BioTector Vacuum Sampler

USER MANUAL
BioTector Vacuum Sampler
For connection to BioTector TOC Analyzers.

ARM M3 system with programmable double reactor wash and tube wash.
Software: Vacuum Sampler V001

Original Instructions

Read the instructions in this manual carefully before installing or starting the Vacuum Sampler for the BioTector TOC analyzer.

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Where manuals are translated into several languages, the source language text is considered as the original.

Caution	Maintenance / operation should not be carried out unless personnel have been fully trained in the operation of the BioTector M3 Vacuum Sampler. Prior to working on the inside of the sampler, the technician should be grounded via an earth strap.

Precautionary Labels Attached to the Instrument

	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

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BioTector Vacuum Sampler, operation.

The Vacuum Sampler is designed to bring samples up from a depth of 6 meters, with a maximum horizontal distance of 40 meters, and to provide the BioTector with a sample at atmospheric pressure.

Additionally, the Vacuum Sampler can be used as a gravity filtration system, where sand and other hard particles, which may be in the sample, are allowed to settle in the sampling chamber before the BioTector takes its sample.

The Vacuum Sampler, when used with the BioTector TOC analyzer has 3 general modes of operation. These modes are made by hardwiring inputs into the PLC used to control the Vacuum Sampler.

Mode 1.

This is the operating mode of the Vacuum Sampler for BioTector TOC analysers fitted with the ARS valve. It is also the mode to be used for single / dual reactor VOC systems.

This mode is selected by making the following connections to the PLC:
Input 5, No Connection.
Input 6, Connection.
Input 7, No Connection.
Input 8, No Connection.

Note: In this mode, once the Vacuum Sampler receives the Sampler Fill command from the BioTector, it will start its fill sequence, and will not reset until it receives a sample pump reverse signal.

All sequences can also be reset at any time by holding down the Fault Acknowledge button on the Vacuum Samplers keyboard for more than 5 seconds.

Phase 1: When the BioTector gives the Sampler Fill signal to the Vacuum Sampler the sampling chamber fills, in the following sequence:
   a. For 11 seconds, no action is performed by the Vacuum Sampler. This time delay allows the BioTector to carryout synchronisation sequences on the sample pump, if required.
   b. This is followed by a 5-second vent period, as the vacuum pump will not start if there is any vacuum in the chamber.
   c. After the vent period the vacuum pump runs, and this generates a vacuum in the sampling chamber.
   d. Timer FBD000 in the Vacuum Sampler starts to time out.

Phase 2: Typically, the Vacuum Sampler will fill from a depth of 5 meters in 40 seconds. When the conductivity probe detects the sample water, the following actions are carried out:
   a. The vacuum pump stops.
   b. The Vacuum Samplers pinch valve closes.
   c. Both three-way valves open, releasing the vacuum and restoring the pressure in the container to atmospheric.
   d. The BioTectors own sample pump should not run at this point.
   e. Timer FBD000 in the Vacuum Sampler system continues to time out.

Note 1: The time of the FBD000 timer should be sufficient to allow the sampling chamber fill, with an additional 50% for a margin of error. Longer times can be used to sediment sand or other hard particles in the sample.
Note 2: if the FBD000 timer times out before the sample is detected by the conductivity probe, then a fault is generated. The fault can be reset from the Vacuum Samplers keypad.

Phase 3: The BioTectors sample pump runs, the timing of this depends on the programmed setting in the BioTector.

Phase 4: When the sample has been injected into the BioTectors reactor, the Sample Fill command is removed by the BioTector, and the Vacuum Sampler waits for the BioTectors sample pump reverse command before carrying out any more actions.

Phase 5: To empty the sampling chamber, the BioTector sample pump reverse command is sent to the Vacuum Sampler. This starts the vacuum pump which pressurises the sampling chamber and purges the sample from the sampling chamber, in the following sequence:
   a. Both three-way valves open.
   b. The vacuum pump runs, but because both three way valves are open, it generates positive pressure in the sampling chamber, which flushes the sample out.

The BioTectors sample pump runs in reverse as normal during this sequence.

Mode 2.

In this mode, Vacuum Sampler chamber is washed with warm water in between each sample. As with mode 1, it is for BioTector TOC analysers fitted with the ARS valve. It is also the mode to be used for single / dual reactor VOC systems.

