Command		Name	Data type	R/W	Meaning
dez	hex				
402	0192	Leak rate filter	UINT8	R/W	Leak rate filter 0 = Dynamic 1 = Static 2 = Without
406	0196	Serial number leak detector	CHAR[16]	R	Serial number of leak detector
409	0199	Zero with Start time [s]	UINT16	R/W	Zero with Start time [s]
410	019A	Zero mode	UINT8	R/W	Zero mode 0 = Disabled 1 = Enabled 2 = with START
419	01A3	Calibration request enable	UINT8	R/W	Calibration request enable 0 = disabled 1 = enabled
420	01A4	Volume	UINT8	R/W	Volume (Volume >= Volume min)
421	01A5	Volume min	UINT8	R/W	Volume min
427	01AB	Calibration access	UINT8	R/W	Calibration access 0 = disabled 1 = enabled
428	01AC	Calibration unit	UINT8	R/W	Calibration unit 0 - mbarl/s 1 - Pam3/s 2 - Torrl/s 3 - sccm 4 - sccs 5 - Atm ccs (6 - ppm) (7 - g/a) (8 - oz/yr) 6...8 only in Sniff
430	01AE	Pressure unit	UINT8	R/W	Pressure unit 0 = mbar 1 = Pa 2 = atm 3 = Torr

Command		Name	Data type	R/W	Meaning
dez	hex				
431	01AF	Leak rate unit	UINT8	R/W	Leak rate unit 0 - mbarl/s 1 - Pam3/s 2 - Torrl/s 3 - sccm 4 - sccs 5 - Atm ccs (6 - ppm) (7 - g/a) (8 - oz/yr) 6...8 only in Sniff
433	01B1	Anode setpoint M2 [V]	UINT16	R/W	Anode voltage setpoint for mass 2 (hydrogen) in V
434	01B2	Anode setpoint M3 [V]	UINT16	R/W	Anode voltage setpoint for mass 3 in V
435	01B3	Anode setpoint M4 [V]	UINT16	R/W	Anode voltage setpoint for mass 4 (helium) in V
441	01B9	Calibration mode	UINT8	R/W	Calibration mode 0 = int. auto. 1 = int. man. 2 = extern
449	01C1	Valve state	UINT16	R	Valve state see table / enumerations
450	01C2	Date+Time [YMDhms]	UINT8[6]	R/W	Date and time use only with array-index 255 (all bytes) year (1..99), month, day, hour (0..23), min, sec
452	01C4	Min pressure Sniff [mbar]	FLOAT	R/W	Minimum pressure for sniff mode [mbar]
453	01C5	Max pressure Sniff [mbar]	FLOAT	R/W	Maximum pressure for sniff mode [mbar]
454	01C6	Lower leak rate limit	UINT8	R/W	Lower leak rate limit 0 = 1.0E-12 mbar*l/s 1 = 1.0E-11 mbar*l/s 2 = 1.0E-10 mbar*l/s 3 = 1.0E-9 mbar*l/s
502	01F6	Amplifier range	UINT8	R	Amplifier range 0 = 13 MOhm 1 = 470 MOhm 2 = 15 GOhm 3 = 500 GOhm 4 = 13 MOhm (fixed) 5 = 470 MOhm (fixed) 6 = 15 GOhm (fixed) 7 = 500 GOhm (fixed)

Command		Name	Data type	R/W	Meaning
dez	hex				
504	01F8	500GOhm value	FLOAT	R/W	500GOhm value
506	01FA	Mass	UINT8	R/W	Mass 2 = Mass 2 (H2) 3 = Mass 3 4 = Mass 4 (Helium)
515	0203	Set desired leak rate	FLOAT	W	Set desired leak rate (KnL)
517	0205	Offset internal [A]	FLOAT[3]	R	Offset internal Index 0: mass 2 Index 1: mass 3 Index 2: mass 4
525	020D	Calibration factors	FLOAT[18]	R/W	Calibration factors see table / enumerations
529	0211	Warnings	UINT8	R/W	Warnings 0 = disabled 1 = enabled
530	0212	Cathode selection	UINT8	R/W	Cathode selection 1 = CAT 1 2 = CAT 2
540	021C	Pressure EVAC GROSS [mbar]	FLOAT	R/W	Pressure limit EVAC --> GROSS [mbar]
541	021D	Pressure GROSS FINE [mbar]	FLOAT	R/W	Pressure limit GROSS --> FINE [mbar]
543	021F	Pressure FINE ULTRA [mbar]	FLOAT	R/W	Pressure limit FINE --> ULTRA [mbar]
548	0224	Background subtraction	UINT8	R/W	Background subtraction 0 = disabled 1 = enabled
550	0226	Vacuum ranges	UINT8[3]	R/W	Vacuum ranges Index 0: GROSS Index 1: FINE Index 2: ULTRA
553	0229	Vent mode	UINT8	R/W	Vent mode 0 = Vent with Stop 1 = Vent manual 2 = No Vent
555	022B	Evacuation time [s]	UINT16	R/W	Evacuation time [s]
600	0258	Audio alarm type	UINT8	R/W	Audio alarm type 0 = Leak rate prop 1 = Trigger alarm 2 = Setpoint 3 = Pinpoint

