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M001g. BioTector TOC Analyzer with Mixer Reactor Commissioning and Startup

## TOC Analyzer with Mixer Reactor Commissioning and Startup

The check list below must be used to ensure that the installation has been properly carried out. Please proceed through the check list in the given order, completing the 5 sections below. Detailed commissioning and startup procedures are available in presentation format in the MMC/SD card shipped with the BioTector. It is recommended to review this document before starting the commissioning and startup procedures. If the BioTector analyzer is certified for hazardous areas, carefully read the hazardous area documentation supplied with the analyzer. This documentation contains important information for compliance with explosion protection regulations. Understanding this information is essential for the safe operation of the equipment.

For system and personal safety, refer to [Section 1](#) [Safety Precautions](#). Necessary safety precautions, such as wearing eye protection and gloves, should be taken throughout the commissioning and startup procedures.

### 1. INSPECTION and SYSTEM CONNECTIONS:

Several tubing are disconnected and labeled in BioTector for shipping. Before connecting any tubing, inspect the analyzer. Check all the electrical and tubing connections and confirm that there are no loose connections within the BioTector. Close the analysis door.

- Reconnect the tube linking the Ozone Generator to the acid TEE, at the TEE.
- Reconnect the tube linking the Cooler and CO<sub>2</sub> analyzer, at the top of the Cooler.
- Reconnect the tube linking the Ozone Destructor to the Exhaust Valve (MV1), at the top of the Ozone Destructor.

The Acid and Base pump tube rails and the tubing of pumps are disconnected and labeled in BioTector for shipping. Reconnect the tube rails and install the pump tubing of the Sample, Acid and Base pumps.

Check the Swagelok / PFA tube connections and confirm there are no loose connections within the BioTector.

Check the electrical connections and confirm there are no loose connections within the BioTector.

Confirm the mains supply voltage and the frequency on site match the analyzer requirements. Connect the power cable.

Connect the 4-20mA cables.

Connect low voltage wiring (e.g. Fault Relay).

Connect the oxygen cylinder/oxygen concentrator to the BioTector's OXYGEN port. See figure 11 in Section [5.3.1 Carrier Gas Connection](#) for details.

Option A: The pressure on the oxygen concentrator with instrument air should be between 1250 and 2000 mbar.

Option B: Depending on the type, the pressure on the oxygen concentrator with compressor should be between 550 mbar and 750 mbar.

Option C: The pressure on the welding grade oxygen cylinder should be 1000 mbar.

Connect the EXHAUST port with ¼" PFA tube to a safe and well ventilated area or to open atmosphere. The tube must have no restrictions and it must be placed so that any condensation and liquid buildup in the tubing is prevented. The maximum length of ¼" PFA tubing installed in Exhaust line is 10 meters. If tubing longer than 10 meters is required, the use of a larger ID tubing or pipe is recommended.

The end of the exhaust tubing should have a slight downward slope so that any condensation or liquid at the outlet of the tubing cannot freeze at night or during cold weather. See figure 15 in Section [5.4.2 Drain, Bypass and Exhaust Connections](#) for details.

Remove the tapes, which are used to seal the ends of the supplied CO<sub>2</sub> filter. Fit the CO<sub>2</sub> filter to the Base container and seal the Base container tightly. See figure 12 and figure 13 in Section [5.3.2 Reagent Connections](#) for details.

Connect the Acid (1.8N Sulfuric Acid, H<sub>2</sub>SO<sub>4</sub>, containing 80 mg/l Manganese catalyst) and Base (1.2N Sodium Hydroxide, NaOH) containers to the BioTector's ACID and BASE ports with ¼" PFA tube. 20 or 25 liter containers are recommended. Confirm that weight fittings supplied are installed at the end of the acid and base reagent dip tubes.

Confirm the sample or samples are supplied to the analyzer and are at ambient pressure. See examples in figure 14 in Section [5.4.1 Sample Inlet Tube Position](#) for the correct positioning of the BioTector sample tube in various sampling systems.

If a sample is under pressure, then the system must be designed to isolate the sample in the event of a tube leak within the BioTector, for example a system consisting of a liquid leak detector and automatic isolation valve (*which must be located outside the BioTector*) must be installed. Note that the maximum allowed sample pressure is 500mbar.

