Catalog Number: 10-MAT-1052

BioTector B7000i Online TOC Analyzer

USER MANUAL

October 2017, Edition 1

BS4Ai 05.02
Dairy

Original Instructions in English

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Section 1 Safety Precautions

Please read this manual before unpacking, setting up, or operating the BioTector.

BioTector should only be used by qualified trained staff and for the purpose it is intended for. Do not use or install this equipment in any way other than the methods specified in this manual. The procedures and methods described in this manual are based on assuming the user have basic, fundamental background on electronics, chemistry and analyzer equipment.

If the instructions in this manual are not followed, the operation and protection provided by the equipment may be impaired.

1.1 Information and Safety Signs used in the Manual

When any supplementary information is required and if any hazards exist, the necessary information and safety signs (Information, Caution, Warning and Danger) will be displayed for the corresponding section or procedure in this manual.

	Used to indicate supplementary information, to call attention to recommendations, to simplify the operation and to guarantee the correct use of the equipment.
	Used when there is a danger of minor damage to the system if the user does not follow precautions.
	Used when there is a danger of minor injury or serious damage to the system if the user does do not follow the precautions.
	Used when failure to observe a safety precaution may result in serious injury or death.

1.2 Precautionary Labels Attached to the Instrument

The labels and tags attached to the instrument are summarized below. Please read all labels and tags attached to the instrument. If not observed, personal injury or damage to the instrument could occur.

	This symbol, when displayed on the instrument, indicates that the user must gather the necessary operation and/or safety information given in the instruction manual.
	This symbol, when attached on an enclosure, indicates an existing risk of electrical shock and/or electrocution. Only qualified personnel should open such enclosures and work with hazardous voltages.
	This symbol, when displayed on a component, identifies that the component surface can be hot. When it is necessary to work with this component, it should be handled with care.
	This symbol, when noted on a product, illustrates the risk of chemical harm due to its corrosive, acidic, caustic or solvent nature. Only qualified and trained staff should handle such chemicals.
	This symbol, when noted on an analyzer, illustrates the risk of the presence of toxic ozone gas produced in the analyzer. Only qualified and trained staff should work with this analyzer.
	This symbol, when displayed on the instrument, indicates the presence of devices sensitive to Electro-Static Discharge (ESD). Prior to any work with such components, the individual should be grounded via an earth strap to prevent any possible damage.
	This symbol, when displayed on the product, indicates that protective eye wear must be used during the maintenance or service of the equipment.
	This symbol, when used on the product, identifies the location of the protective earth (ground) connection.

	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.

1.3 Certification Marks Attached to the Instrument

The standard certification marks attached to the instrument and their meanings are summarized below. Additional certification marks if required for specific markets are at the back of this manual.

CE	This mark, which stands for European Conformity "Conformité Européene", indicates that "**The instrument complies with the European product directives, health, safety and environmental protection legislations**".
C ETL CM US LISTED Intertek 3187097 **Conforms to ANSI/UL Std. 61010-1** **Certified to CAN/CSA Std. 61010-1**	If these marks are displayed on the instrument, they indicate that "**This product has been tested to Safety Requirements of Electrical Equipment for Measurements, Control and Laboratory use; Part 1: General Requirements of ANSI/UL 61010-1 and CAN/CSA-C22.2 No 61010-1**". Intertek ETL listed mark, which stands for Electrical Testing Laboratories, identifies that the product has been tested by Intertek, found in compliance with accepted national standards, and it meets the minimal requirements required for sale or distribution.

1.4 Potential System Safety Hazards

The potential safety hazards, which are associated with a running BioTector system, are as follows:

- Electrical hazards
- Potentially hazardous chemicals
- Oxygen gas and components generating Ozone gas

Maintenance and operation should not be carried out unless personnel have been fully trained in the operation of the BioTector.
Prior to working on the inside of the analyzer, the technician should be grounded via an earth strap.

Please read the instructions in this manual carefully before installing or starting the BioTector.

The manufacturer cannot accept liability for damages due to non-observance of this manual. Use of spare parts not supplied by the manufacturer will invalidate the warranty. The manufacturer shall not be liable for omissions or errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

The information contained in this manual is subject to change without notice.

Product names mentioned herein are for identification purposes only and may be trademarks or registered trademarks of their respective companies.

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

1.4.1 Ozone and Toxicity

Ozone is found in gaseous form as a natural ingredient of the earth's atmosphere. Some of the chemical and physical properties of ozone are as follows:

Terms	Properties of Ozone (O_3)
Molecule Weight	47.9982 g/g-mol
Boiling Point	-119 $\pm$ 0.3 °C
Melting Point	-192.7 $\pm$ 0.2 °C

Exposure to even low concentrations of ozone can be damaging to delicate nasal, bronchial and pulmonary membrane. Symptoms of acute ozone toxification appear at a concentration of about 1 ppm by volume. The type and severity of symptoms depend on the concentration and duration of exposure. In mild cases and in the early phases of severe cases, symptoms will include one or more of the following:

- Irritation or burning of the eyes, nose or throat
- Lassitude
- Frontal headache
- Sensation of sub-sternal pressure
- Constriction or oppression
- Acid taste in mouth
- Anorexia

In more severe cases, the symptoms may include dyspnoea, cough, choking sensation, tachycardia, vertigo, lowering of blood pressure, severe cramping, chest pain, and generalized body pain. Pulmonary oedema may develop with delayed onset, usually one or more hours after exposure.

Following severe acute ozone toxification, recovery is slow. In the few severe human cases reported, 10 -14 days of hospitalization were required. In these cases, minimal residual symptoms were present for as long as 9 months, but all cases eventually recovered completely.

The 1983 ACGIH has recommended a Threshold Limit Value (TLV) of 0.1 ppm (0.2 mg/m3) for ozone. The safe level for short human exposure to concentrations of ozone in excess of 0.1 ppm (Threshold Limit Value) is not known with certainty. The atmospheric concentration immediately hazardous to life is likewise not known, but inhalation of 50 ppm for 30 minutes would probably be fatal. The odor threshold of ozone for a normal person is 0.01 - 0.02 ppm by volume in air.

1.4.2 First Aid Treatment

Move the victim to an uncontaminated atmosphere. Control restlessness and pain by the administration of sedatives and anodynes orally. Severe cases may require subcutaneous injections of small doses of meperidine hydrochloride (Demerol) for relief of pain. Give oxygen inhalation by facemask when the acute symptoms have subsided. Severe cases require hospitalization since deferred pulmonary oedema may develop.

1.5 General Safety Precautions

Please pay attention to all caution, warning and danger statements at all times. Non-observance of the safety instructions can result in serious personal injury, death or damage to the equipment. Therefore observe the following:

- Only engineers trained by the manufacturer should carry out maintenance on the BioTector.
- The power supplies contain capacitors that are charged to hazardous voltages. After disconnecting the main power, allow a minimum of one minute for discharge before opening the control section.
- Never wash or spray the system with water. Do not allow water to enter the interior.
- Protect the system from one-sided heat radiation, direct sunlight and vibration. System must be installed in a dry, dust-free room. Special precautions are required in environments with corrosive gases, vapors or explosion risk.
- Please do not place anything on top of the system.

1.5 Précautions générales de sécurité

Prière d'être toujours attentif à toutes les notices de prudence, d'avertissement ou de danger. Le non respect des instructions de sécurité peut engendrer la blessure grave d'individus, leur décès ou la dégradation du matériel. Pour ces raisons, prière d'observer les règles suivantes:

- Seuls les ingénieurs formés par le fabricant doivent réaliser des travaux de maintenance sur le BioTector.
- L'alimentation électrique contient des condensateurs qui sont chargés à des tensions dangereuses. Après avoir débranché l'alimentation électrique, attendre au moins une minute pour permettre la décharge avant d'ouvrir le boîtier de commande.
- Ne jamais laver ou arroser l'appareil avec de l'eau. Ne pas laisser de l'eau pénétrer à l'intérieur.
- Protéger l'appareil des radiations de chaleur sur un seul côté, des rayons directs du soleil et des vibrations. L'appareil doit être installé dans une pièce sèche et sans poussière. Il est nécessaire de prendre des précautions particulières dans les environnements contenant des vapeurs ou gaz corrosifs ou ceux à risque d'explosion.
- Prière de ne rien poser sur le dessus de l'appareil.

1.5.1 Electrical and Burn Precautions

BioTector contains electrical components operating under high voltages. Contact may result in electric shock and severe or fatal injury.

During system installation, maintenance or servicing:

- Isolate the system power lines before starting any work in the electronic enclosure.
- All electrical work should be carried out by qualified electrical personnel only.
- Comply with all local and national regulations when working with electrical connections.
- Make sure the system is properly earthed (grounded) before switching on.
- It is required to connect the mains through an external isolator (2-pole disconnection switch), and if possible connect the mains through an earth leakage circuit breaker.
- When working with hot surfaces, use protective gloves and handle the components with care.

1.5.1 Précautions relatives à l'électricité et aux brûlures

BioTector contient des composants électriques qui fonctionnent à des tensions élevées. Un contact peut engendrer un choc électrique et des blessures graves ou mortelles.

À l'installation de l'appareil, sa maintenance ou son entretien:

- Isoler les fils électriques de l'appareil avant de commencer tout travail dans le boîtier électronique.
- Seul le personnel électricien qualifié est habilité à effectuer tous travaux d'électricité.
- Se conformer aux règlementations locales et nationales pour tout travail sur un branchement électrique.
- Avant de l'allumer, veiller à la bonne mise à la terre de l'appareil.
- Le branchement sur le courant secteur doit obligatoirement se faire par l'intermédiaire d'un interrupteur sectionneur externe (interrupteur bipolaire), et prévoyez si possible un disjoncteur différentiel.
- Utiliser des gants de protection pour les travaux sur les surfaces très chaudes et prendre soin en manipulant les composants.

1.5.2 Carrier Gas and Exhaust Gas Precautions

BioTector uses oxygen (O_2) gas as the carrier gas during its operation. The oxygen gas must be free of carbon dioxide (CO_2) and nitrogen (N_2) gases. The average rate of oxygen consumption in BioTector is 22 L/hour (367 ml/min). Carbon dioxide filtered air, carbon dioxide and nitrogen contaminated oxygen gas are not suitable for BioTector TOC analyzer. When handling oxygen:

- The same precautions, which are required for any high pressure or compressed gas system, must be taken to avoid accidents.
- Comply with all local and national regulations and/or manufacturer's recommendations and guidelines when working with oxygen.
- If oxygen cylinders are used, they must be transferred safely using appropriate equipment (e.g. carts, hand trucks etc.)
- If oxygen cylinders are used, they should be labeled clearly for identification and well secured for storage and transport.
- Avoid the use of extensive number of adaptors and couplers.
- Do not allow oxygen to come in direct contact with grease, oil, fat, and other combustible materials. If uncertain how to handle oxygen cylinders and high concentration oxygen, contact your local oxygen manufacturer.
- If oxygen concentrator is used, take precautions to avoid a fire in the area of the concentrator, install the concentrator only in a well ventilated area and comply with all local and national regulations.

Vent waste gases to atmosphere or to a well ventilated area making the necessary connections on system exhaust. Under normal operating conditions, waste gases will contain oxygen, traces of carbon dioxide and the traces of volatiles/gases which may exist in the sample stream. Under abnormal conditions, the waste gases may contain traces of ozone.

1.5.2 Précautions relatives au gaz porteur et d'échappement

Pour son fonctionnement, BioTector emploie de l'oxygène (O_2) comme gaz porteur. L'oxygène ne doit comporter aucun gaz carbonique (CO_2) ni d'azote (N_2). Le taux moyen de consommation d'oxygène du BioTector est de 22L/heure (367 ml/min). L'analyseur BioTector TOC ne tolère pas l'air filtré de gaz carbonique ni l'oxygène contaminé de gaz carbonique et d'azote. À la manipulation de l'oxygène:

- Afin d'éviter les accidents, prendre les mêmes précautions que pour tout appareil à haute pression ou gaz comprimé.
- Pour toute opération avec de l'oxygène, se conformer aux règlementations locales et nationales et/ou aux recommandations et consignes du fabricant.
- S'ils sont employés, les cylindres d'oxygène doivent être transportés en toute sécurité à l'aide du matériel approprié (chariots, diables, etc.)
- S'ils sont employés, les cylindres d'oxygène doivent être clairement étiquetés pour en permettre l'identification et bien arrimés pour leur stockage et leur transport.
- Éviter d'utiliser un nombre élevé d'adaptateurs et de dispositifs de couplage.
- Ne pas laisser l'oxygène entrer en contact direct avec de la graisse, de l'huile, des matières grasses ou d'autres matières combustibles. Veuillez contacter votre fabricant local d'oxygène si vous avez des doutes sur la manière de manipuler les cylindres d'oxygène et l'oxygène de haute concentration.
- Dans le cas où un concentrateur est employé, prendre les précautions nécessaires pour éviter un incendie dans la zone du concentrateur, n'installer le concentrateur que dans un endroit bien ventilé et se conformer aux règlementations locales et nationales.