Command		Name	Data type	R/W	Meaning
dez	hex				
602	025A	Audio alarm delay [s]	UINT16	R/W	Audio alarm delay 0, 1, 2, 3, ... 10, 12, 14, ... 30, 35, 40, ... 100, 110, 120, 300, 330, 360, ... 600 60000 = infinite
604	025C	Audio beep	UINT8	R/W	Audio beep 0 = disabled 1 = enabled
626	0272	Bypass evacuation	UINT8	R/W	Bypass option evacuation 0 = Fore pump only 1 = Both pumps 2 = External pump only
627	0273	Bypass measure	UINT8	R/W	Bypass option measure 0 = Fore pump only 1 = Both pumps 2 = External pump only
630	0276	AutoTest delay timer [s]	UINT16	R/W	Auto Test Delay timer [s]
631	0277	AutoTest test timer [s]	UINT16	R/W	Auto Test test timer [s] 0 means infinite
632	0278	AutoTest background timer [s]	UINT16	R/W	AutoTest background timer [s] 0 means infinite
640	0280	AutoTest background [mbar*l/s]	FLOAT	R/W	AutoTest background limit [mbar*l/s]
641	0281	AutoTest external trigger	UINT8	R/W	AutoTest external trigger 0 = disabled 1 = enabled
642	0282	AutoTest reject mode	UINT8	R/W	AutoTest reject mode 0 = Q max 1 = Q last
645	0285	Fill complete	NO_DATA	W	Autotest Fill complete
650	028A	Postamplifier range	UINT8	R	Postamplifier range 0 = 0.4 1 = 1.6 2 = 6.4 3 = 25.6 4 = 0.4 (FIXED) 5 = 1.6 (FIXED) 6 = 6.4 (FIXED) 7 = 25.6 (FIXED)
652	028C	Postamplifier voltage [V]	FLOAT	R	Postamplifier voltage [V]
700	02BC	AutoTest status	UINT8	R	AutoTest status see table / enumerations

Command		Name	Data type	R/W	Meaning
dez	hex				
702	02BE	AutoTest result	UINT8	R	AutoTest status see table / enumerations
703	02BF	Auto Test result leak rate [sel. unit]	FLOAT	R	AutoTest result leak rate in selected unit
704	02C0	AutoTest timer [s]	UINT16	R	AutoTest timer [s]
705	02C1	Auto Test result leak rate [mbar*l/s]	FLOAT	R	AutoTest result leak rate in mbar*l/s
1161	0489	Parameter reset	UINT8	W	Parameter reset: 1 = Load factory settings 5 = Clear PINs 10 = Clear calibration history 11 = Clear error list 12 = Clear Maintenance list 13 = Clear Service list
1350	0546	Valve cycle counter	UINT32[7]	R	Valve cycle counter see table / enumerations
1360	0550	Maintenance device [h]	UINT32	R	Maintenance device [h]
1361	0551	Maintenance fore pump [h]	UINT32	R	Maintenance fore pump [h]
1362	0552	Maintenance TMP [h]	UINT32	R	Maintenance TMP [h]
1363	0553	Maintenance ion source [h]	UINT32	R	Maintenance ion source [h]
1399	0577	Group measure [sel. unit]	UINT[12]	R	Measurement data [sel. Unit] see table / enumerations
1400	0578	Group measure	UNIT8[12]	R	Measurement data see table / enumerations
1567	061F	Offset current amplifier [A]	FLOAT	R	Offset current amplifier [A]
1568	0620	Unfiltered ion current [A]	FLOAT	R	Unfiltered ion current [A]
1573	0625	Filtered ion current [A]	FLOAT	R	Filtered ion current [A]
1854	073E	Gross leak limit [mbar*l/s]	FLOAT	R/W	Gross leak protection limit [mbar*l/s]
1855	073F	Gross leak protection	UINT8	R/W	Gross leak protection 0 = disabled 1 = enabled
2490	09BA	Internal pressure 1 [V]	FLOAT	R	Internal pressure 1 [V]
2491	09BB	Internal pressure 2 [V]	FLOAT	R	Internal pressure 2 [V]
2501	09C5	Parameter set	UINT8	R/W	Parameter set 0 = load default 1, 2 = load 1, 2 4, 5 = save 1, 2
2591	0A1F	Control location	UINT8	R/W	Control location 0 = local 1 = RS232 2 = PLC 3 = local / RS232 4 = all

Command		Name	Data type	R/W	Meaning
dez	hex				
2628	0A44	Pressure sensor offset [mV]	SINT16[2]	R/W	Pirani offset [mV] Index 0: Offset p1 Index 1: Offset p2
2640	0A50	Used entries in service history	UINT8	R	Used entries in service history
2641	0A51	Service history	UINT8[15]	R	Service history To read send after the array index 255 the UINT8 service list index (0...11). Without index you will get the last (newest) entry. see table / enumerations
2642	0A52	Used entries in maintenace history	UINT8	R	Used entries in maintenace history
2643	0A53	Maintenace history	UINT8[15]	R	Maintenace history To read send after the array index 255 the UINT8 maintenace list index (0...11). Without index you will get the last (newest) entry. see table / enumerations
2660	0A64	Maintenace activ	UINT8	R/W	Maintenace activ 0 = disabled 1 = enabled