Referring to typical examples in figure 14 in Section [5.4.1 Sample Inlet Tube Position](#), connect the sample or samples to the BioTector with ¼" PFA tube. These ports are marked SAMPLE 1, SAMPLE 2, ..., SAMPLE 6.

If a BioTector SAMPLER has been supplied with the system, connect the sampler in accordance with the drawings and instructions in the sampler manual.

Connect the PVC-U Drain Pipe (installed outside the BioTector) to a well ventilated pressure free drain using the supplied 1 inch braided hose. See figure 15 in Section [5.4.2 Drain, Bypass and Exhaust Connections](#) for details.

Confirm the SAMPLE OUT port is connected to the PVC-U Drain Pipe. If the PVC-U Drain Pipe is not used, connect the SAMPLE OUT with ¼" PFA tube to well ventilated pressure free drain. The tube should be fitted so that it cannot freeze in cold weather. See figure 15 in Section [5.4.2 Drain, Bypass and Exhaust Connections](#) for details.

Confirm the sample BYPASS port is connected to the PVC-U Drain Pipe. If the PVC-U Drain Pipe is not used, connect the sample BYPASS port with ¼" PFA tube to a large diameter tube, as shown in drawing 81104041. The end of the sample bypass tube should be level with the center of the Sample (ARS) Valve. The large diameter tube should be connected to a pressure free drain. The end of the sample bypass line should not be under the surface of the water in the drain at any time. The tube should be fitted so that it cannot freeze in cold weather. See figure 15 in Section [5.4.2 Drain, Bypass and Exhaust Connections](#) for details.

If fitted, connect ¼" PFA tube to the MANUAL or CALIBRATION ports. Remove all tapes placed around the fittings for shipment.

If the BioTector is supplied as a "purge ready" system (*i.e. if the BioTector is supplied without any fan and vent ports*), connect the -20°C dew point, oil, water and dust free purge air to the BioTector. The purge air is instrument air which is typically at 100 L/min flow, and filtered with a 40 microns or smaller filter. Drill and connect the air inlet port to the top left hand side of the upper enclosure. Drill and install an air outlet port "vent" to the bottom left hand side of the lower enclosure.

## 2. POWER UP:

Power up the analyzer. Go to Operation, Time & Date menu and adjust the time and the date.

Using the Simulate menu (see Section [8.1.2 Simulate](#)), check the following:

Confirm that the Exhaust, Sample Out and TOC Acid Valves are working.

Confirm that the Sample (ARS) Valve is working.

If installed, confirm that all other valves (e.g. multi-stream valve) are working.

Set the Mass Flow Controller “MFC” flow to 20 l/hr and confirm that the pressure on the BioTector oxygen regulator is 350 mbar.

**Oxygen Purity Test:** Power up the oxygen concentrator or enable the oxygen supply if an oxygen cylinder is used. When an oxygen concentrator is used, let the concentrator run for at least 10 minutes before the oxygen purity test is carried out. Using the Simulate menu (see Section [8.1.2 Simulate](#)) set the MFC (see figure 1 and table 2 in Section [4.1.1 Analysis Enclosure](#)) flow to 10 l/hr and flow oxygen gas through the CO<sub>2</sub> analyzer for 5 minutes. At the end of this period, the CO<sub>2</sub> analyzer zero reading (ppm CO<sub>2</sub>) should be within ±0.5% of full scale of the CO<sub>2</sub> analyzer range. For instance, if the CO<sub>2</sub> analyzer range is 10000ppm, then the CO<sub>2</sub> analyzer zero reading should be typically within ±50ppm.

*(If the CO<sub>2</sub> analyzer zero reading is outside the specifications, confirm that there is no CO<sub>2</sub> in the oxygen by connecting the CO<sub>2</sub> filter “used with the sodium hydroxide reagent container” between the oxygen source and BioTector oxygen inlet port and set the MFC to 10 l/h. As the size of the CO<sub>2</sub> filter is small, keep the 10 l/h gas flow running for at least for 5 minutes and record the CO<sub>2</sub> readings at the end of the 5 minute period. If the CO<sub>2</sub> readings do not drop significantly with the CO<sub>2</sub> filter in place, this will indicate that there is no CO<sub>2</sub> contamination in the oxygen supply.)*

### 3. PUMP TESTS:

Caution! Below procedures involves handling strong acid and base reagents. Necessary safety precautions, such as wearing eye protection and gloves, should be taken throughout these tests.