Évacuer les gaz usés dans l'atmosphère ou dans un endroit bien ventilé en réalisant les branchements voulus sur l'échappement de l'appareil. Dans des conditions normales de fonctionnement, les gaz usés contiennent de l'oxygène, des traces de gaz carbonique et des traces de composants volatiles/gaz qui peuvent être présents dans l'échantillon. Dans des conditions anormales, les gaz usés peuvent contenir des traces d'ozone.

1.5.3 Chemical Precautions

A number of chemicals and compounds to be used with BioTector are listed in Section 6 Reagents and Calibration Standards. Some of these compounds are harmful, corrosive, acidic and oxidizing. Appropriate precautions must be taken when handling these chemicals or solutions prepared from these chemicals.

Physical contact with these chemicals and inhalation of any vapors must be minimized using appropriate safety equipment.

1.5.3 Précautions chimiques

La liste de la Section 6 Réactifs et Standards de Calibration (Section 6 Reagents and Calibration Standards) énumère un certain nombre de produits chimiques et composés à utiliser avec BioTector. Certains de ces composés sont nocifs, corrosifs, acides et oxydants. Il est essentiel de prendre les précautions appropriées lors de la manipulation de ces produits chimiques ou des solutions dont ils sont la base.

Il est essentiel d'employer l'équipement de sécurité approprié afin de minimiser le contact direct avec ces produits chimiques et l'inhalation de toutes vapeurs.

1.5.4 Sample Stream Precautions

The user is responsible to establish the potential hazard associated with each sample stream. Necessary precautions must be taken, to avoid physical contact with any harmful sample stream, which may contain chemical or biological hazards.

System components and their composition, which come in contact with the sample liquid and possible volatile gases from the sample, are tabulated in table 1 below. If there are suspected compatibility issues between the sample stream and BioTector components, please contact the manufacturer or the distributor.

Table 1 System components and their composition

Component	Material
Tubing	PFA (Per-fluoro-alkoxy)
Fittings	PFA (Per-fluoro-alkoxy) Stainless Steel (SS-316) PVDF (Poly-vinylidene-flouride)
Pump Tubing	EMPP (Elastomer-modified-poly-propylene)
Connectors	PP (Poly-propylene)
Connector & Valve Tubing	EMPP (Elastomer-modified poly-propylene) Viton
Sample (ARS) Valve	PEEK (Poly-ether-ether-ketone) PVDF (Poly-vinylidene-flouride) Stainless Steel (SS-316)
Reactor	Hastelloy (C-276) Stainless Steel (SS-316) PFA (Per-fluoro-alkoxy) PTFE (Poly-tetra-fluoro-ethylene) Borosilicate Glass Kalrez
Valve Seals	Kalrez Viton
Oxidized Sample Catch-pot/Cleaning Vessel	Borosilicate Glass
NDIR CO_2 Analyzer	Hastelloy (C-276) Stainless Steel (SS-316)
NDIR CO_2 Analyzer Lens	Sapphire

1.5.4 Précautions relatives aux échantillons

L'usager assume la responsabilité d'établir le danger possible que représente chaque échantillon. Il est essentiel de prendre les précautions voulues afin d'éviter le contact physique avec tout échantillon nocif qui pourrait présenter un danger chimique ou biologique.

Le tableau 1 ci-dessous présente les composants de l'analyseur (et leur composition) qui entrent en contact avec l'échantillon liquide et les éventuels gaz volatiles émanant de l'échantillon. Si vous soupçonnez des problèmes de compatibilité entre l'échantillon et les composants BioTector, veuillez contacter le distributeur ou le fabricant.

Tableau 1 Composants de l'analyseur et leur composition

Composant	**Équipement**
Tuyauterie	PFA (perfluoroalkoxy)
Installations	PFA (perfluoroalkoxy) Acier inoxydable (SS-316) PVDF (polyfluorure de polyvinylidène)
Tuyauterie de la pompe	PPMOD (polypropylène modifié par élastomère)
Connecteurs	PP (polypropylène)
Tuyauterie des connecteurs & vannes	PPMOD (polypropylène modifié par élastomère) Viton
Vanne d'entrée de l'échantillon (sélection automatique)	PEEK (polyéther éther cétone) PVDF (polyfluorure de polyvinylidène) Acier inoxydable (SS-316)
Réacteur	Hastelloy (C-276) Acier inoxydable (SS-316) PFA (perfluoroalkoxy) PTFE (polytetrafluoroethylene) Verre borosilicaté Kalrez
Joints des vannes	Kalrez Viton
Bac de récupération/récipient de nettoyage de l'échantillon oxydé	Verre borosilicaté
Analyseur infrarouge non diffuseur de CO_2	Hastelloy (C-276) Acier inoxydable (SS-316)
Lentille de l'analyseur infrarouge non diffuseur de CO_2	Saphir

Section 2 Operator's Manual

2.1 Software Screens and Software Menu Diagram

The BioTector is equipped with a built-in microprocessor, which has been programmed to enable the user to control the instrument using just six buttons of its membrane keypad. By pressing the appropriate button, the user can move through the various levels of the software menu.

The functions of the 6 keys on the membrane keypad are described below:

The ESCAPE [↰ , ⇐] key, which returns user to the previous screen, can also be used to cancel programming entries. If the ESCAPE key is pressed for longer than 1 second the user returns to the main menu.

The LEFT [◁ , ⇦] and RIGHT [▷ , ⇨] arrow keys are used for numerical entries and programming the BioTector.

The UP [△ , ⇧] and DOWN [▽ , ⇩] arrow keys are used for numerical entries and programming the BioTector.

The ENTER [✓ , ↵] key, which advances user to the next screen, is also used to enter programmed settings in the BioTector.

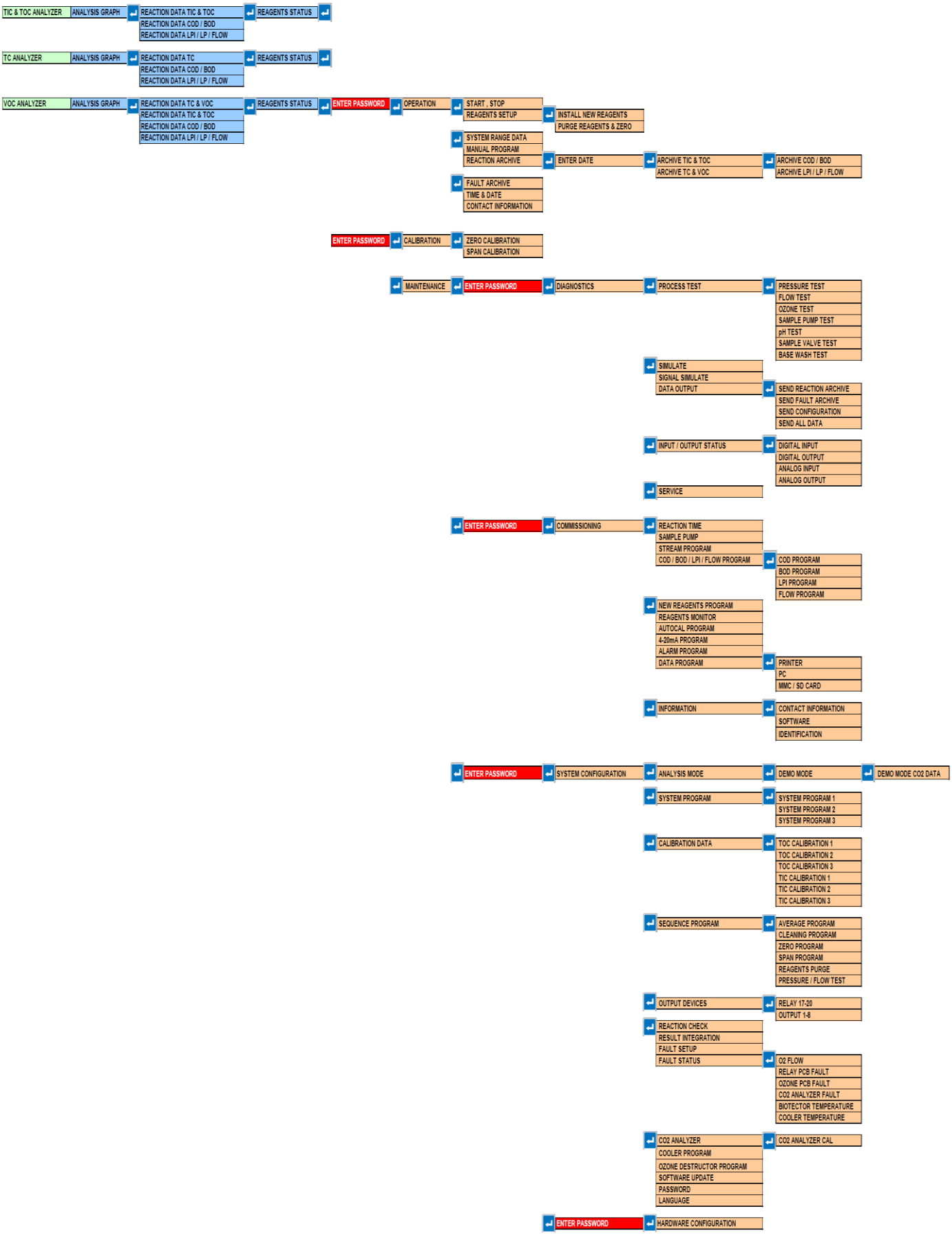
The symbols used on BioTector LCD screen and their meanings are as follows:

<	Selector. Used to designate the menu item being selected.
*	Highlighter. Used to highlight an active or ongoing function of the BioTector.
_	Blinking Cursor. Used to indicate current user position when setting changes are being made.

There are three main menu levels in BioTector in addition to the analysis graph, analysis data and reagent status screens:

- **Level 1 – Operation:** This level controls the basic operation of the BioTector and allows access to the archives.
- **Level 2 – Calibration:** This level allows the user to run zero and span calibration cycles.
- **Level 3 – Maintenance:** This level allows the user to test the individual components of the BioTector for diagnostics, to download data, to program the software functions and to program the system specific settings in the BioTector.

Software Menu Diagram



2.1.1 Startup State

When the BioTector is powered up, its LCD screen will automatically display the Analysis Data screen after a delay of 60 seconds.

By pressing the ESCAPE key the user moves from the Analysis Data screen to the Analysis Graph screen. Pressing the ENTER key on the Analysis Graph screens brings the user back to the Analysis Data screen.

Pressing ENTER key on the Analysis Data screen will bring up the Select Level screen, from where the user can select the desired menu level using the UP or DOWN and ENTER keys.

Entry to each menu level can be controlled by numerical passwords. If the passwords are not set, pressing the enter key will bring the user directly to the sub menu screen of the selected level. If the system has been set up with passwords, the Password menu will appear and the password must be entered before access to the selected level is allowed.

In all cases, pressing the ESCAPE key will return the user to the previous screen.

2.1.2 System Status Messages

The system status messages are displayed on the top left hand side of the Analysis Data and Reagent Status screens. On most other screens, only the screen name is displayed in this location.

System status messages are displayed in the following priority:

1. SYSTEM MAINTENANCE – the BioTector is in Maintenance mode, activated by the maintenance switch.
2. SYSTEM FAULT – There is a fault on the BioTector. System is stopped.
3. SYSTEM WARNING – There is a warning on the BioTector. System is running.
4. SYSTEM NOTE – There is a notification on the BioTector. System is running.
5. SYSTEM CALIBRATION – The BioTector is calibrating. This could be Span Calibration, Span Check, Zero Calibration or Zero Check.
6. Running status. This could be one of either:
   - SYSTEM RUNNING – system is running.
   - SYSTEM STOPPED – system has been stopped by a fault or from the keypad.
   - REMOTE STANDBY – system has been put into standby mode remotely.

The BioTector time and date is displayed on the top right side of each screen. When a fault is logged in the system, a FAULT LOGGED message will alternate with the time/date in this location until the fault has been corrected.

Changing most system settings are prevented when the BioTector is running.