12.5 Enumerations**

Interface protocol (command 26)

Value	Meaning
0	ASCII (RS232/RS485 only)
1	Diagnostics (RS232/RS485 only)
2	LD Protocol (both)
3	LRC (RC only)

Analog output configuration (command 222)

Value	Meaning
0	off
1	Pressure p2
2	Pressure p1
3	Leak rate mantissa
4	Leak rate exponent
5	Leak rate linear
6	Leak rate logarithmic

Analog output leak rate scale (log. only) (command 223)

Value	Meaning
0	0,5 V / decade
1	1 V / decade
2	2 V / decade
3	2,5 V / decade
4	5 V / decade
5	10 V / decade

State calibration (command 260)

Value	Meaning
0	Inactive
1	Wait "Test leak connected"
2	Pump down
3	Wait "Test leak signal stable"
4	Autotune
5	Measure ULTRA
6	Measure FINE
7	Measure GROSS
8	Wait "Test leak closed" or "Background stable"
9	Background ULTRA
10	Background FINE

** Feature not available in TITANTEST™ Maintenance model

Value	Meaning
11	Background GROSS
12	Wait "Calibration result"

PLC input state (command 261)

Value Index Bit	Meaning
0x0001	Pin 6 Start / Stop
0x0002	Pin 7 Vent
0x0004	Pin 8 Zero
0x0008	Pin 9 Calibrate
0x0010	Pin 10 Para 2
0x0020	Pin 11 ---
0x0040	Pin 12 Fill complete
0x0080	Pin 13 ---
0x0100	Sniffer button
0x0200	-----
0x0400	-----
0x0800	-----
0x1000	-----
0x2000	-----
0x4000	-----
0x8000	-----

PLC output state (command 262)

Value Index Bit	Meaning
0x0001	Pin 15 Ready
0x0002	Pin 16 Measure mode
0x0004	Pin 17 Leak
0x0008	Pin 18 Error
0x0010	Pin 19 Calibrate Acknowledge
0x0020	Pin 20 Fill Helium
0x0040	Pin 21 Bypass valve
0x0080	Pin 22 No Leak
0x0100	Relay 1
0x0200	Relay 2
0x0400	-----
0x0800	-----
0x1000	-----
0x2000	-----
0x4000	-----
0x8000	-----

Relais configuration (command 265)

Value	Meaning
0	Off
1	Start
2	Stop
3	Start / Stop
4	Ready
5	Setpoint
6	On
7	Warn limit LR
8	Bypass valve
9	Warning
10	Error
11	Warning / Error
12	Vented

TMP error history (command 288)

Answer	ListNo, code
Example	5 Err006

Present warnings (command 297)

Value Index Bit	Meaning
0x01	-----
0x02	-----
0x04	-----
0x08	Warning maintenance
0x10	Warning calibration request
0x20	Warning capillary
0x40	Warning temperature electronic
0x80	Warning temperature preamplifier

Valve state (command 449) and
Valve cycle counter (command 1350)

Index	Meaning
0	V1
1	V2
2	V3
3	v4
4	V5
5	V6
6	VBypass
7	-----
8	-----

Calibration factor (command 525)

Index	Meaning
0	ULTRA, Vacuum, Mass 2
1	ULTRA, Vacuum, Mass 3
2	ULTRA, Vacuum, Mass 4 (Helium) (not used)
3	ULTRA, Sniff, Mass 2
4	ULTRA, Sniff, Mass 3
5	ULTRA, Sniff, Mass 4 (Helium)
6	FINE, Vacuum, Mass 2
7	FINE, Vacuum, Mass 3
8	FINE, Vacuum, Mass 4 (Helium)
9	FINE, Sniff, Mass 2
10	FINE, Sniff, Mass 3
11	FINE, Sniff, Mass 4 (Helium)
12	GROSS, Vacuum, Mass 2
13	GROSS, Vacuum, Mass 3
14	GROSS, Vacuum, Mass 4 (Helium)
15	GROSS, Sniff, Mass 2
16	GROSS, Sniff, Mass 3
17	GROSS, Sniff, Mass 4 (Helium) (not used)

AutoTest status (command 700)

Value	Meaning
0	Standby (Idle)
1	State 1
2	Evacuation
3	GROSS
4	State 4
5	State 5
6	FINE
7	State 7
8	ULTRA
9	State 9
10	State 10
11	State 11
12	State 12
13	Evacuation
14	State 14
15	Evacuation (MS-Evac)
16	State 16
17	State 17
18	State 18

Value	Meaning
19	Delay timer
20	Helium BG limit
21	External trigger
22	Test timer

AutoTest result (command 702)

Value	Meaning
0	Idle
1	Running 1
2	Pass
3	Fail

12.6 Group commands**

Group calibration history (command 275, one entry)