This mode is selected by making the following connections to the PLC:
Input 5, Connection.
Input 6, Connection.
Input 7, No Connection.
Input 8, No Connection.

Phases 1 to 5 are carried out the same as Mode 1. However, when the BioTector switches the Sample Pump Reverse command off, the Vacuum Sampler automatically carries out the following warm water purge sequence:

Phase 6: The Vacuum Sampler fills the sampling chamber from the warm water boiler, with the following sequence of operations:
    a. In the Vacuum Sampler, after an initial 5-second vent period, the vacuum pump runs, generating a vacuum in the sampling chamber.
    b. The Vacuum Samplers pinch valve closes.
    1. The Vacuum Sampler commands the valve on the boiler to open.
    d. Timer FBD000 in the Vacuum Sampler starts to time out.

Phase 7: when the conductivity probe detects the warm water, the following actions are carried out:
    2. There is an initial delay of 2.5 seconds so that the sampling chamber is filled with warm water 1-2cm higher than the sample water level. This ensures that the warm water fully cleans the sampling chamber.
    3. The vacuum pump stops.
    4. The pinch valve remains closed.
    d. The boiler valve closes.
    e. Both three-way valves open, releasing the vacuum and restoring the pressure in the container to atmospheric.
    5. Timer FBD000 in the Vacuum Sampler system continues to time out.
Note: if the FBD000 timer times out before the sample is detected by the conductivity probe, then a fault is generated. The fault can be reset from the Vacuum Samplers keypad.

Phase 8: The warm water remains in the sampling chamber for 5 seconds. It is then purged down the Vacuum Sampler line. The purge sequence is as follows:
    a. The pinch valve opens.
    b. Both three-way valves open.
    c. The vacuum pump runs, but because both three-way valves are open, it generates positive pressure in the sampling chamber, which flushes the sample out. This phase lasts for approximately 110s (assuming that FBD094 is set to 60s).

Mode 3.

In this mode, Vacuum Sampler chamber is washed with warm water twice in between each sample. The vacuum sampler's tube is also washed with warm water. As with mode 1, it is for BioTector TOC analysers fitted with the ARS valve. It is also the mode to be used for single / dual reactor VOC systems.

This mode is selected by making the following connections to the PLC:
Input 5, Connection.
Input 6, Connection.
Input 7, Connection.
Input 8, Connection.

Phases 1 to 8 are carried out the same as Mode 1 and 2. The only exception is that phase 8 lasts for 20s, not 50s. When the Vacuum Sampler has finished its first wash, it carries out a second wash:

Phase 9: The Vacuum Sampler fills the sampling chamber from the warm water boiler, with the following sequence of operations:
- a. In the Vacuum Sampler, after an initial 5-second vent period, the vacuum pump runs, generating a vacuum in the sampling chamber.
- b. The Vacuum Samplers pinch valve closes.
- 6. The Vacuum Sampler commands the valve on the boiler to open.
- d. Timer FBD000 in the Vacuum Sampler starts to time out.

Phase 10: when the conductivity probe detects the warm water, the following actions are carried out:
- 7. There is an initial delay of 2.5 seconds so that the sampling chamber is filled with warm water 1-2cm higher than the sample water level. This ensures that the warm water fully cleans the sampling chamber.
- 8. The vacuum pump stops.
- 9. The pinch valve remains closed.
- d. The boiler valve closes.
- e. Both three-way valves open, releasing the vacuum and restoring the pressure in the container to atmospheric.
- 10. Timer FBD000 in the Vacuum Sampler system continues to time out.

Note: if the FBD000 timer times out before the sample is detected by the conductivity probe, then a fault is generated. The fault can be reset from the Vacuum Samplers keypad.

Phase 11: The warm water remains in the sampling chamber for 5 seconds. It is then purged down the Vacuum Sampler line. The purge sequence is as follows:
- a. The pinch valve opens.
- b. Both three-way valves open.
- c. The vacuum pump runs, but because both three-way valves are open, it generates positive pressure in the sampling chamber, which flushes the sample out.
- d. This phase lasts for 20s, and is timed by FBD001.

Phase 12: After the 20 second purge above, the boiler valve opens, and hot water is flushed directly down the vacuum sampler line. This phase lasts for 20s, and is timed by FBD093.

Phase 13: The boiler valve closes, and the purge continues for another 50s. This time is controlled by FBD094.