2.1.3 Analysis Data Screen

```
BIOTECTOR  RUNNING                    09:17:28  12-09-02

09:13:02  12-09-02     REACTION  START
   TIC&TOC  STREAM2     REACTION  TYPE
                TOC     REACTION  PHASE
                  1     RANGE
              266s      REACTION  TIME
              360s      REACTION  DURATION

REACTION  RESULT              TICmgC/l     TOCmgC/l
09:07:02  12-09-02     S1 √      130.0        540.0
09:01:02  12-09-02     S2 √        3.6          3.6
08:55:02  12-09-02     S3 √        7.2          7.2
08:49:02  12-09-02     S4 x       10.7         10.7
08:43:02  12-09-02     S5 x       14.3         14.3
08:37:02  12-09-02     CF          0.9          7.9
```

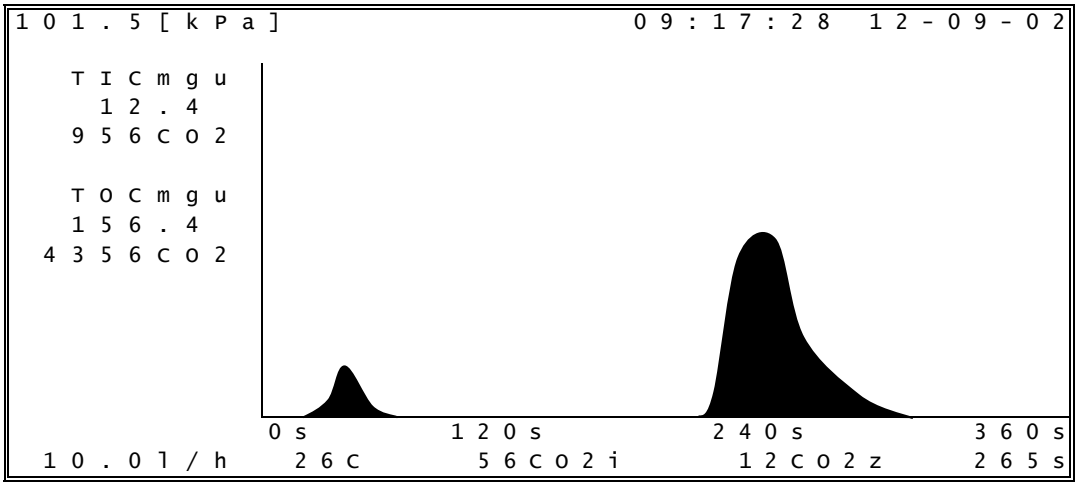
The Analysis Data screen is the default display screen on the BioTector for carbon (TIC, TOC, TC, VOC in mgC/l), COD & BOD in mgO/l, LPI in % & LP in l/h, Flow in m^3/h & e.g. TOC in kg/h, analyses depending on analysis type and specific configuration settings. When the user moves through the various levels of the software menu, BioTector returns to this screen automatically after 15 minutes if there is no further activity on the membrane keypad.

This screen gives information on:
- The Reaction Start time.
- The Reaction Type, for example a TIC & TOC reaction, TC reaction, Cleaning Reaction.
- The Reaction Phase, for example if the reaction is currently in the TIC, Base Oxidation, TOC phase.
- The operation Range (e.g. Range 1, 2 or 3) the BioTector is using to carry out its analysis.
- The Reaction Time, which is the elapsed time (seconds) since the analysis start.
- The Reaction Duration, which is the overall duration (seconds) of the analysis.

The Analysis Data screen also has an archive of the last 25 reactions. The most recent six reactions are shown on the screen. In order to access the remaining reactions, use the DOWN or RIGHT keys to scroll down, use the LEFT or UP keys to scroll up.

Each reaction record in the reaction archive contains:
- Start Time - reaction start time.
- Date - reaction date.
- Record Type, using the prefixes below:
  - S1 to S6 – reactions from stream 1 to stream 6.
  - M1 to M6 – reactions from manual sample stream 1 to manual stream 6.
  - √ – sample sensor detected the sample or there is no significant quantity of air bubbles in the stream/manual grab sample lines.
  - x – sample sensor detected no sample or there is significant quantity of air bubbles in the stream/manual grab sample lines. See Sample Status in section 8.3.8 Fault Setup for details.
  - W1-6 – stream specific reactor wash reaction.
  - CF – full cleaning reaction.
  - RW – reactor wash reaction.
  - RS – remote standby reaction.
  - ZC – zero calibration reaction.
  - ZK – zero check reaction.
  - ZM – manual zero adjust.
  - SC – span calibration reaction.
  - SK – span check reaction.
  - SM – manual span factor adjust.
  - A1 to A6 – 24 hours average result from stream 1 to stream 6.
- Analysis Results – analysis results according to the analysis type (e.g. TIC, TOC in mgC/l).

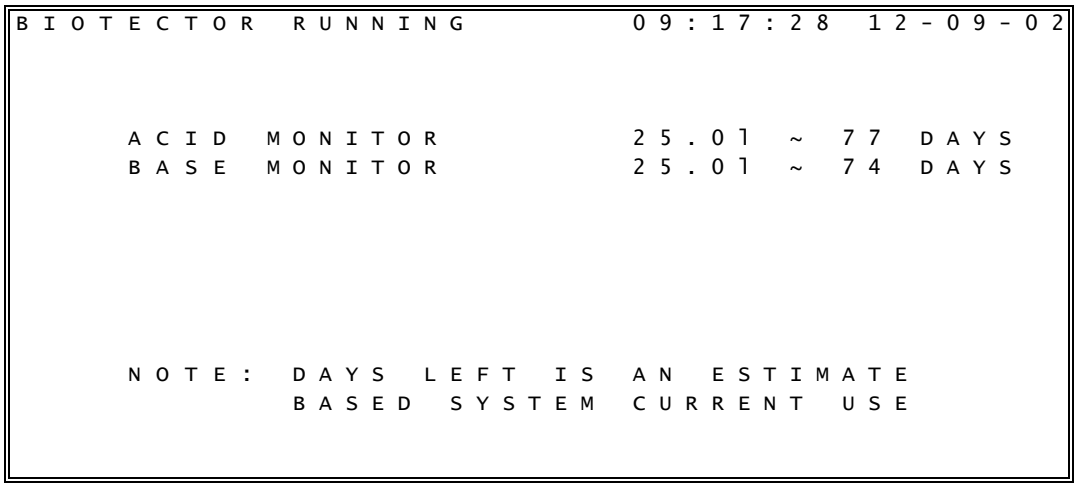
2.1.4 Analysis Graph Screen



The Analysis Graph screen gives information on the current analysis in progress, and allows the user to monitor the progression of the analysis. This screen gives information on:

- The current atmospheric pressure, measured in kPa (e.g. 101.5 kPa).
- The milligram per liter un-calibrated (mgu) data from the analysis, for example TICmgu or TOCmgu without any compensation for atmospheric pressure.
- The height of the CO_2 peaks in each phase of the reaction (e.g. 956ppm CO2).
- The current MFC flow in l/h (e.g. 10.0 l/h).
- The temperature of the analyzer in °C (e.g. 26°C).
- The CO_2 instantaneous value (e.g. 56ppm CO2i) and the CO_2 zero value (e.g. 12ppm CO2z) of the reaction.
- The elapsed time (e.g. 265s) since the start of the analysis.

2.1.5 Reagent Status Screen

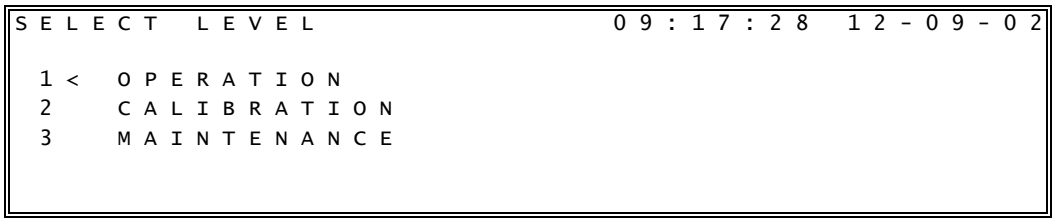


If the Reagent Status screen has been activated, the estimated number of days left for each reagent type is shown on the display.

If the reagents run low, a LOW REAGENTS fault is activated. This fault has to be cleared by resetting the reagent level in the Install New Reagents menu.

Note that the LOW REAGENTS fault can be set as a warning (where the common fault relay will activate) or a notification, in which case a special programmable relay is required to signal the LOW REAGENTS condition.

2.1.6 Select Level Menu



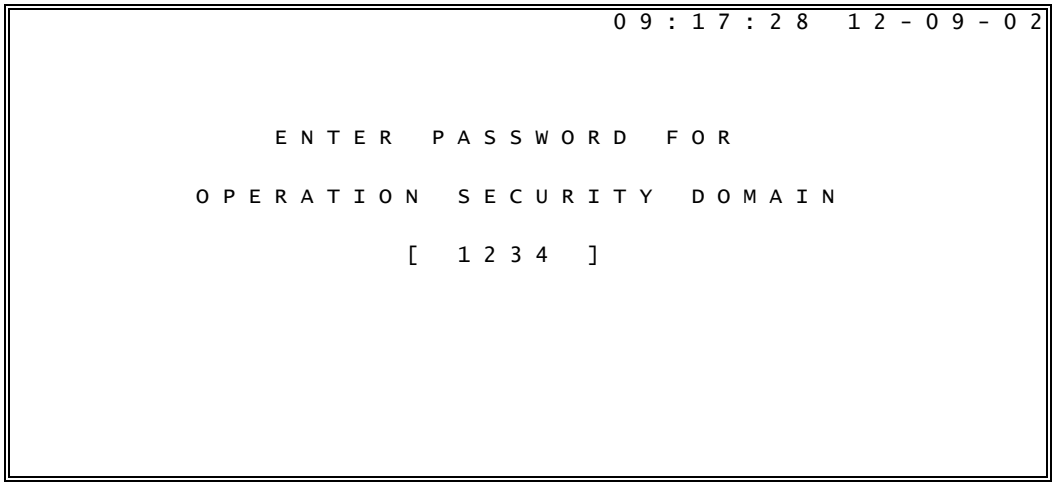
The Select Level screen allows the user to access the operation, calibration and maintenance menus.

1. **Operation.** This menu gives access to the basic operation of the BioTector and allows access to the archives. The level can be password protected using the Password menu.

2. **Calibration.** This menu allows the user to run zero and span calibration cycles. The level can be password protected using the Password menu.

3. **Maintenance.** This menu allows the user to test the individual components of the BioTector for diagnostics, to download data, to program the software functions and to program the system specific settings in the BioTector. The sub menus in this level can be password protected using the Password menu.

2.1.7 Enter Password Menu



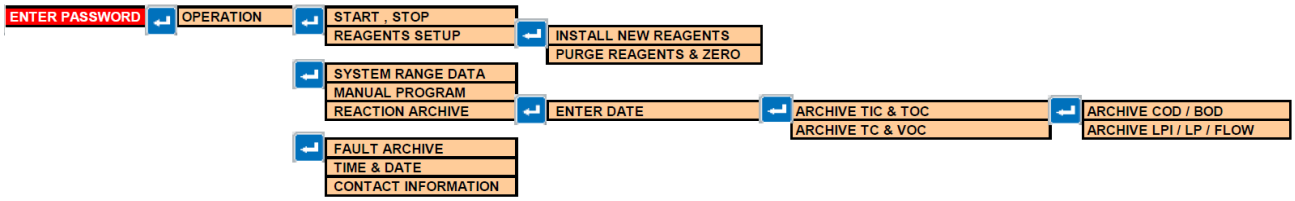
The BioTector has separate passwords for all levels/security domains, which are operation, calibration diagnostics, commissioning, system configuration and hardware configuration.

These passwords are programmable, and if a password has been set up for a particular level in Password menu (see Section 8.3.14 Password for details), then it must be entered before the BioTector will grant access to the password-protected security domains.

Use of a higher menu level password also allows access to lower levels/domains.

2.2 Operation Menu

Operation Menu Diagram



Operation menu allows the user to start and stop the analyzer. Menus related to system operation are also accessed using this menu.

2.2.1 Start Stop

The user can Start or Stop the BioTector using the Start Stop menu.

1. **Remote Standby.** Remote Standby is an optional function, which is activated from Input 19 (by default) on the Signal PCB (e.g. from a flow switch). A “REMOTE STANDBY” message is displayed on the top left corner of the main Analysis Data screen to indicate that the BioTector is in remote standby state. When remote standby signal is activated, the BioTector stops analyzing. All menu access and operational functions remain as for BioTector normal running state. The BioTector runs one standby reaction every 24 hours, at the time programmed for the Pressure/Flow Test (at 08:15 AM by default). Sample is not taken during the remote standby reaction (only acid and base reagents are used). This reaction is tagged as “RS” (Remote Standby) in the system reaction archive. The 4-20mA signal or other output devices are not updated. When remote standby signal is deactivated, the BioTector starts analyzing.

   When remote standby signal is activated, the “Finish & Stop” or “Emergency Stop” must be selected before using such functions as Install New Reagents, Zero and Span Calibrations, Process Tests etc. If the BioTector is stopped using the “Finish & Stop” or “Emergency Stop” functions or automatically by a system fault, it will not be possible to start the BioTector by the removal of the remote standby signal. The “Start” function must be used to re-start the BioTector. When BioTector is started while the remote standby signal is activated, BioTector goes into remote standby state. The manual grab sample analysis can be carried out normally using the Manual Program menu when the BioTector is in remote standby state.

Maintenance should only be carried out when “SYSTEM STOPPED” message is displayed on the top left corner of the main Analysis Data screen or when the system is powered down. When “REMOTE STANDBY” or “SYSTEM RUNNING” message is displayed on the screen, stop the BioTector using the “Finish & Stop” or “Emergency Stop” function.

2. Start. This function starts the BioTector. When BioTector is started, the multi-stream operation sequence (if programmed) is reset. BioTector performs Ozone Purge, Pressure/Flow Test, Reactor Purge and Analyzer Purge sequences automatically before starting its analysis.

- Ozone Purge sequence purges any residual ozone through the ozone destructor.
- Pressure/Flow Test sequence confirm that there is no gas leak and there is no gas flow restriction in the BioTector.
- Reactor Purge sequence purges any liquid from the reactor through the Sample Out Valve.
- Analyzer Purge sequence purges any CO_2 gas from the CO_2 Analyzer through the Exhaust Valve.

An "*" is displayed to let the operator know the function has been activated. If there is a fault in the system, it will not be possible to start the analyzer until the fault has been rectified.