Meaning	Data type	Offset
Year	UINT8	0
Month	UINT8	1
Day	UINT8	2
Hour	UINT8	3
Minute	UINT8	4
Second	UINT8	5
Calibration mode	UINT8	6
Filament	UINT8	7
Measure mode	UINT8	8
Mass	UINT8	9
Anode voltage	UINT16	10
Factor ULTRA	FLOAT	12
Factor FINE	FLOAT	16
Factor GROSS	FLOAT	20
Calibrated leak [mbar*l/s]	FLOAT	24
Ion current (leak opened) [A]	FLOAT	28
Ion current (leak closed) [A]	FLOAT	32

** Feature not available in TITANTEST™ Maintenance model

Group error history (command 287, one entry)

Meaning	Data Type	Offset
Year	UINT8	0
Month	UINT8	1
Day	UINT8	2
Hour	UINT8	3
Minute	UINT8	4
Second	UINT8	5
Priority	UINT8	6
Number	UINT16	7
Value	UINT16	9

Group measure, selected unit (command 1399)

Meaning	Data Type	Offset	Command dec
Leak rate [sel. unit]	FLOAT	0	128
Internal pressure 1 [sel. unit]	FLOAT	4	130
Internal pressure 2 [sel. unit]	FLOAT	8	132

Group measure (command 1400)

Meaning	Data type	Offset	Command dec
Leak rate [mbar*l/s]	FLOAT	0	129
Internal pressure 1 [mbar]	FLOAT	4	131
Internal pressure 2 [mbar]	FLOAT	8	133

Group service history (command 2641, one entry)
Group maintenace history (command 2643, one entry)

Meaning	Data type	Offset
Year	UINT8	0
Month	UINT8	1
Day	UINT8	2
Hour	UINT8	3
Minute	UINT8	4
Second	UINT8	5
Operating hours	UINT32	6
Hours	UINT32	10
Component 0 = TMP 1 = Fore pump 2 = Ion source 3 = Device	UINT18	14

12.7 Error messages**

Telegram error handling

- Slave discards all characters until it receives a STX as telegram start identifier.
- Slave does not generate an error message, if address is not correct.
- Slave reports CRC errors with error message 1 (CRC failure)
- Slave reports length errors with error message 2 (Illegal telegram length) or 11 (Data length is not correct for the command)

To prevent the response from colliding with the next request, the slaves do not respond in case of a timeout.

Error numbers (if status word Bit 15 is set 1)

Error No.	Error numbers	
1	ERR_CRC	CRC-failure
2	ERR_LEN	Illegal telegram length
10	ERR_CMD_ILLEGAL	command doesn't exist
11	ERR_DATA_LENGTH	Data length is not correct for the command
12	ERR_NO_READ	Read not allowed
13	ERR_NO_WRITE	Write not allowed
14	ERR_ARRAY_INDEX	Array-Index out of range or missing
20	ERR_CONTROL	Control actually not allowed with this interface
21	ERR_PASSWORD	Password not OK
22	ERR_CMD_NOT_ALLOWED	Command actually not allowed (e.g. calibration during Run-Up)
30	ERR_DATA	Data not in range
31	ERR_NO_DATA	No data available

** Feature not available in TITANTEST™ Maintenance model

13.ASCII Protocol

13.1 Communication Parameters

Data format	
Baudrate	19200, 8 data bits, 1 stop bit, no parity

13.2 Command Format

In ASCII protocol any command starts with « * » (ASCII code 42dec/2Ahex) and is finished with the end sign CR (ASCII code 13dex/0Dhex). There is no differentiation between upper and lower case. A blank is required between the command and the parameter, no other blanks are allowed.

There is a short and an extended form of the command. Either the short or the extended command must be used, no other abbreviations are allowed. Command Words have to be separated by a colon. A command can be composed of up to three words. Parameters have to be separated by a comma.

Each command is answered with the requested data, „ok“ or „EXX“ (in case of an error). For a list of all error messages *see chapter 13.7: "Error Messages**", page 142*. The transmission can be cancelled and the receive-buffer will be cleared with ESC (ASCII code 27dec/1Bhex), ^C (ASCII code 3dec/03hex) or ^X (ASCII code 24dec/18hex).

Some commands can be used as queries, some can be used to set menu parameter and some can be used for both. A query is marked by a „?“ (ASCII code 63dec/3Fhex) after the command; for setting data the command has to be followed by the new value to be set.

Parameter can be Boolean or numerical:

<b>	Boolean	0 / 1 or OFF / ON
<No>	Numeric representation format: integer, real (15.6) or exponential (4.5^{-7})	
	Format: [space] [sign] [ddd] [.] [e[sign]ddd] (d:digit)	

NOTICE Always use a point as the decimal marker. If a comma is used during numerical data entry, the conversion of the number is cancelled at this point and only the integer part of the number will be used.

Timing recommendations for the PC/PLC - Program:

Sample rate > 100 ms

Timeout between request to and answer from TitanTest: 1500 ms

After sending a command the answer must be waited for before sending a new command. Otherwise the receive buffer may be overwritten.