Combinations of all modes are also possible.

Manual operation of the vacuum sampler.

Note: It is essential that the BioTector is stopped before carrying out any of these tests.

Fill: To fill the vacuum sampler, press and hold the button marked [A] on the vacuum samplers PLC. The sampler will fill.

Empty: To empty the vacuum sampler, press and hold the button marked [B] on the vacuum samplers PLC. The sampler will empty.

To reset the vacuum sampler press and hold the [ESC] button on the PLC or the [!] button on the vacuum samplers keyboard for >5 seconds.

Fault conditions.

To reset the fault on the vacuum sampler press and hold the [ESC] button on the PLC or the [!] button on the vacuum samplers keyboard for >5 seconds.

Possible fault conditions:

1. Vacuum sampler does not fill on time – check sample, vacuum pump and / or valves.

Vacuum Sampler, connecting to the BioTector.

Instructions for connecting the BioTector TOC analysers to the Vacuum Sampler.

5 connections are required:

1. The Sampler Fill command is provided by the BioTector. This connection is made from the BioTector to Vacuum Sampler terminal 81. This is for the Sampler Fill command, and when this line has a 24V DC voltage, the sampler will fill.

2. The Sampler Empty command is provided by the BioTector. This connection is made from the BioTector to Vacuum Sampler terminal 82. This if for the Sample Empty command, and typically the Sample Pump Reverse signal is used for this. When this line has a 24V DC voltage, the sampler will empty.

3,4. 24V DC power for the sampling system is provided by the BioTector. These connections are made from the BioTector to Vacuum Sampler terminals 85 and 86. An appropriate fuse should be fitted in the BioTector.

5. If the Vacuum Sampler does not fill in the programmed time, then a fault can be sent to the BioTector. This connection is made from the BioTector to Vacuum Sampler terminal 87. When this line has a 0V DC voltage, the BioTector will register a fault.

See appropriate connection drawings for additional details.

Vacuum Sampler, programming for the BioTector.

Sampler Fill: "SAMPLER" setting in the BioTector.

As an example, it takes 60 seconds for the sampling system to fill. An additional 50% (30 seconds) should be allowed for a margin of error, to prevent any un-necessary faults from being generated by the sampling system – a fault will be generated if the sampling chamber does not fill within the programmed time. Longer times can be used to sediment sand or other hard particles in the sample. This time should be the same as the timer FBD000 in the Vacuum Sampler.
This time (+ an additional 11 seconds which is required by the Vacuum Sampler for its start up sequence) should therefore be programmed as the SAMPLER setting in the BioTectors Sample Pump menu.

Note that the default time for timer FBD000 in the vacuum sampler is 90s.

Additionally, the BioTectors Sample Pump should be programmed for an appropriate forward running time.

Sampler Empty: Sample pump reverse setting on the BioTector.

As the sample pump reverse command is essential for the operation of the Vacuum Sampler, this must have a programmed setting in the BioTectors menu.

Using the example above, the recommended setting is 75s (the same as the time required to bring the sample from the sampling chamber to the BioTector, plus an additional 30 seconds). This time should be sufficient to empty the sample tube inside the BioTector, and also empty the Vacuum Samplers line back to the sample point.
This is the time that the Sample Pump Reverse setting should be in the Sample Pump menu.

Summary example:

BioTector Sampler Fill time	"SAMPLER"	101s
BioTector Sample Pump Forward time	"FORWARD"	45s
BioTector Sample Pump Reverse time	"REVERSE"	75s
Vacuum Sampler timer	"FBD000"	90s

Programming the Vacuum Samplers PLC.

In Mode 1, only one setting is required on the PLC.
In Mode 2, two settings are required.
In Mode 3, several settings are available, but generally only FBD000 and FBD094
    are used.

Mode 1: In the previous example, the fill time for the Vacuum Sampler was calculated as
60s+30s giving the programmed time in the PLC as 90s.This setting is required for all modes.