3. Finish & Stop. When this function is activated from the keyboard, the BioTector stops as soon as its present reaction is completed. An "*" is displayed to let the operator know the function has been activated.

4. Emergency Stop. When this function is activated the BioTector cancels the execution of the present reaction and quickly stops operation after the Ozone Purge, Reactor Purge and CO_2 Analyzer Purge sequences. An "*" is displayed to let the operator know the function has been activated. The Emergency Stop has highest priority, and always overrules the "Finish & Stop" function.

Quick Startup Function: During maintenance, system testing etc. it may be necessary to quickly start and stop the BioTector to check various parameters. Pressing the ENTER key for the "Start", when the RIGHT ARROW key is also pressed, bypasses the Pressure/Flow Test sequence, ensuring a quick startup.

When the quick startup function is used, system will log a "28_NO PRESSURE TEST" warning in the fault archive and will start operation. The same warning will also be logged, when the BioTector is started from the Reagents Setup, Manual Program and Calibration menus using this function.

2.2.2 Reagents Setup

This menu allows the user to access the Reagent menus.

1. **Install New Reagents.** Menu used to install and prime the reagents in the BioTector. Any “85_Reagents Low” and “20_No Reagents” warnings and notifications can also be reset in this menu.

2. **Purge Reagents & Zero.** Menu used to purge the reagents, and carryout a zero calibration cycle.

2.2.2.1 Install New Reagents

```
INSTALL NEW REAGENTS      09:17:28  12-09-02
      CONFIRM THE FOLLOWING:

 1 <  NEW ACID CONNECTED 80mg/lMnSO4.H2O
 2      RESET ACID MONITOR   25.0l  ~61 DAYS
 3    NEW BASE CONNECTED
 4      RESET BASE MONITOR   25.0l  ~61 DAYS
 5    TOC 200mgC,TIC 50mgC CONNECTED
 6    START NEW REAGENT CYCLE


      NOTE: BIOTECTOR WILL STOP
        WHEN THE NEW REAGENTS
        CYCLE IS COMPLETE
```

The install new reagents procedure is an automatic procedure for installing new reagents, setting the zero offset by Zero Calibration cycle, setting the reaction check levels and checking the span by Span Calibration or Span Check cycles. Span Calibration or Span Check cycles are part of the Install New reagents sequence if SPAN CALIBRATION or SPAN CHECK is activated in New Reagents Program menu. The basic Zero Check/Calibration and Span Check/Calibration parameters (operation ranges, number of reactions, standard solution concentrations etc.) are programmed in Zero Calibration and Span Calibration menus respectively (see Section 2.3 Calibration Menu for details). The comprehensive Zero Check/Calibration and Span Check/Calibration parameters are programmed in Zero Program and Span Program menus respectively (see Section 8.3.4.3 Zero Program and 8.3.4.4 Span Program for details).

To run the Install New Reagents cycle, the BioTector must be stopped. Confirm that all or the corresponding new reagents have been installed on the BioTector, for instance for acid reagent, select New Acid Connected, and press the ENTER key. A tick mark will appear as confirmation that the new acid has been connected. Note that when one or more reagent volumes are updated in Reagents Monitor menu, system automatically resets the new reagents volumes in this menu and also updates the figures displayed in the main Reagents Status screen.

All reagents volumes can be reset while system is running. This function allows the user to top up the reagents, without stopping the system. However, when acid and/or base reagents are replaced or topped up, system requires a new Zero Calibration cycle. A “ZERO CALIBRATION REQUIRED” warning will be displayed on the screen when RESET ACID MONITOR and/or RESET BASE MONITOR are selected. Therefore, it is strongly recommended to stop the BioTector and activate the Start New Reagent Cycle or to run the Zero Calibration cycle using the Zero Calibration menu. Failure to do so may have an impact on system zero response and the analysis results.

When all or the necessary reagents have been confirmed to be connected and reset in this menu, and when Start New Reagent Cycle is selected, the Install New Reagents cycle will be executed. It is the responsibility of the user to make sure that all reagent volumes are programmed correctly in Reagents Monitor menu, the reset of the reagents monitoring are carried out correctly in Install New Reagents menu and finally if necessary the Zero Calibration cycle is activated either with the Start New Reagent Cycle function in Install New Reagents menu or with the Run Zero Calibration function in Zero Calibration menu.

The Install New Reagents cycle consists of the following steps:

1. Reagent Purge: System purges and fills all reagent lines with the new reagents.
2. Zero Calibration: The Zero Adjust (zero offset) level is set for all analysis ranges, and the Reaction Check level for TOC is updated (if the CO2 LEVEL is programmed as AUTO in Reaction Check menu).
3. If Span Calibration or Span Check is activated in New Reagents Program menu, a Span Calibration or Span Check is carried out.

Once the procedure is completed the BioTector either stops or returns online, depending on the programmed setting of AUTOMATIC RE-START in New Reagents Program menu (see Section 8.2.5 New Reagents Program for details).

2.2.2.2 Purge Reagents & Zero

The Purge Reagents & Zero function is an automatic procedure to purge the reagents, to set the zero offset and to set the reaction check levels in the BioTector. The program settings for the Reagent Purge are set up in the Reagents Purge menu.

1. **Purge Reagents & Zero.** This option allows the user to run the Purge Reagents & Zero cycle.

2.2.3 System Range Data Screen

This menu displays the system specific, factory calibrated, analysis range data for all measured components (e.g. TIC, TOC, TC). BioTector can be calibrated with up to 3 analysis ranges for each measured component. When a specific component of a sample (e.g. TOC) is measured at a specific range (e.g. Range 2), the analysis of any other components (e.g. TIC etc.) of the sample are also carried out at the same analysis range.

2.2.4 Manual Program Menu

```
MANUAL  PROGRAM                    09:17:28  12-09-02

  1 <   RUN  AFTER  NEXT  REACTION
  2     RUN  AFTER                                  00:00
  3     RETURN  TO  ON-LINE  SAMPLING               YES
  4     RESET  MANUAL  PROGRAM
  5
  6     MANUAL        1   ,   4              RANGE      1
  7     MANUAL        2   ,   4              RANGE      3
  8     MANUAL        3   ,   4              RANGE      2
  9     MANUAL        -   ,   ---            RANGE      -
 10     MANUAL        -   ,   ---            RANGE      -
 11     MANUAL        -   ,   ---            RANGE      -
 12     MANUAL        -   ,   ---            RANGE      -
 13     MANUAL        -   ,   ---            RANGE      -
  ▼
```

Manual Program menu allows the user to run system in manual operation mode in order to analyze grab samples/standards or a sequence of samples/standards manually. This is achieved by one or a set of Manual Valves installed in the system. The manual analysis sequence can be started at the end of the current reaction, or at a time set by the user. When the manual sequence is complete, the system can be programmed to return online automatically. Note that all cleaning cycle, pressure/flow tests, zero or span cycles are interrupted by the manual operation mode. The Sample Pump reverse operation is also disabled during the manual operation mode by default, unless a Manual Bypass Valve is installed in the system and the REVERSE time is programmed for the corresponding Manual Valve in Sample Pump menu. All items in this menu can be modified when the BioTector is running unless:

- No Manual Valves have been defined in the Output Devices menu.
- The manual mode is currently running.
- The manual mode is scheduled to start when the current reaction is completed.

Note that the Manual mode always starts at the first programmed valve, and works its way down the programmed sequence.

1. **Run After Next Reaction.** To start the manual operation mode sequence after the next reaction the BioTector is currently running, press the ENTER key at this menu item. An "*" will indicate that this function has been selected. If the BioTector is stopped, then the Manual mode will start immediately. To deactivate this function before the manual operation mode has started, press the ENTER key again, or activate an alternative function. In systems built with the remote control of Manual Program option, the remote signal (Manual Mode Trigger from Input 7) activates the Run After Next Reaction function.

2. **Run After 00:00.** Similar to menu option 1 above, but the manual operation mode starts after the programmed time.

3. **Return to On-line Sampling.** This menu item allows the user to specify whether the BioTector should stop (with NO setting) or return to online monitoring (with YES setting) when the manual operation sequence is complete.

4. **Reset Manual Program.** Use this function to reset all the programmed settings to their default values.

6. - 30. **Manual.** In order to analyze one or a number of samples/standards using the manual operation mode, first connect the sample/standard to the manual port/s outside the BioTector. Then, select the corresponding Manual Valve in this menu (the first setting). Then, enter the number of samples (number of analysis reactions) to be taken through each Manual Valve (the second setting). Finally select the correct analysis range (RANGE 1, 2 or 3) if the concentration levels of the sample/standard are known. See System Range Data screen (see Section 2.2.3 System Range Data Screen for details) to view the available system ranges and to select the correct operation range. If the concentration levels of the samples/standards are not known, select AUTO so that BioTector can automatically select the optimum analysis range. When RANGE is programmed as AUTO, a minimum of five analysis reactions is recommended (the second setting) so that BioTector can find the optimum operation range with its automatic exceedance tracking function. When AUTO option is selected, depending on analysis range and system response, the first two or three analysis results may need to be discarded.

2.2.5 Reaction Archive Screen

The Reaction Archive holds information on TIC, TOC, TC, VOC (in mgC/l), COD, BOD (in mgO/l), LPI (%), LP (l/h), Flow (m^3/h), stream valve, reaction range, start date & time and related analysis information for the last 9999 reactions depending on system analysis type and specific configuration settings. If the archive is full, then every new reaction overwrites the oldest one in the archive. As the Reaction Archive contains 9999 events, the user must first enter the date at which the viewing of the archive starts. The Enter Date menu allows the user to specify the date of the first displayed reaction from the archive.

Each reaction record in the reaction archive contains:

- Start Time - reaction start time, which is displayed without seconds in this menu
- Date - reaction date
- Reaction Type - with the prefixes below:

S1 to S6:	Reactions from stream 1 to stream 6.
M1 to M6:	Reactions from manual sample stream 1 to manual stream 6.
√	Sample sensor detected the sample or there is no significant quantity of air bubbles in the stream/manual grab sample lines.
x	Sample sensor detected no sample or there is significant quantity of air bubbles in the stream/manual grab sample lines. See Sample Status in section 8.3.8 Fault Setup for details.
CF:	Full cleaning reaction.
W:	Reactor wash reaction.
RS:	Remote standby reaction.
ZC:	Zero calibration reaction.
ZK:	Zero check reaction.
ZM:	Manually input zero adjust.
SC:	Span calibration reaction.
SK:	Span check reaction.
SM:	Manually input span adjust.
A1 to A6:	24 hours average result from stream 1 to stream 6.

The user can navigate through the displayed reactions individually by pressing the UP and DOWN keys each time, or can navigate in steps of 10 reactions using the LEFT and RIGHT keys. Depending on system analysis type (e.g. VOC, TC –TIC etc.) and system display options (e.g. COD, BOD and/or LPI) settings, BioTector displays additional reaction data held on additional Reaction Archive screens. To access the screens, press the ENTER key, and to return to the previous screen, press the ESCAPE key.

2.2.6 Fault Archive Menu

In the Fault Archive menu, the user can view the last 99 faults/warning/notification events logged in the system, confirm if these events are current or not, and acknowledge the current events. If the archive is full, then every new event overwrites the oldest one in the archive. The user can navigate through the displayed reactions individually by pressing the UP and DOWN keys each time, or can navigate in steps of 10 reactions using the LEFT and RIGHT keys. See Section 9 Troubleshooting of System Fault, Warning and Notification Events for a list of all systems fault, warning and notification events.

The faults archive events are divided into three categories:

- **Fault:** Faults are categorized as events, which stop BioTector operation. The 4-20mA signals are set to the fault level, and the fault relay is activated. The BioTector cannot be started unless the fault in the archive has been acknowledged.
- **Warning:** Warning is a minor event, which does not require the BioTector to stop. The 4-20mA signals are not changed, only the fault relay is activated.
- **Notification:** A notification is an information (e.g. “86_Power Up”, “87_Service Time Reset” etc.) displayed on the screen.

To acknowledge any current events marked with an “*” in the archive, first identify and locate the faults/warnings/notification. Follow the necessary troubleshooting procedures to solve the problem. See Section 9 Troubleshooting of System Fault, Warning and Notification Events for details. Acknowledge the fault by pressing the ENTER key in the Fault Archive menu. Please note that there are system faults (e.g. 05_Pressure Test Fail), which cannot be acknowledged by the user. Such faults are reset and acknowledged automatically by the system when system is started, when system is rebooted or when the fault condition is solved. If an event cannot be acknowledged when the system is running, a “SYSTEM RUNNING” message is displayed on screen.

2.2.7 Time & Date Menu

This menu allows the system time and date to be set by the user. To change the system time or date (hours, minutes, seconds, day, month and year), press the ENTER key, enter the new time and date and press the ENTER key again.

In order to change the system date format, press the ENTER key, select new date format from the following day, month and year options: DD-MM-YY, MM-DD-YY, YY-MM-DD and press the ENTER key again.

When the time is changed, it is possible for the BioTector to automatically start up if the new time is after the startup time for a scheduled task, for example the startup time for a manual sample sequence in Manual Program menu.

2.2.8 Contact Information

Contact Information menu displays the manufacturer/distributor contact details.