13.3 Commands**

Command	Meaning	Relates to LD cmd. no.	Read/Set
*CAL	Start calibration, acknowledge closed external test leak	4	W
*CLS	Clear Error	5	W
*CONFig:ALARMDelay	Alarm delay after evacuation [s]	602	R/W
*CONFig:AUDio	Audio alarm type (PIN, SET, TRIG, PROP)	600	R/W
*CONFig:AUTOTest:BACKGround	Auto test BG limit [sel. unit]	640	R/W
*CONFig:AUTOTest:BGTimer	Auto test BG timer [s]	632	R/W
*CONFig:AUTOTest:DELAYTimer	Auto test delay timer [s]	630	R/W
*CONFig:AUTOTest:EXTTrigger	Auto test external trigger	641	R/W
*CONFig:AUTOTest:REJECTMode	Auto test reject mode	642	R/W
*CONFig:AUTOTest:TESTTimer	Auto test test timer [s]	631	R/W
*CONFig:BEEP	Beep-sound (OFF, ON)	604	R/W
*CONFig:CALAccess	CAL access (OFF, ON)	427	R/W
*CONFig:CALleak:EXTSniff	External test leak in sniff mode	392	R/W
*CONFig:CALleak:EXTVac	External test leak in vacuum mode	390	R/W
*CONFig:CALleak:INT	Internal test leak	394	R/W
*CONFig:CALREQ	Calibration request (OFF,ON)	419	R/W
*CONFig:CAThode	Cathode (1,2)	530	R/W
*CONFig:CONTrol	location of control (LOCAL, RS232, PLC, LOCAL/RS232, ALL)	2591	R/W
*CONFig:FILTER	Leak rate filter "DYNAMIC","STATIC","WITHOUT"	402	R/W
*CONFig:LANGuage	Language (ENGlish, DEUtch, FRAncais, ESPanol, RUSsian)	398	R/W
*CONFig:LCDAutorange	Display range auto / manual	---	R/W
*CONFig:LCDDECades	Number of display decades	---	R/W
*CONFig:LCDInvert	Invert display	---	R/W
*CONFig:LCDSCALELog	Display scale lin. / log.	---	R/W
*CONFig:LIMITLOW	Lower display limit	454	R/W
*CONFig:MASS	Mass (2 (H2), 3, 4(Helium))	506	R/W
*CONFig:MFAE	Actual anode potential reference [V]	167	R/W
*CONFig:MFAE:M2	anode potential reference [V] mass 2	433	R/W
*CONFig:MFAE:M3	anode potential reference [V] mass 3	434	R/W
*CONFig:MFAE:M4	anode potential reference [V] mass 4	435	R/W
*CONFig:MINVOLume	Minimum audio volume	421	R/W
*CONFig:MODE	Mode (VAC, SNIFF, AUTO_TEST)	401	R/W
*CONFig:PARTIALFlow:EVACuation	Configuration of partial flow pump for evacuating (Fore_PUMP, Fore_AND_Partial_flow_PUMP, Partial_flow_PUMP)	626	R/W

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Command	Meaning	Relates to LD cmd. no.	Read/Set
*CONFig:PARTIALFlow:MEASure	Configuration of partial flow pump for measuring mode (Fore_PUMP, Fore_AND_Partial_flow_PUMP)	627	R/W
*CONFig:PEVACgross	pressure limit EVAC -> GROSS in mbar	540	R/W
*CONFig:PFINEultra	pressure limit FINE -> ULTRA in mbar	543	R/W
*CONFig:PGROSSfine	pressure limit GROSS -> FINE in mbar	541	R/W
*CONFig:PLCOUTLINK	Configuration of Relais Output 1 (*CONFig:PLCOUTLINK:1) or 2 (*CONFig:PLCOUTLINK:2). The following settings are possible: "OFF", "START", "STOP", "START_STOP", "READY", "SETPOINT", "ON", "WARN_LIMIT", "BYPASS", "WARNING", "ERROR", "WARNING_ERROR", "VENTED"	263	R/W
*CONFig:PROTection: CONTamination	Gross leak protection (ON,OFF)	1855	R/W
*CONFig:PROTection:CONTLimit	Gross leak protection limit	1854	R/W
*CONFig:PROTection:EVACtime	Maximum evacuation time (0 means infinite)	555	R/W
*CONFig:PROTection:PMAX	Maximum pressure in sniff	453	R/W
*CONFig:PROTection:PMIN	Minimum pressure in sniff	452	R/W
*CONFig:RECorder:LINK1	Function at analog output channel 1 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG)	222	R/W
*CONFig:RECorder:LINK2	Function at analog output channel 2 (OFF, P1, P2, MANT, EXP, LR_LIN, LR_LOG)	222	R/W
*CONFig:RECorder:SCALE	Analog leak rate scale	223	R/W
*CONFig:RECorder:UPPEREXP	Analog output upper exponent	224	R/W
*CONFig:RS232	RS232 protocol (ASCII, BINARY, LD)	26	R/W
*CONFig:SETPoint	Leak rate setpoint in selected unit	385	R/W
*CONFig:SUPPRession	Offset suppression at start (OFF, INTERN, INLET)	548	R/W
*CONFig:TIMEAXIS	Resolution of the time axis of Q(t) graph	---	R/W
*CONFig:UNIT:LR	Leak rate unit (mbar*l/s, Pa*m3/s, Torr*l/s, sccm, sccs, atm*cc/s, ppm, g/a, oz/yr)	431	R/W
*CONFig:UNIT:Pressure	Pressure unit (mbar, Pa, atm, Torr)	430	R/W
*CONFig:VACRANGE	Active vacuum ranges: GROSS, FINE and ULTRA as comma seperated list	550	R/W
*CONFig:VOLume	Volume	420	R/W
*CONFig:WARNLimit	Warning limit	386	R/W
*CONFig:ZERO	Zero mode (OFF, ON, AT_START)	410	R/W
*FACtor:RESistor	Resistor factor 500G/15G	504	R/W
*FACtor:SNiff:M2	Calibration factor sniff mass 2	525	R/W
*FACtor:SNiff:M3	Calibration factor sniff mass 3	525	R/W
*FACtor:SNiff:M4	Calibration factor sniff mass 4	525	R/W
*FACtor:VACUUM_Fine:M2	Calibration factor vacuum FINE mass 2	525	R/W
*FACtor:VACUUM_Fine:M3	Calibration factor vacuum FINE mass 3	525	R/W