Go to Zero Calibration menu and select RUN REAGENTS PURGE function to prime the pumps. The factory Reagents Purge settings to prime reagents typically cover ~3 meters distance between the reagent containers and the BioTector. If it is necessary to increase the reagent purge times, see section [8.3.4.5 Reagents Purge](#) for details.

Remove the nut at the T fitting located between the Mixer Reactor and the Sample Out Valve. See figure 4 in Section [4.2.2 BioTector Sample Injection](#) for details. Place a small container under the reactor and place the open end of the tubing coming from the reactor into the container to capture any possible liquid discharged. Confirm the Acid Pump is pumping correctly by using a 10ml graduated cylinder placed under the open end of the T fitting. Run the Acid Pump in Simulate menu. Acid Pump rate for SR25 Pump at 20 pulses should be between 3.9ml and 4.9ml in ~13 seconds. *(Depending on the quantity of the liquid injected into the reactor and due to an internal system interlock, the system may request the activation of Reactor Purge cycle to purge any excess liquid from the reactor. If necessary run “REACTOR PURGE” function in the same menu.)*

Confirm the Base Pump is pumping correctly. Base Pump rate for SR25 Pump at 20 pulses should be between 3.9ml and 4.9ml in ~13 seconds. Reconnect the tubing and the fitting.

Important Note: For the correct operation of the system, the measured Acid and Base Pump rates must be identical or similar. The maximum allowable difference in the measured volumes for acid and base injections above should not be more than 0.2ml.

Confirm the WMM60 Sample Pump is pumping correctly. The pump rate at 16 pulses should be between 5.5ml and 7.5ml in ~8 seconds. *(Any variation between these pumped volumes is corrected when the zero and span calibration is carried out.)*

#### 4. COMMISSIONING MENU SETTINGS:

Using the Commissioning menus (see Section [8.2 COMMISSIONING MENU](#)), follow below procedures to set up the BioTector for specific site requirements:

In Reaction Time menu, program the INTERVAL time depending on the required sample analysis frequency.

In Sample Pump menu, set the correct Sample Pump FORWARD and REVERSE times. These times are unique for each site depending on the distance between the sample and the BioTector. Sample Pump times can be set individually for each stream in the Sample Pump menu. Adjust the Sample Pump FORWARD times and confirm that sample liquid coming from each stream bypasses the system and drips into the drain.

In order to establish the required Sample Pump forward and reverse times, go to Simulate menu and run SAMPLE PUMP reverse (REV) and confirm that the sample tube is completely empty. Run SAMPLE PUMP forward (FWD) and measure the time (in seconds) required for a fresh sample to fill and flow out through the bypass port. Add 10 seconds to the measured time and enter this value as the FORWARD time in the Sample Pump menu. The sample pump REVERSE time will be automatically set as 15 seconds greater than the FORWARD time.

Go to Process Test, Sample Pump Test menu and select the PUMP FORWARD TEST and PUMP REVERSE TEST functions to confirm that the programmed sample pump times are correct to properly fill and empty the sample tube of each stream.

If the BioTector SAMPLER is used, then the default sampler time is 100s. This default time must not be changed unless the time programmed in the PLC of the sampler is also changed. See BioTector Sampler User Manual for details.

In Stream Program menu, set the required multi-stream parameters (stream operation sequence, number of reactions to run at each stream and operation range for each stream). Automatic range change function should not be used in multi-stream systems.

In COD/BOD/LPI/FLOW program menu, if COD/BOD/LPI and/or FLOW parameters are required, program DISPLAY with the required parameter. Install the relevant STREAM, TOC FACTOR, LPI VALUE, HEADING for applicable streams, and the full scale of sample flow meter analog input signals for STREM 1-3. See Section [8.2.4 COD/BOD/LPI/FLOW Program](#) for details. *If required, the factors for each stream can be obtained following the procedures described in information sheet "1030. TOC to COD or BOD Correlation Method", which is available in the MMC/SD card shipped with the BioTector.*

In New Reagents Program menu, confirm the factory settings are suitable for site requirements.

In Reagents Monitor menu, if required, activate/deactivate the reagent monitoring function, program the reagent volumes and set the relevant reagent warnings.

In Autocal Program menu, if required, program the automatic zero and span calibration cycles.