2.3 Calibration Menu

Calibration menu allows the user to calibrate the analyzer. Zero and Span Calibration menus allow the user to run the zero and span calibration cycles for a single range or for all system ranges available.

Calibration Menu Diagram

2.3.1 Zero Calibration

```
ZERO  CALIBRATION                09:17:28  12-09-02

  1 <   ZERO  ADJUST          1      0.0      [0.0]
  2                           2      0.0      [0.0]
  3                           3      0.0      [0.0]
  4     RUN  REAGENTS  PURGE
  5     RUN  ZERO  CALIBRATION
  6     RUN  ZERO  CHECK
  7                                  R1       R2       R3
  8     ZERO  PROGRAM                 6   ,    4   ,    4
  9     ZERO  AVERAGE                 4   ,    2   ,    2
10
11      - - >  ZERO  PROGRAM
```

Zero Calibration menu allows the user to enter the suggested Zero Adjust values, to start the Reagent Purge cycle, to start the Zero Calibration and Zero Check cycles and to program the number of zero reactions run at each range.

1.-3. Zero Adjust. The Zero Adjust is used to compensate any organic contamination in the acid and base reagents and any absorbed CO_2 in the base reagent. The Zero Adjust values are generated automatically by the system for each range when the zero calibration cycle is completed without any system warnings. Zero Calibration cycle is activated by selecting the RUN ZERO CALIBRATION function in this menu.

When a Zero Check cycle is run using the RUN ZERO CHECK function, the system only checks the zero response at each range and displays the suggested Zero Adjust values in brackets "[ ]" for all ranges next to the current Zero Adjust settings. When a Zero Check cycle is completed, if necessary the suggested Zero Adjust values can be programmed manually by entering the corresponding suggested Zero Offset values for each range (1, 2 and 3) in this menu. When the Zero Adjust settings are entered manually, system logs this information in the reaction archive with the prefix "ZM" (Zero Manual).

4. **Run Reagents Purge.** The RUN REAGENTS PURGE function is used to prime all reagents in the BioTector. If necessary, the pump operation time for Reagent Purge cycle can be increased in the Reagents Purge menu (see Section 8.3.4.5 Reagents Purge for details).

5. **Run Zero Calibration.** Each time BioTector reagents are replaced or topped up and each time a service is carried out, it is strongly recommended to use the RUN ZERO CALIBRATION function so that the system can set the zero offset values automatically. The zero calibration reactions operate in the same manner as a normal reaction, but BioTector does not take any sample. To start the zero calibration, press the ENTER key at this menu item. An "*" will indicate that the function is running. At the end of the Zero Calibration cycle, the following settings are checked and updated:

1. The Zero Adjust settings for each range are updated automatically by the system using the un-calibrated TOC measurement (not the results seen on the LCD screen). If a Zero Check is used to check the zero offset, the suggested values are shown in brackets "[ ]" next to the actual Zero Adjust settings.
2. If the CO2 LEVEL is set as AUTO for automatic updating in the Reaction Check menu, then the reaction check CO_2 Level is also updated automatically.
3. The CO_2 Level is also checked against the BASE CO2 ALARM setting in Fault Setup menu. If the measured CO_2 Level is greater that the BASE CO2 ALARM value, system generates a "52_HIGH CO2 IN BASE" warning.

6. Run Zero Check. Zero Check cycle is similar to the Zero Calibration above, but BioTector does not update any of the Zero Adjust or CO_2 Level settings. System only checks the BASE CO2 ALARM described above.

8. Zero Program. Zero Program function allows the user to program the number of zero reactions run at one or more ranges (R1, R2 and/or R3). When the number of zero calibration reactions for one or two of the ranges is set to zero, system runs the zero cycle on the programmed range or ranges and calculates the Zero Adjust values for the other ranges automatically. It is recommended not to modify the factory set Zero Program values unless it is absolutely necessary. Any unnecessary modification in this setting may have an impact on the zero offset values.

9. Zero Average. Zero Average function allows the user to program the number of zero reactions to be averaged for each range (R1, R2 and/or R3) at the end of the zero cycles. It is recommended not to modify the factory set Zero Average values unless it is absolutely necessary. Any unnecessary modification in this setting may have an impact on the zero offset values.

11. → Zero Program. Zero Program is a link to Maintenance, System Configuration, Sequence Program, Zero Program menu. See Section 8.3.4.3 Zero Program.

2.3.2 Span Calibration

```
SPAN  CALIBRATION                  09:17:28  12-09-02

 1 <  TOC  SPAN  ADJUST        1      1.00
 2                              2      1.00
 3                              3      1.00
 4    TIC  SPAN  ADJUST        1      1.00
 5                              2      1.00
 6                              3      1.00
10    RUN  SPAN  CALIBRATION
11    RUN  SPAN  CHECK
12
13    SPAN  PROGRAM                  6
14    SPAN  AVERAGE                  4
15    RANGE                          1
16    TOC  CAL  STD                  100.0  mgC/l
17    TOC  CHECK  STD                 50.0  mgC/l
18    TIC  CAL  STD                  125.0  mgC/l
19    TIC  CHECK  STD                 60.0  mgC/l
22
23    -->  SPAN  PROGRAM
```

Span Calibration menu allows the user to enter the Span Adjust values manually, to start the Span Calibration and Span Check cycles and to program the number of span reactions, span operation range and the concentrations of the standard solutions used. Above menu displays the parameters for the TIC & TOC systems. In TC and VOC Systems, the relevant parameters, identified below, are displayed in this menu.

1.-3. TOC Span Adjust. This menu item allows the user to set the TOC span adjust factors manually by entering the STANDARD solution used and the calibrated average reaction RESULT at each range (1, 2 and 3). When the STANDARD and RESULT values are entered, system automatically calculates the corresponding span factors of each parameter for each range. In TC and VOC systems, this function is named as TC Span Adjust. In order to manually set the Span Adjust factors:

First enter the concentration of the standard solution used.

```
SPAN  ADJUST                       09:17:28  12-09-02
                                   STANDARD    RESULT
 1 <  TOC  SPAN  ADJUST              100.0
 2                              2      1.00
 3                              3      1.00
 4    TIC  SPAN  ADJUST        1      1.00
```

Next enter the average result.

```
SPAN  ADJUST                       09:17:28  12-09-02
                                   STANDARD    RESULT
 1 <  TOC  SPAN  ADJUST              100.0        99.5
 2                              2      1.00
 3                              3      1.00
 4    TIC  SPAN  ADJUST        1      1.00
```

When the ENTER key is pressed again, the new span factor is automatically calculated. In order to set the span adjust factors to 1.00, enter 0.0 values for both standard and result.

4.-6. TIC Span Adjust. This menu item allows the user to set the TIC span adjust factors manually for each range as described for TOC Span Adjust above.

10. Run Span Calibration. This function starts the Span Calibration cycle. The span calibration reactions are run at a single range programmed by the RANGE in this menu below. At the end of the span calibration cycle, BioTector automatically calculates the Span Adjust factors and displays it for Span Adjusts above. Unless it is manually modified, the same Span Adjust factor calculated for the programmed RANGE in this menu is used for the other two ranges as well. The span reactions operates in the same manner as a normal reaction, but the Sample Pump reverse operation is disabled to prevent the contamination of the standard solution connected to calibration/manual port. Span Calibration reactions have the prefix of "SC".

11. Run Span Check. This function starts the Span Check cycle. The operation is similar to the Span Calibration cycle above, but BioTector does not update any Span Adjust values at the end of the span check cycle. Span Check reactions have the prefix "SK".

13. Span Program. Span Program function allows the user to program the number of span reactions to be carried out during the Span Calibration and Span Check cycles. It is recommended not to modify the factory set Span Program value unless it is absolutely necessary. Any unnecessary modification in this setting may have an impact on the span adjust values.

14. Span Average. Span Average function allows the user to program the number of reactions to be averaged at the end of the Span Calibration and Span Check cycles. It is recommended not to modify the factory set Span Program value unless it is absolutely necessary. Any unnecessary modification in this setting may have an impact on the span adjust values.

15. Range. Range function allows the user to program the operation range at which the Span Calibration and Span Check reactions are carried out. If the selected range is in conflict with the programmed CALIBRATION STANDARD concentration in this menu, system automatically displays a "Caution! Reaction range or Standard is Incorrect" warning. See System Range Data screen (see Section 2.2.3 System Range Data Screen for details) in order to select the correct operation range or correct standard solution.

16. TOC Cal Std. TOC Calibration Standard function allows the user to program the concentration (mgC/l) of the TOC standard solution used in Span Calibration reactions. If the programmed concentration level is in conflict with the programmed RANGE above, system automatically displays a "Caution! Reaction Range or Standard is Incorrect" warning. See System Range Data screen in order to select the correct operation range or correct standard solution. If TOC Calibration Standard is programmed as 0.0mgC/l, system does not calculate or update any Span Adjust factors and therefore omits any span related warnings defined above. See Section 6.2 Calibration Standards for the details of BioTector standard solutions and preparation procedures. In TC systems, this parameter is named as TC Calibration Standard.

17. TOC Check Std. TOC Check Standard function allows the user to program the concentration (mgC/l) of the TOC standard solution used in Span Check reactions. If TOC Check Standard is programmed as 0.0mgC/l, any span related warnings are omitted. In TC systems, this parameter is named as TC Check Standard.

18. TIC Cal Std. TIC Calibration Standard function allows the user to program the concentration (mgC/l) of the TIC standard solution used in Span Calibration reactions. If TIC Calibration Standard is programmed as 0.0mgC/l, any span related warnings are omitted. In VOC and TC – TIC systems, it is recommended to run the TIC and TOC calibrations separately using separate standard solutions.

19. TIC Check Std. TIC Check Standard function allows the user to program the concentration (mgC/l) of the TIC standard solution used in Span Check reactions. If TIC Check Standard is programmed as 0.0mgC/l, any span related warnings are omitted.

20. **TC Cal Std.** In VOC systems, the sum of the TIC and TOC Calibration Standard solution is displayed as TC Calibration Standard. When TOC Calibration Standard is programmed as 0.0mgC/l, and when a concentration of TIC Calibration Standard is programmed above, BioTector displays the TC Calibration Standard as 0.0mgC/l on purpose. This allows the calibration of TIC without any effect on the TC calibration. See definitions for TOC Calibration Standard above, Section 8.3.4.4 Span Program and Section 6.2 Calibration Standards for further details.

21. **TC Check Std.** In VOC systems, the sum of the TIC and TOC Check Standard solution is displayed as TC Check Standard. When TOC Check Standard is programmed as 0.0mgC/l, and when a concentration of TIC Check Standard is programmed above, BioTector displays the TC Check Standard as 0.0mgC/l on purpose. This allows the check of TIC without any effect on the TC check.

23. → **Span Program.** Span Program is a link to Maintenance, System Configuration, Sequence Program, Span Program menu (see Section 8.3.4.4 Span Program).

Section 3 Technical Specifications

TYPICAL TECHNICAL DATA

Enclosure:	Fiberglass Reinforced Polyester
Dimensions (HxWxD):	1250mm x 750mm x 320mm Enclosure height may increase to 1750mm, depending on system optional features.
Weight:	90 kg – 120 kg Enclosure weight may change depending on system optional features.
Power Consumption:	300 W (VA)
Mains Connection:	115V AC, 60Hz or 230V AC, 50Hz (±10%) Other power options are available on request.
Mains Wire Specification:	Number of Cores = 3, Current Rating minimum = 10 Amps, CSA (Cross Sectional Area minimum) = 1.50mm^2
Signal Wire Specification:	Number of Cores = 8 (+2 cores per additional signal), Current Rating minimum = 1 Amp, CSA (Cross Sectional Area minimum) = 0.22mm^2.

FEATURES IN DETAIL

Display:	High Contrast 40 Character x 16 Line Backlit LCD with CFL Backlight
Data Storage:	Previous 9999 analysis data on screen in the microcontroller memory and storage of data archive for the lifetime of the analyzer in the SD/MMC card Previous 99 fault data on screen in the microcontroller memory and storage of fault data archive for the lifetime of the analyzer in the SD/MMC card
SD/MMC Card:	Flash memory card for data transfer and for software & configuration updates
Operation:	Microcontroller with BioTector OS3 Software and Membrane Keyboard
Language Options:	English, French, German Other language options are available on request.

INPUT & OUTPUT SIGNALS

Standard Output:	One programmable 4-20mA output signal (typically for TOC) For systems requiring more than six 4-20mA standard outputs, 4-20mA Output Multiplex option is implemented to provide 4-20mA data for up to 35 output signals.
Digital Output:	Three freely programmable system relays (volt free changeover contact with a current rating of 1Amp at 30V DC) One of the system relay is factory set to Fault.
Data Transfer Port:	SD/MMC Card and serial RS232 Output for Printer, PC or Data Logger

OPTIONAL FEATURES

Result Output:	TIC, TC, VOC, after correlation COD, BOD
Remote Control:	Input for remote start / standby Input for remote stream and range selection Input for remote manual grab sample analysis Network Control Unit for remote access over Internet or Intranet connection using HTTP over TCP/IP protocol
Industrial Interface:	Modbus, Profibus, Ethernet (when any of the Modbus, Profibus or Ethernet option is selected, the digital output signals are sent through the relevant device with its specific communication protocol)
Calibration & Cleaning:	Valves for Automatic Calibration and Sample Line Cleaning
Multi-stream:	Valves for up to 6 streams with up to six 4-20mA signals (TIC & TOC, TC, VOC systems). The number of available outputs depends on the manual stream configuration.
Manual stream:	Valves for up to 6 manual streams with up to six 4-20mA signals (TIC & TOC, TC, VOC systems). The number of available outputs depends on the multi-stream configuration.