Command	Meaning	Relates to LD cmd. no.	Read/Set
*FACtor:VACUUM_Fine:M4	Calibration factor vacuum FINE mass 4	525	R/W
*FACtor:VACUUM_Gross:M2	Calibration factor vacuum GROSS mass 2	525	R/W
*FACtor:VACUUM_Gross:M3	Calibration factor vacuum GROSS mass 3	525	R/W
*FACtor:VACUUM_Gross:M4	Calibration factor vacuum GROSS mass 4	525	R/W
*FACtor:VACUUM_Ultra:M2	Calibration factor sniff mass 2	525	R/W
*FACtor:VACUUM_Ultra:M3	Calibration factor sniff mass 3	525	R/W
*FACtor:VACUUM_Ultra:M4	Calibration factor sniff mass 4	525	R/W
*HOUR:DATE	Date (DD,MM,YYYY)	450	R/W
*HOUR:DEVice	Operating hours of device	142	R
*HOUR:POWer	Time since power on [min]	147	R
*HOUR:RUNUP	Run up time [s]	158	R
*HOUR:SERVice:DEVICE	Opration hour timer reading at last service (complete leak detector) [h]	1360	R
*HOUR:SERVice:FOREPUMP	Opration hour timer reading at last fore pump service (complete leak detector) [h]	1361	R
*HOUR:SERVice:IONSOURCE	Opration hour timer reading at last ion source service (complete leak detector) [h]	1363	R
*HOUR:SERVice:TURBO	Opration hour timer reading at last TMP service [h]	1362	R
*HOUR:TC	Operating hours frequency converter	141	R
*HOUR:TIME	Time (HH,MM)	450	R/W
*HOUR:TURBO	Operating hours of TMP	140	R
*IDN:CRC	Check sum of firmware	320	R
*IDN:DEVice	Name of instrument (always "TitanTest")	301	R
*IDN:DIP1	MSB DipSwitch 1	321	R
*IDN:DIP2	MSB DipSwitch 2	321	R
*IDN:GBversion	Hardware identification control panel	299	R
*IDN:IOversion	Hardware identification IO panel	299	R
*IDN:MC68	Hardware identification MC68	299	R
*IDN:SERial	Serial-number leak detector	406	R
*IDN:TCNAME	Name of TMP frequency converter	317	R
*IDN:TURBO	Software version TMP controller	315	R
*IDN:VDversion	Hardware identification mother board	299	R
*IDN:VERsion	Software version leak detector	310	R