In 4-20mA Program menu, set the required parameter for each stream. Set the full scale concentration level for each 4-20mA channel. Full scale should be compatible with the external process control device (e.g. DCS) and BioTector calibrated ranges. In order to see BioTector calibrated ranges, see System Range Data screen ([2.2.3 System Range Data Screen](#)) and Stream Program menu ([8.2.3 Stream Program](#)).

In Alarm Program menu, set the available relays to the required ALARM levels for each stream. If necessary, to modify the relay parameters and conditions, go to Output Devices menu. See section [8.3.5 Output Devices](#) for details.

In Data Program menu, if required, program the relevant configuration parameters for the specific output device communication port.

Go to Signal Simulate menu and test 4-20mA signals. Simulate 1mA, 4mA, 12mA and 20mA signals and confirm that the signals are received by the external process control device (e.g. DCS). Simulate all digital input and output signals and confirm correct operation.

### 5. ZERO and SPAN CALIBRATION:

Go to Operation, Reagents Setup, Install New Reagents menu, confirm the menu items and select the "START NEW REAGENT CYCLE" function for the system to prime the reagents and set the Zero Adjust (zero offset) values automatically. See Section [2.2.2.1 Install New Reagents](#) and [8.2.5 New Reagents Program](#) for details.

Observe that the automatic pressure/flow test passes when analyzer is started up. See Section [2.1.3 Analysis Data Screen](#) and [8.3.4.6 Pressure/Flow Test Program](#) for details.

It is recommended to check the zero response. When the Zero Calibration cycle is completed, go to Operation, Start Stop menu (see Section [2.2.1 Start Stop](#) for details) and stop the analyzer. Go to Zero Calibration menu and select RUN ZERO CHECK function. Alternatively, to confirm that the zero response is correct, connect DIW to the manual sample port and run 5 analysis cycles on DIW using the Manual Program menu. *(If manual port is not available, use the input point for SAMPLE 1. If the BioTector has been in storage for a long period, and if the zero readings are not satisfactory, a second "Install New Reagents" cycle may be required.)*

*If the zero readings and CO<sub>2</sub> peaks are correct, items from 1 to 6 below can be skipped.*

- 1 *Confirm that the pH in the reactor is correct, using the test sequence in the pH Test menu. See Section [8.1.1.5 pH Test](#) for details.*
- 2 *Check for a pH of <2 during the TIC phase.*
- 3 *Check for a pH of >12 during the Base Oxidation phase.*
- 4 *Check for a pH of <2 during the TOC phase.*
- 5 *Run a further 2 reactions on DIW.*
- 6 *Run an "Install New Reagents" cycle on the system to adjust the zero offset.*

Program the concentration of the standard solution in the Span Calibration menu ([2.3.2 Span Calibration](#)). The concentration of the calibration standard used must be typically greater than 50% of the full scale of the RANGE the calibration is carried out. In order to see BioTector calibrated ranges, see System Range Data screen ([2.2.3 System Range Data Screen](#)). *(To prepare a standard solution, see procedures described in Section [6.2 Calibration Standards](#) or information sheet "R009. Standard Solutions for BioTector Multi-component Analyzer", which is available inside the MMC/SD card shipped with the BioTector.)*

Connect the standard solution to the MANUAL/CALIBRATION port. If these ports are not available, use the SAMPLE 1 port. Avoid the manual purging of the calibration, manual grab sample and sample lines using the Simulate menu, because the system reactor may get contaminated during the automatic sample valve and pump synchronization process. To purge these lines, it is recommended to use PUMP FORWARD TEST and PUMP REVERSE TEST functions in the Sample Pump Test menu (see [8.1.1.4 Sample Pump Test](#) for details). It is recommended that the standard solution is located at the same height as the sample pump. Run the Span Calibration cycle using the RUN SPAN CALIBRATION function in Span Calibration menu. A minimum of five complete analysis cycles is recommended for the span calibration.

Download BioTector "All Data" in text format into the MMC/SD card using the SEND ALL DATA function in Data Output menu to record all changes made in the system configuration. See Section [8.1.4 Data Output](#) for details.

Go to Start Stop menu and start the BioTector. When the BioTector is running online, carefully observe the first two or three reactions and confirm that the CO<sub>2</sub> peaks are correct.

Signed, Engineer		Date	
Signed, Customer		Date	