4-20mA Outputs:	As individual signal up to maximum of 6 or as multiplex signal up to maximum of 35. Maximum impedance: 500 ohms.
Hazardous Area:	Certification options are available to European Standards (ATEX for Zone 1 and Zone 2) and to North American Standards (Class I Division 1 and Class I Division 2). Other options, such as IECEx, are available on request.

CONSUMABLES — Typical Replacement Frequency & Consumption

Acid & Base:	5 - 15 weeks/25 Liters (application dependent)
Instrument Air:	1.5 bar, - 20°C dew point (free of water, oil and dust) Average consumption is less than 5.4 m^3/hour.
	Filter pack is recommended and available to meet the air quality specification. BioTector Air Compressor is available for air supply.
Service:	6 Monthly Intervals

ANALYSIS PARAMETERS

Oxidation Method:	Patented Two-Stage Advanced Oxidation Process using Hydroxyl Radicals
TOC Measurement:	NDIR measurement of CO_2 after oxidation
Measurement Terms:	TOC (Total Organic Carbon) including Non-Purgeable Organic Carbon (NPOC) and Purgeable Organic Carbon (POC) BioTector TIC&TOC mode measures NPOC. BioTector VOC mode measures TOC as NPOC+POC.
Measured Components:	TOC (NPOC) TOC (NPOC + POC) TIC TC VOC (POC) TOC as TC - TIC COD* BOD*

* COD & BOD by correlation algorithm incorporating TOC measured results

Cycle Time:	from 6.5 minutes, depending on range and application

MONITORING RANGES: TOC

Standard Range	0-250mgC/l up to 0-20,000mgC/l

Up to 3 ranges configurable for each component within each range band detailed above.
A wide combination of TOC monitoring ranges, including higher ranges, are available upon request.

Exceedance Tracking:	Full Exceedance Tracking to Maximum Range
Range Selection:	Automatic or Manual Range Selection
Repeatability:	±3% of reading or ±0.3mg/l whichever is greater, with Automatic Range Selection
Detection Limit:	0.6mg/l with Automatic Range Selection

Sodium Chloride Interference:

	TOC
All Ranges	None

SAMPLE & ENVIRONMENTAL CONDITIONS

Sample Volume:	Up to 8.0ml
Sample Inlet Pressure:	Typically ambient (for applications with high sample pressure, sampling systems are available)
Drain Pressure:	Typically ambient (for applications with high drain pressure, optional systems are available)
Sample Inlet Temperature:	2°C – 60°C (36°F - 140°F)
Sample Flow Rate:	Minimum 100ml per sample
Sample Particle Size:	Up to 2 mm, soft particulates
Ambient Temperature:	5°C – 40°C (41°F - 104°F) Air conditioning and heating options are available.
Humidity:	5% - 85%, non-condensing
Ingress Protection:	IP44 Optional IP54 with air purge
System Sound:	< 60 dBa

The manufacturer has a continuous research and development program. Specifications may therefore be changed without notice. For specification updates, please contact the manufacturer.

Section 4 Introduction

4.1 BioTector Major Components

4.1.1 Analysis Enclosure

Figure 1 and table 2 below shows the typical major analysis enclosure components of BioTector TOC Analyzers.

Figure 1 BioTector analysis enclosure major components

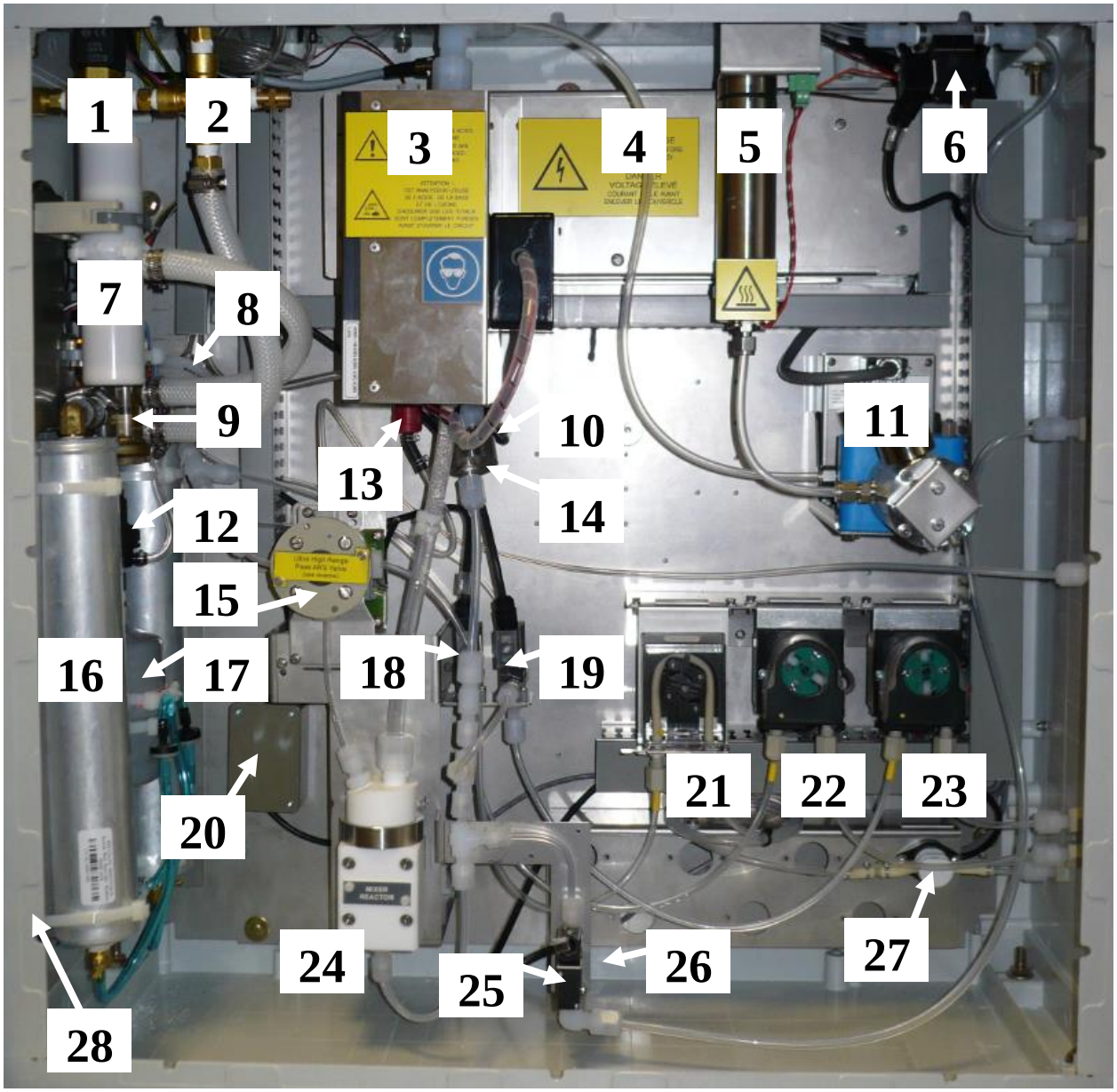


Table 2 BioTector analysis enclosure major components

1	Air Isolation Valve, OV1
2	Pressure Relief Valve
3	Cooler
4	Ozone Generator
5	Ozone Destructor
6	Exhaust Valve, MV1
7	Exhaust Filter
8	Hepa Filter
9	Rotary Valve, OV2
10	Injection Valve, MV7
11	NDIR CO_2 Analyzer
12	Oxygen Pressure Regulator
13	Non-return Valve (Check Valve)
14	Ozone Line Filter
15	Sample Valve (ARS Valve), MV4
16	Molecular Sieve Bed
17	Oxygen (O_2) Tank
18	Acid Valve, MV6
19	Base Valve, P2
20	Filter Board (Electronic Filter PCB)
21	Sample Pump, P1
22	Acid Pump, P3
23	Base Pump, P4
24	Mixer Reactor
25	Sample Out Valve, MV5
26	Liquid Leak Detector
27	Manual/Calibration Valve (Span Calibration Valve), MV9
28	Vent

4.1.2 Electronics Enclosure

Figure 2 and table 3 below shows the major electronics enclosure components of BioTector TOC Analyzer.

Figure 2 BioTector electronics enclosure major components

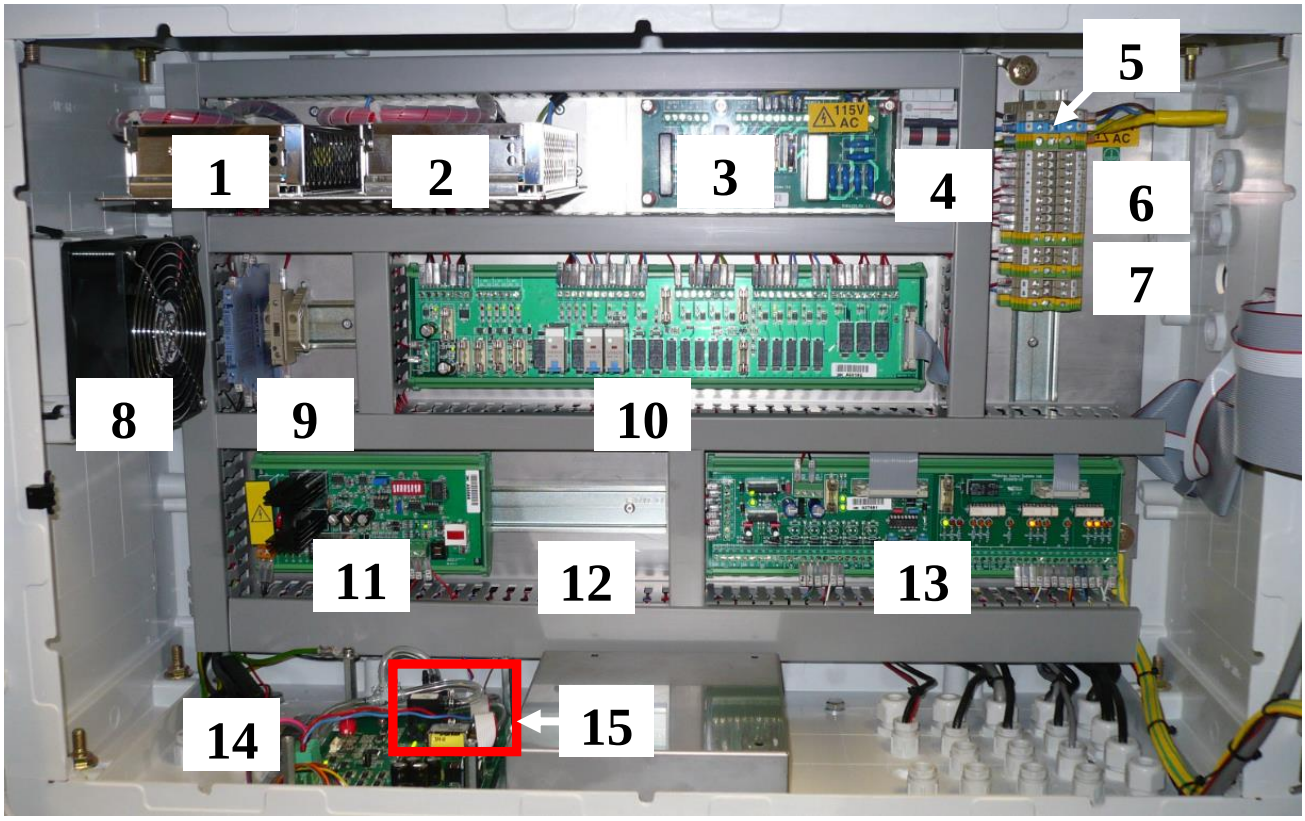


Table 3 BioTector electronics enclosure major components

1	Power Supply (for Main Board/Motherboard)
2	Power Supply (for Pumps and Valves)
3	Power PCB (Mains PCB)
4	Main Power Switch
5	Mains Terminals
6	Relay Terminals
7	4-20mA & Stream Alarm Terminals
8	Fan
9	4-20mA Isolators
10	Relay PCB
11	Ozone PCB
12	Auxiliary/Stream Expansion PCB (Option)
13	Signal PCB
14	Oxygen (O_2) Controller Board
15	Mass Flow Controller (MFC)

Figure 3 and table 4 below shows the BioTector main board (motherboard) components.