Command	Meaning	Relates to LD cmd. no.	Read/Set
*MEASure:DIGITALIN	State of the digital inputs 0x0001 Pin 6 Start / Stop 0x0002 Pin 7 Vent 0x0004 Pin 8 Zero 0x0008 Pin 9 Calibrate 0x0010 Pin 10 Para 2 0x0020 Pin 11 --- 0x0040 Pin 12 Fill complete 0x0080 Pin 13 --- 0x0100 Sniffer button	261	R
*MEASure:IFilter	Filtered ion current [A]	1573	R
*MEASure:IMeas	Unfiltered ion current [A]	1568	R
*MEASure:LRMAX	Maximum leak rate since last inquiry via interface in selected unit	---	R
*MEASure:MIAKP	Anode-/cathode potential [V]	170	R
*MEASure:MIAP	Anode potential [V]	167	R
*MEASure:MIKP	Cathode potential [V]	168	R
*MEASure:MISP	Suppressor potential [V]	169	R
*MEASure:OFFset	Offset current [A]	1567	R
*MEASure:P1	p1 pressure (fore line) in selected unit	130	R
*MEASure:P1:ATM	p1 pressure (fore line) in atm		R
*MEASure:P1:MBAR	p1 pressure (fore line) in mbar	131	R
*MEASure:P1:PA	p1 pressure (fore line) in Pa		R
*MEASure:P1:TORR	p1 pressure (fore line) in Torr		R
*MEASure:P2	p2 pressure (inlet) in selected unit	132	R
*MEASure:P2:ATM	p2 pressure (inlet) in atm		R
*MEASure:P2:MBAR	p2 pressure (inlet) in mbar	133	R
*MEASure:P2:PA	p1 pressure (inlet) in Pa		R
*MEASure:P2:TORR	p2 pressure (inlet) in Torr		R
*MEASure:REC0	Outpot voltage recorder channel 1	221	R
*MEASure:REC1	Outpot voltage recorder channel 2	221	R
*MEASure:RESULTLR	AutoTest result in selected unit	703	R
*MEASure:RESULTLR:ATM*cc/s	AutoTest result in atm*cc/s		R
*MEASure:RESULTLR:G/a	AutoTest result in g/a		R
*MEASure:RESULTLR:LB/yr	AutoTest result lb/yr		R
*MEASure:RESULTLR:MBAR*l/s	AutoTest result in mbar*l/s	705	R
*MEASure:RESULTLR:OZ/yr	AutoTest result oz/yr		R
*MEASure:RESULTLR:PA*m3/s	AutoTest result Pa*m3/s		R
*MEASure:RESULTLR:PPM	AutoTest result in ppm		R
*MEASure:RESULTLR:TORR*l/s	AutoTest result in Torr*l/s		R

Command	Meaning	Relates to LD cmd. no.	Read/Set
*MEASure:SAVEDOFFset:M2	Saved leak rate offset for mass 2	517	R
*MEASure:SAVEDOFFset:M3	Saved leak rate offset for mass 3	517	R
*MEASure:SAVEDOFFset:M4	Saved leak rate offset for mass 4	517	R
*MEASure:TEMPeratur:Amplifier	Preamplifier temperature [°C]	166	R
*MEASure:TEMPeratur:Electronic	Electronic temperature [°C]	165	R
*MEASure:TEMPeratur:TCBearing	TMP temperature bearing [°C]	145	R
*MEASure:TEMPeratur:TCElectronic	TMP electronic temperature [°C]	144	R
*MEASure:TEMPeratur:TCMotor	TMP motor temperature [°C]	146	R
*MEASure:TEMPeratur:TCPump	TMP temperature bottom [°C]	143	R
*MEASure:TURBO:Current	TMP current [A]	151	R
*MEASure:TURBO:Frequency	TMP frequency [Hz]	138	R
*MEASure:TURBO:Power	TMP power [W]	139	R
*MEASure:TURBO:Voltage	TMP voltage[V]	150	R
*MEASure:UFB	Remote control voltage [V]	212	R
*MEASure:UNV	Amplifier voltage [V]	652	R
*MEASure:UOUT	Voltage extern [V]	213	R
*MEASure:UVV	Preamplifier voltage [V]	202	R
*READ	Leak rate in selected unit	128	R
*READ:ATM*cc/s	Leak rate in Atm*cc/s		R
*READ:G/a	leak rate in g/a (only in sniff)		R
*READ:MBAR*l/s	Leak rate in mbar*l/s	129	R
*READ:OZ/yr	Leak rate in oz/yr (only vaild in sniff)		R
*READ:PA*m3/s	Leak rate in $Pa*m^3/s$		R
*READ:PPM	Leak rate in ppm (only vaild in sniff)		R
*READ:TORR*l/s	Leak rate in Torr*l/s		R
*STArt	Start (switch from Standby to Measure)	1	W
*STATus	Status of leak detector (INIT, ACCL, STBY, VENT, WAIT_EVAC, EVAC, MEAS, CAL, ERROR)	Status word	R
*STATus:CAL	Calibration status: "IDLE", "WAIT", "EVAC", "WAIT_TL_STABLE", "TUNE", "TL_OPEN_ULTRA", "TL_OPEN_FINE", "TL_OPEN_GROSS", "WAIT_CLOSE", "TL_CLOSE_ULTRA", "TL_CLOSE_FINE", "TL_CLOSE_GROSS", "WAIT_RESULT"	260	R
*STATus:CALHist	Calibration history 1 to 12 (date, time, type of calibration, mode, calibration factors)	275	R
*STATus:CALMode	Kind of calibration (AUTO, MANUAL, EXTERNAL)	---	R