1.   Press the ESC and OK buttons on the PLC together.
2.   Press OK to select the STOP command.
3.   Press OK again to confirm the STOP command.
4.   Press the – (down) key to select PARAMETERS. Press OK.
5.   The display should show FBD:000, with the cursor is blinking on all the last three
        characters.
6.   If FBD:000 is not selected, Press OK, and the three numbers will blink.
7.   Select FBD:000 with the – and + keys, and press OK.
8.   Press the – key twice, so that cursor blinks on the setting at the bottom of the
        screen. The default setting is 90.0 seconds.
9.   Press OK, and the numbers will blink.
10.   With the – and + keys, select the time required for your application.
11.   Press OK, and the cursor will blink on your setting.
12.   Press ESC, and the cursor will blink on RUN.
13.   Press the OK button twice, and then the ESC button to return to the Vacuum
        Sampler Standby screen.

To save the setting to the memory cartridge, see the instructions on the following pages.

Modes 2 and 3 where the warm water wash is used require an additional programmed setting.
This is the final purge time, which should normally be the same as the fill time (90s in the
above example).

1.   Press the ESC and OK buttons on the PLC together.
2.   Press OK to select the STOP command.
3.   Press OK again to confirm the STOP command.
4.   Press the – (down) key to select PARAMETERS. Press OK.
5.   The display should show FBD:094, with the cursor is blinking on all the last three
        characters.
6.   If FBD:094 is not selected, Press OK, and the three numbers will blink.
7.   Select FBD:094 with the – and + keys, and press OK.
8.   Press the – key twice, so that cursor blinks on the setting at the bottom of the
        screen. The default setting is 60.0 seconds.
9.   Press OK, and the numbers will blink.
10.   Press OK, and the cursor will blink on your setting.
11.   Press ESC, and the cursor will blink on RUN.
12.   Press the OK button twice, and then the ESC button to return to the Vacuum
        Sampler Standby screen.

Additional blocks used for timing:
FBD062, Default 11s, Sample pump forward timer.
FBD088, Default 10s, Sample pump forward timer, must be 1s less that FBD062.
FBD053, Default 11s, Sample pump reverse timer, must be the same as FBD062.
FBD089, Default 10s, Sample pump reverse timer, must be the same as FBD088.
FBD083, Default 5s, Water hold time in the vacuum sampler chamber.
FBD001, Default 20s, Initial water purge.
FBD093, Default 20s, Vacuum Sampler tube wash time.

To save modified program settings to the Memory Card.

When the modification has been validated, the modified program must be stored to the Memory Cartridge. Proceed as follows:

1.   Press the ESC and OK buttons on the PLC together.
2.   Press OK to select the STOP command.
3.   Press OK again to confirm the STOP command.
4.   Press the – (down) key to select MEMORY CARD. Press OK.
5.   Select SAVE. Press OK.
6.   Press OK again to confirm the SAVE command. Wait a few seconds while the SAVE sequence runs.
7.   Press OK, and the cursor will blink on RUN.
8.   Press the OK button twice, and then the ESC button to return to the Venturi Driven Vacuum Sampler Standby screen.

To restore the original program settings from the Memory Card.

If any modification you made to the program causes the sampler PLC to fail, the original program can be downloaded from its Memory Cartridge. Proceed as follows:

1.   Press the ESC and OK buttons on the PLC together.
2.   Press OK to select the STOP command.
3.   Press OK again to confirm the STOP command.
4.   Press the – (down) key to select MEMORY CARD. Press OK.
5.   Press the – key to select RESTORE. Press OK.
6.   Press OK again to confirm the RESTORE command. Wait a few seconds while the RESTORE sequence runs.
7.   Press OK, and the cursor will blink on RUN.
8.   Press the OK button twice, and then the ESC button to return to the Venturi Driven Vacuum Sampler Standby screen.

Weekly maintenance on the Vacuum Sampler.

Confirm that the chamber and conductivity probe is clean.   _____
Confirm that the vacuum sampler pump is operating correctly and the chamber is   _____
filling in the required time.
Confirm that the conductivity probe is operating correctly.   _____
Confirm that all the valves are operating correctly.   _____

This document contains information which is only required for the export of this instrument into the People's Republic of China.

本手册只包含出口到中华人民共和国的仪器的必要信息。

Statement on China "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products", Ministry of Information Industry Order #39. (China RoHS2)

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汞 - Hg - Mercury

镉 - Cd – Cadmium

六价铬 - Cr+6 - Hexavalent Chromium

多溴联苯 - PBB - Polybrominated Biphenyl

多溴二苯醚 - PBDE - Polybrominated Diphenylether
(Ref: Chinese Ministry of Information Industry Order #39)
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