Figure 3 BioTector main board components

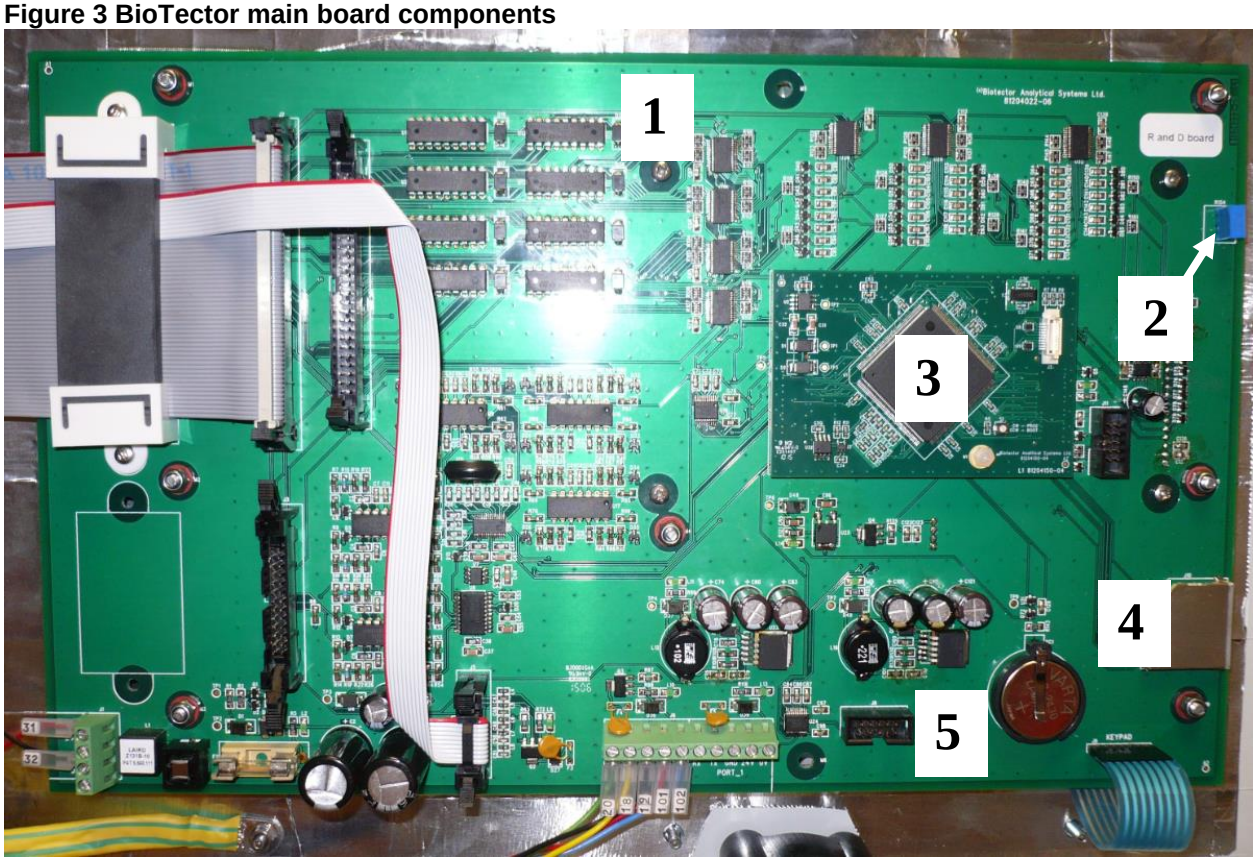


Table 4 BioTector main board components

1	Motherboard (Main Board)
2	LCD Screen Contrast Adjustment Dial
3	Processor PCB
4	MMC/SD Flash Memory Card Slot
5	Battery (Varta, CR2430, Lithium, 3V, 285mAh) Hazardous area analyzers may have a special battery. Contact manufacturer for details.

4.2 BioTector Operation

Detailed information on the system operation is available, in presentation format, in the MMC/SD card shipped with the BioTector. It is recommended to review this file to understand the system operation.

The BioTector is designed to provide continuous online single-component (e.g. TOC) or multi-component (e.g. TOC & TN & TP) monitoring. The BioTector can operate with unfiltered samples including soft particulates up to 2 mm in diameter, and will give accurate measurements even when fats, high levels of salts and/or calcium is present in the sample.

In BioTector multi-component analyzers, the system can be configured as a;

1) TIC & TOC system to measure the Total Inorganic Carbon (TIC) and Total Organic Carbon (TOC) content of a sample. The TOC result obtained from a TIC & TOC system represents the Non-Purgeable Organic Carbon (NPOC). The TIC & TOC system is the standard system for samples which does not contain any volatile organic material or for samples which contains insignificant concentration of volatile organic material.
2) TC system to measure the Total Carbon (TC) content of a sample. The TC result obtained from a TC system represents the sum of TIC, NPOC and Purgeable Organic Carbon (POC) content.
3) VOC system to measure the TIC, TOC, TC and Volatile Organic Carbon (VOC) contents of a sample by means of two analysis reactions in single reactor configuration. VOC result represents the Purgeable Organic Carbon (POC). The TOC result in a VOC system is calculated from the TC and TIC measurements as TC – TIC. Therefore the TOC result includes the VOC (POC) content of the sample. In other words, the TOC result represents the sum of NPOC and POC content.

TC and VOC configurations are system optional features.

As a brief introduction, the operation of BioTector analyzers can be summarized as follows:

i. A sample liquid is brought to the analyzer by means of a peristaltic pump. The sample is injected into the BioTector reactor chamber.
ii. A patented Two Stage Advanced Oxidation process (TSAO) oxidizes the organic material in the sample.
iii. The carbon dioxide formed in the oxidation process is sparged and measured by a Non-dispersive Infrared (NDIR) analyzer.
iv. The results are displayed as TIC, TOC, TC and VOC depending on system configuration.
v. The oxidized liquid is discharged and collected in a sample catch-pot and again depending on system configuration, the Total Nitrogen and/or Total Phosphorus analysis is carried out applying direct photometric and/or colorimetric methods.

4.2.1 BioTector Oxidation Method

A patented Two Stage Advanced Oxidation process (TSAO), which uses hydroxyl radicals as the oxidizing agent, is used for the oxidation of the sample.

The hydroxyl radical oxidation is a powerful oxidation technology, which keeps the wetted reactor parts clean in all types of applications. The base reagent is used as a cleaning agent, where the sample lines and the reactor are washed with an automated cleaning cycle. BioTector self-cleaning technology using hydroxyl radical oxidation together with the automated cleaning cycle ensures that the cleaning of the reactor and the replacement of sample tubing are not necessary.

4.2.2 BioTector Sample Injection

The BioTector analyzes a precise volume of liquid. The Sample Pump injects a pre-programmed number of pulses (half revolutions of pump) of liquid into the reactor for each measurement and therefore the volume of liquid included in each pulse is consistent irrespective of sample source pressure.

Sample is initially drawn from the source by a peristaltic Sample Pump.

In standard TIC & TOC systems, Manual/Calibration Valve is activated to isolate any stream pressure or vacuum coming from the sample lines. Sample Pump rotates forward for 4 pulses by default to remove any pressure/vacuum within the pump tube. Sample Valve rotates 90 degrees clockwise and Sample Pump rotates forward and injects the sample directly into the reactor with the relevant number of pulses appropriate to the range. Sample Valve rotates a further 90° clockwise and the sample volume remaining within the Sample Valve is washed into the BioTector reaction chamber (reactor) by the first TIC acid injection.

In TC systems, the sample injection is carried out similar to the one described for TIC & TOC systems above but the sample volume remaining within the Sample Valve is washed into the reactor by a small quantity of acid reagent.

In VOC systems, BioTector carries out two separate sample injections for the two analysis reactions run consecutively in a single reactor configuration. The first analysis reaction is a TC reaction and the second one is a TIC & TOC reaction. The sample injection takes place as described for the TC systems and for the TIC & TOC systems above. Figure 4 shows the typical analysis layout of TIC & TOC, TC and VOC systems below.

Detailed information on sample injection is available, in presentation format, in the MMC/SD card shipped with the BioTector. It is recommended to review this file to understand BioTector sample injection.

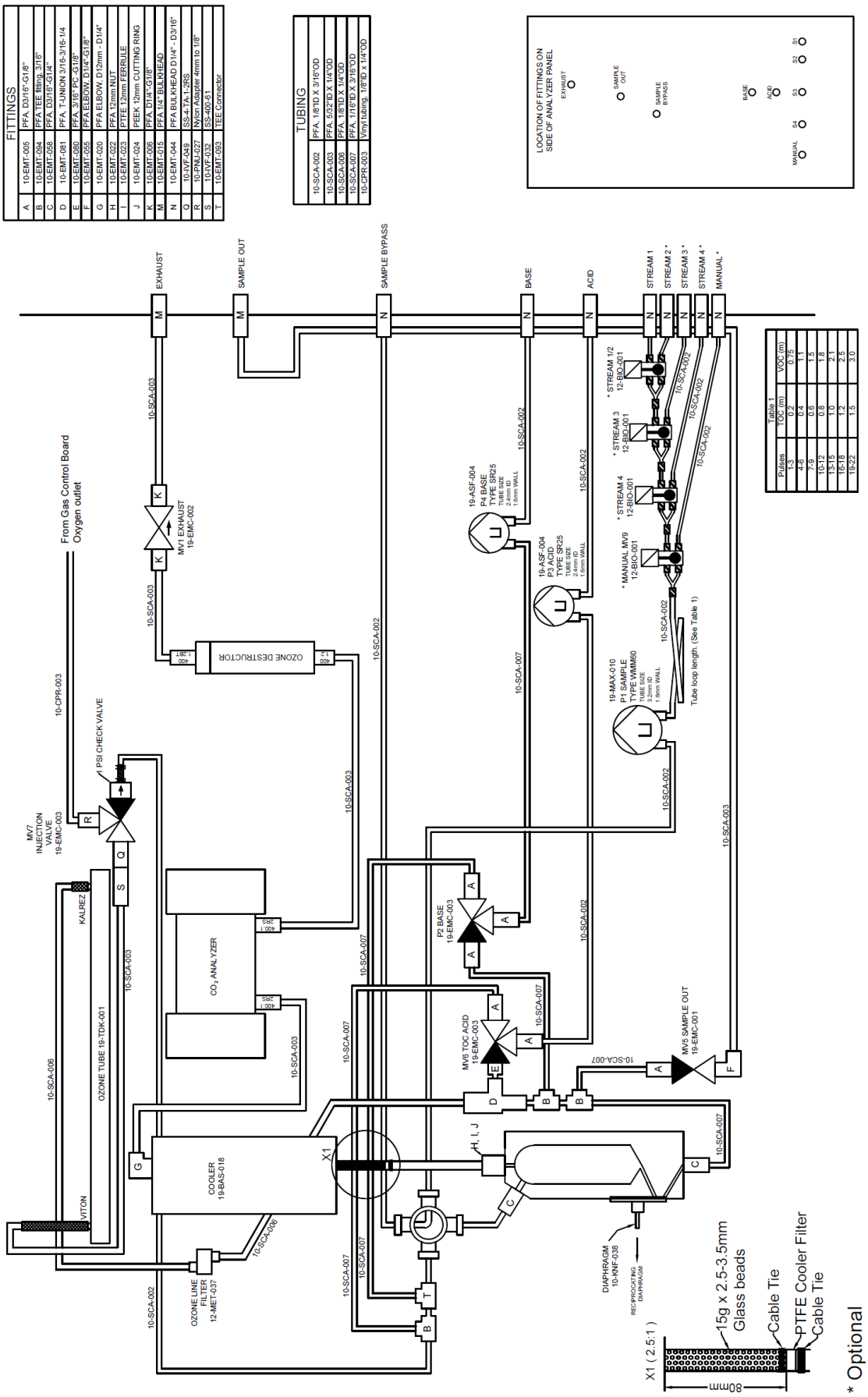


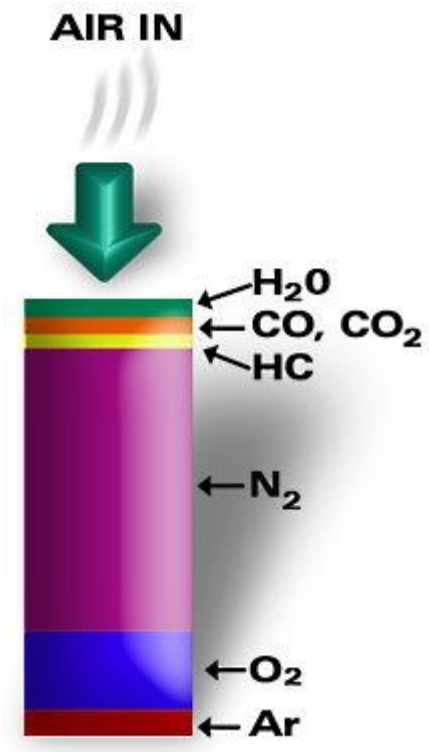
Figure 4 BioTector analysis layout (typical TIC & TOC system)

4.2.3 BioTector Oxygen Concentrator

The operation of BioTector oxygen concentrator is based on the crystalline zeolite molecular sieves, which permits the separation of oxygen gas from the mixture of gases that comprise air. As air flows through a column or bed of molecular sieve, the component gases it contains are adsorbed and stratified in the order of their relative affinity to the molecular sieve material. The process may continue until the next to last gas component stratifies near the end of the bed. Once the full bed length is used, the bed must be regenerated by desorbing (or purging) the adsorbed gases. Purging is accomplished by reducing the pressure in the bed and back-flushing with some of the concentrated gas product. Adsorption and desorption are completely reversible processes and are carried out indefinitely.