Command	Meaning	Relates to LD cmd. no.	Read/Set
*STATus:ERRHist	Error history *STATus:ERRHist Actual entry *STATus:ERRHist:1 Entry 1 (newest) *STATus:ERRHist:2 Entry 2 ... *STATus:ERRHist:15 Entry 15 (oldest)	287	R
*STATus:ERRor	Current number of error / warning („NO ERROR/WARNING“ if no error / warning)	290	R
*STATus:MAINTenanceHist	Maintenance history 1 to 12	2643	R
*STATus:PREAMPRESistor	Currently used resistance of pre-amplifier (13M, 470M, 15G, 500G, 13M_FIXED, 470M_FIXED, 15G_FIXED,500G_FIXED)	502	R
*STATus:RANGE	Measuring range (GROSS, FINE, ULTRA)	status word	R
*STATus:RESULT	Status / result of auto leak test (IDLE, RUNNING, PASS, FAIL, NONE)	702	R
*STATus:SECINMEAS	Time since change of measuring mode [s]	159	R
*STATus:SERviceHist	Service history 1 to 12	2641	R
*STATus:ZERO	Zero (ON, OFF)	6	R
*STOp	Stop (switch from Measure to Standby)	2	W
*VENt	Vent inlet port	3	W
*ZERO	Switch zero on	6	W
*ZERO:OFF	Switch zero off	6	W
*ZERO:ON	Switch zero on	6	W

13.4 External Calibration Sequence

1. Open test leak
2. Start calibration: *CAL
3. Wait until *STATUS:CAL? answers "WAIT_TL_STABLE"
4. Send *CAL if signal is stable
5. Wait until *STATUS:CAL? answers "WAIT_CLOSE"
6. Close test leak
7. Send *CAL
8. Wait until *STATUS:CAL? answers "WAIT_RESULT"
9. Send *CAL to accept new calibration factors

13.5 Internal Calibration Sequence

1. Start caribration: *CAL
2. Wait until *STATUS:CAL? answers "WAIT_RESULT"
3. Send *CAL to accept new calibration factors

13.6 Examples

Command	answer	
*stat? (CR)	MEAS (CR)	mode
*status? (CR)	MEAS (CR)	mode
*read? (CR)	2.876E-7 (CR)	leak rate according to programmed unit
*read:pa*m3/s? (CR)	2.876E-6 (CR)	leak rate in a different unit
*start (CR)	OK (CR)	start measurement
*conf:trig1? (CR)	1.0E-9 (CR)	retrieve trigger 1
*conf:trig1 2.0E-9 (CR)	OK (CR)	set trigger 1

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13.7 Error Messages**

Message	Meaning
OK	command completed
E01	wrong command start (no „*“)
E02	illegal blank
E03	command word 1 illegal
E04	command word 2 illegal
E05	command word 3 illegal
E06	control by RS232 not enabled
E07	argument faulty
E08	no data available
E09	error buffer overflow
E10	command invalid
E11	query not allowed
E12	only query allowed
E13	not yet implemented

14.Trouble Shooting

14.1 Serial communication via RS232 (common)**

Error	Possible Reason	Solution
No characters are received via the interface/the leak detector does not answer	Wrong cable	Please use a 1:1 cable, (NO null-modem cable, also called cross-over cable!)
	Problems with flow control	Deactivate flow control in PC/PLC or use cable according to the wiring diagram in Section 2
	Wrong COM-Port used at PC	Select correct COM-Port
No characters are received via the interface/the leak detector does not answer	Wrong interface parameters (Baud rate, Data bits, Parity, Stop bits)	Check if interface parameters (Baud rate, number of data bits, parity bit and number of stop bits in the leak detector and PC/PLC match)
	Wrong protocol selected in the leak detector	Select correct protocol in the leak detector
	PC uses an USB-RS232 converter	In general the IO1000 will also work with an USBRS232- converter. However, these often cause multiple difficult to track problems (driver, flow control.) Please test your PC program on a “real” RS232 interface first preferably. Especially with USB-RS232-converters it is often helpful to use a cable according to the wiring diagram in chapter 4 of the IO1000 documentation.
	Serial interface of PC is (still) occupied with a different program	Check if other programs uses the serial interface. It is also possible that an already closed program has not released the interface again yet. In this case a restart of the PC will help.
The leak detector replies with “unreadable? characters	Wrong interface parameters (Baud rate, Data bits, Parity, Stop bits)	Check if interface parameters (Baud rate, number of data bits, parity bit and number of stop bits in the IO1000 and PC/PLC match)
	Wrong protocol selected in the leak detector	Select correct protocol in the leak detector

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14.2 LD Protocol specific**

Error	Possible Reason	Solution
IO1000 does not reply	Wrong Address	Always use Address 1 in LD protocol.
	Other protocol errors	Try to use NOP command (05hex 04hex 01hex 00hex 00hex 77hex) first, to check if connection works in general. The answer should be 02hex 05hex XXhex XXhex 00hex 00hex XXhex
IO1000 replys with CRC error (error code 1)	Wrong CRC calculation	Check you CRC code calculation. See example C source file "CRC_calculation.c" provided by INFICON. Check your code with unit test function in this source code file.

14.3 ASCII Protocol specific**

Error	Possible Reason	Solution
IO1000 does not reply/leak detector replies after several command with “E10?	“Carriage Return? at the end of the command is missing	Finish all commands with “Carriage Return? (ASCII 0dhex/13dez)
leak detector replies with error message to the first command only, following commands are interpreted correctly	Receiving buffer of the leak detector was not empty before sending the first command (e.g. by plugging in the RS232 cable during operation)	In the ASCII protocol the leak detector has not time out function which will empty the receiving buffer automatically. Therefore, the buffer should be emptied before the first command by sending of ESC, ^C or ^X

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