The theory behind the operation of the oxygen concentrator is Pressure Swing Adsorption (PSA). This is based on flowing air through the column (the sieve bed) packed with molecular sieve material. The components of the air (Water Vapor, Carbon Dioxide, Carbon Monoxide, Hydrocarbons, Nitrogen, Oxygen and Argon) are adsorbed in order of their relative affinity to the molecular sieve material. Figure 5 shows the adsorption of air components inside the molecular sieves.

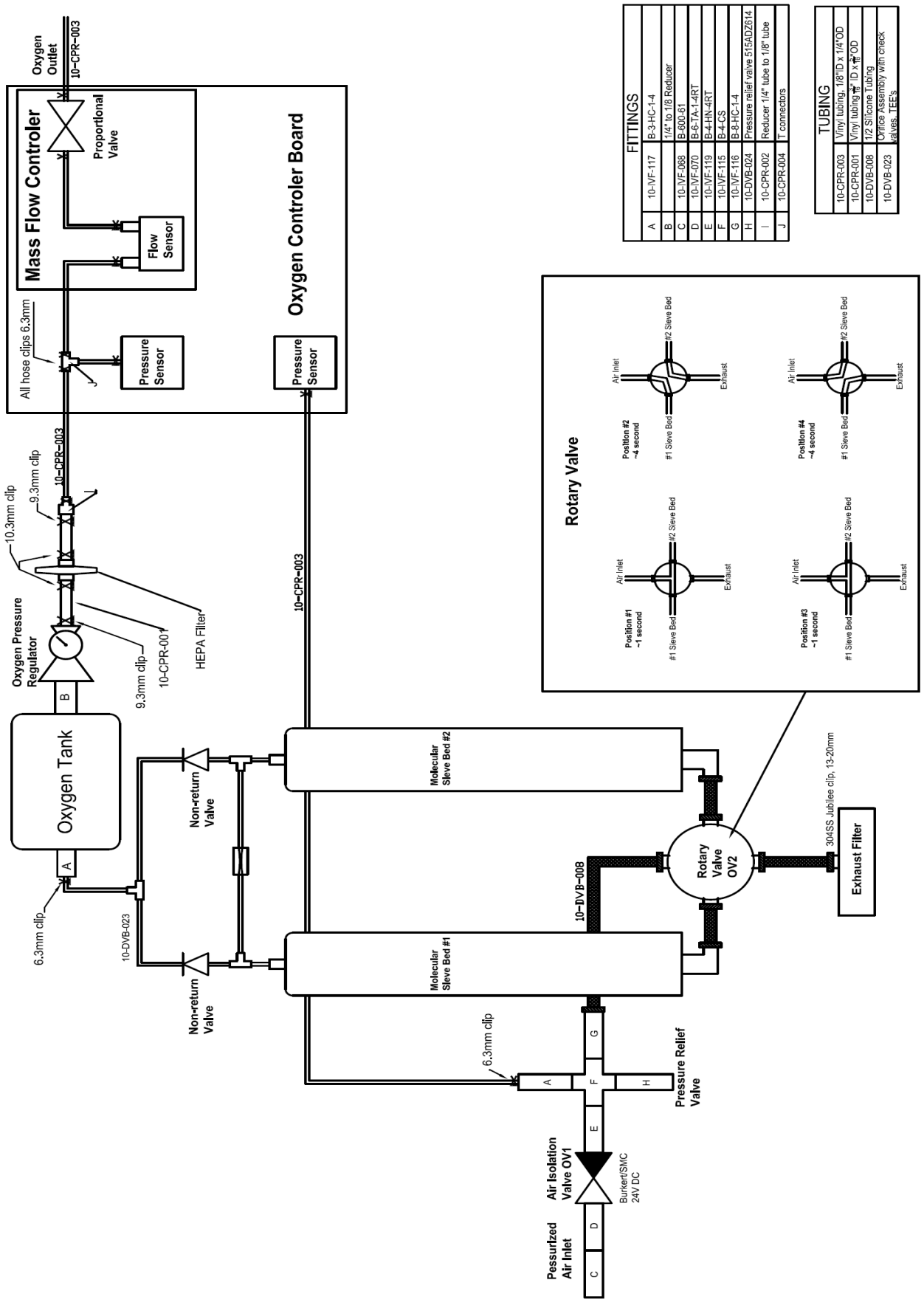
Figure 5 Adsorption of air components in oxygen concentrator molecular sieves.



Once the sieve bed is used, then it is re-generated by purging the adsorbed gasses from the molecular sieve. This is achieved by removing the air supply from the inlet to the sieve bed, and back-flushing the sieve bed with some of the concentrated gas product. The typical oxygen purity obtained from a PSA oxygen concentrator is 93% (±3%) with balance gas Argon.

Figure 6 below shows the layout of BioTector oxygen concentrator and the operation of the Rotary Valve used for the PSA process.

Figure 6 BioTector oxygen concentrator layout



4.2.4 BioTector Analysis Types

BioTector TOC analyzer has four factory calibrated analysis types:

1. TIC & TOC (NPOC) Analysis: Total Inorganic Carbon & Total Organic Carbon (Non-Purgeable Organic Carbon) Analysis
2. TC Analysis: Total Carbon Analysis
3. VOC (POC) Analysis: Volatile (Purgeable) Organic Carbon Analysis

4.2.4.1 TIC & TOC Analysis

1. An unfiltered sample is injected into the BioTector reaction chamber (reactor).
2. An acid reagent (e.g. Sulfuric Acid) is added and the oxygen carrier gas flow is activated to remove the inorganic carbon. The carbon dioxide gas is sparged by the addition of the acid reagent and is carried by the oxygen carrier gas and measured with a non-dispersive infrared (NDIR) CO_2 analyzer. The result is displayed as Total Inorganic Carbon (TIC). This reaction phase is called TIC phase.
3. Ozone generator is activated. A base reagent (e.g. Sodium Hydroxide) is injected and the sample is then oxidized with hydroxyl radicals, a strong oxidizing agent, which is generated by exposing high pH reagents to ozone. This reaction phase is called Base Oxidation phase. The complete oxidation of organic compounds takes place and carbonates are formed.
4. After the Base Oxidation phase, the carbonates are sparged in the form of carbon dioxide gas by the addition of an acid reagent. The carbon dioxide gas is carried by the oxygen carrier gas and measured with the NDIR CO_2 analyzer. The result is displayed as Total Organic Carbon (TOC). This reaction phase is called TOC phase. The TOC result obtained from the TIC & TOC analysis type represents the Non-Purgeable Organic Carbon (NPOC).
5. At the end of the reaction, the oxidized sample liquid is discharged from the reactor with increased oxygen flow.

4.2.4.2 TC Analysis

1. The oxygen carrier gas flow and the ozone generator are activated. Base reagent is injected into the reactor and hydroxyl radicals are generated by exposing the base reagent to ozone. This reaction phase is called Pre-Oxidation.
2. An unfiltered sample is injected into the reactor of the BioTector with a low flow of oxygen carrier gas.
3. The volatile organic content of the sample is oxidized with hydroxyl radicals. This reaction phase is called VOC Oxidation, as the oxidation of the volatile organic matter is achieved without being sparged.
4. When the VOC Oxidation phase is complete, the oxygen gas flow and the ozone generator is activated and the remaining Non-Purgeable Organic Carbon (NPOC) content in the sample is oxidized by the hydroxyl radicals in Base Oxidation phase. The complete oxidation of organic and inorganic compounds takes place and carbonates are formed.
5. When the oxidation processes are completed, the carbonates are sparged in the form of carbon dioxide gas by the addition of an acid reagent. The carbon dioxide gas is carried by the oxygen carrier gas and measured with the NDIR CO_2 analyzer. The result is displayed as Total Carbon (TC). The TC result obtained from the TC analysis type represents the sum of TIC, NPOC and Purgeable Organic Carbon (POC):
   $$TC = TIC + NPOC + POC$$
6. At the end of the reaction, the oxidized sample liquid is discharged from the reactor with increased oxygen flow.

BioTector analysis types are optional features. If the BioTector is built as a TIC & TOC system only, modifications in the system configuration will be required for TC analysis to be possible.

4.2.4.3 VOC (POC) Analysis

BioTector Volatile Organic Carbon (VOC) analysis type is a combination of TC analysis followed by a TIC & TOC (NPOC) analysis. The VOC result obtained from the VOC analysis type represents the Purgeable Organic Carbon (POC) content of the sample. When both TC and TIC & TOC analysis are complete, the flowing data is available:

- TC result, as measured and displayed from the TC analysis.
- TIC result, as measured and displayed from the TIC & TOC analysis. TOC result obtained from the TIC & TOC analysis represents the NPOC.
- TOC result including the VOC, which is calculated from the difference between the TC and TIC:
  $TOC_v = TC - TIC$
  The TOC result displayed in VOC analysis type includes the purgeable organic carbon (POC) present in the sample. In other words the TOC result, obtained in VOC analysis type, is the sum of NPOC and POC:
  $TOC_v = NPOC + POC$
- VOC (POC) result, which is calculated from the difference between the measured TC (from the TC analysis), and the sum of measured TIC and measured NPOC (from the TIC & TOC analysis):
  VOC (POC) = TC – (TIC + NPOC)
  The NPOC result, as measured from the TIC & TOC analysis, is not displayed, it is only used to calculate the VOC (POC) element in the sample. All displayed results can be programmed in the system and sent as 4-20mA output signals to an external device.

BioTector analysis types are optional features. If the BioTector is built as a TIC & TOC system only, modifications in the system configuration will be required for VOC analysis to be possible.

BioTectors built with the VOC analysis option can be programmed on site to operate with the TIC & TOC only or TC only analysis types.

Section 5 Installation

5.1 Basic System Requirements

Power and Signal Requirements

- Mains Connection: 115V AC, 60Hz or 230V AC, 50Hz (±10%)
- Mains Wire Specification: Number of Cores = 3
  Current Rating minimum = 10 Amps
  CSA (Cross Sectional Area minimum) = 1.50mm^2
- Signal Wire Specification: Number of Cores = 8 (+2 cores per additional signal)
  Current Rating minimum = 1 Amp
  CSA (Cross Sectional Area minimum) = 0.22mm^2
- Power Consumption: Maximum 300 W (VA)
- Electrical Connections: Typically 5 cable glands, PG13.5, clamping range 6 - 12 mm

Air Supply and Reagent Requirements

Instrument Air Requirements

- Air Quality: - 20°C dew point (free of water, oil and dust)
  To meet or exceed the air quality specification, filter pack may be required.
- Air Supply Pressure: 1.5 bar
- Air Supply Flow Rate: Minimum 8.4 m^3/hour at 1.5 bar
- Air Consumption: Average consumption is less than 5.4 m^3/hour, typically 3.6 m^3/hour

Typical Reagent Requirements

- Acid Reagent: 1.8 N Sulfuric Acid (H_2SO_4),
- Base Reagent: 1.2 N Sodium Hydroxide (NaOH),

Sample, Drain and Exhaust Requirements

- Sample Inlet & Outlet Pressure: Ambient
- Sample Inlet Temperature: 2°C – 60°C (36°F - 140°F)
- Sample Flow Rate: Minimum 100ml per sample
- Sample Particle Size: Up to 2 mm Ø, soft particulates
- Drain & Exhaust: Ambient

5.2 Unpacking and Installation

The BioTector analyzer weighs more than 100kg (220lb). Therefore, appropriate precautions are required for unpacking and installing the BioTector.

The BioTector analyzer is shipped ready to be installed, with a kit of parts including sample tubes, reagent tubes and a selection of spare parts, spare fuses and ferrules.

When the BioTector shipping container is opened, it must be inspected against the shipping list located inside the container. Additionally, it should be confirmed that no damage was caused to the BioTector during shipment.

Any issues must be reported to the manufacturer within 3 days.

The BioTector is shipped with a Commissioning and Startup checklist (see Section 7 Analyzer Commissioning and Startup for details). In order to ensure a quick and trouble free installation, this list should be followed in the correct sequence.

Points to note regarding installation:

- The BioTector should be located as close to the sample point as possible.
- The BioTector has an Ingress Protection rating of IP44. It is recommended that the BioTector is installed in a dry, well ventilated and dust free area.
- The BioTector should be installed where the ambient temperature is between 5 and 40°C. If the ambient temperature exceeds 40°C, a vortex cooler can be installed to reduce the internal temperature of the BioTector.
- The BioTector should be installed vertically, with the maximum variation on each axis less than 2°.
- Ensure that there is enough clearance at the front of the BioTector to allow the door to be opened.
- Ensure that there is enough clearance at the right hand side of the BioTector for the tube and electrical connections. There should be enough clearance at the left hand side for the cooling fan to operate unimpeded.

If there are corrosive gasses in the area, then the BioTector fan should be blanked off, and an instrument air purge system should be fitted.

5.2.1 Analyzer Dimensions and Mounting

The BioTector TOC analyzer enclosure is a dual compartment Fiberglass Reinforced Polyester (FRP) cabinet. This enclosure facilitates easy access to all components and thus eases the service and maintenance procedures. Figure 7 and table 5 below gives the dimensions of various BioTector enclosures.

Figure 7 BioTector Dimensions

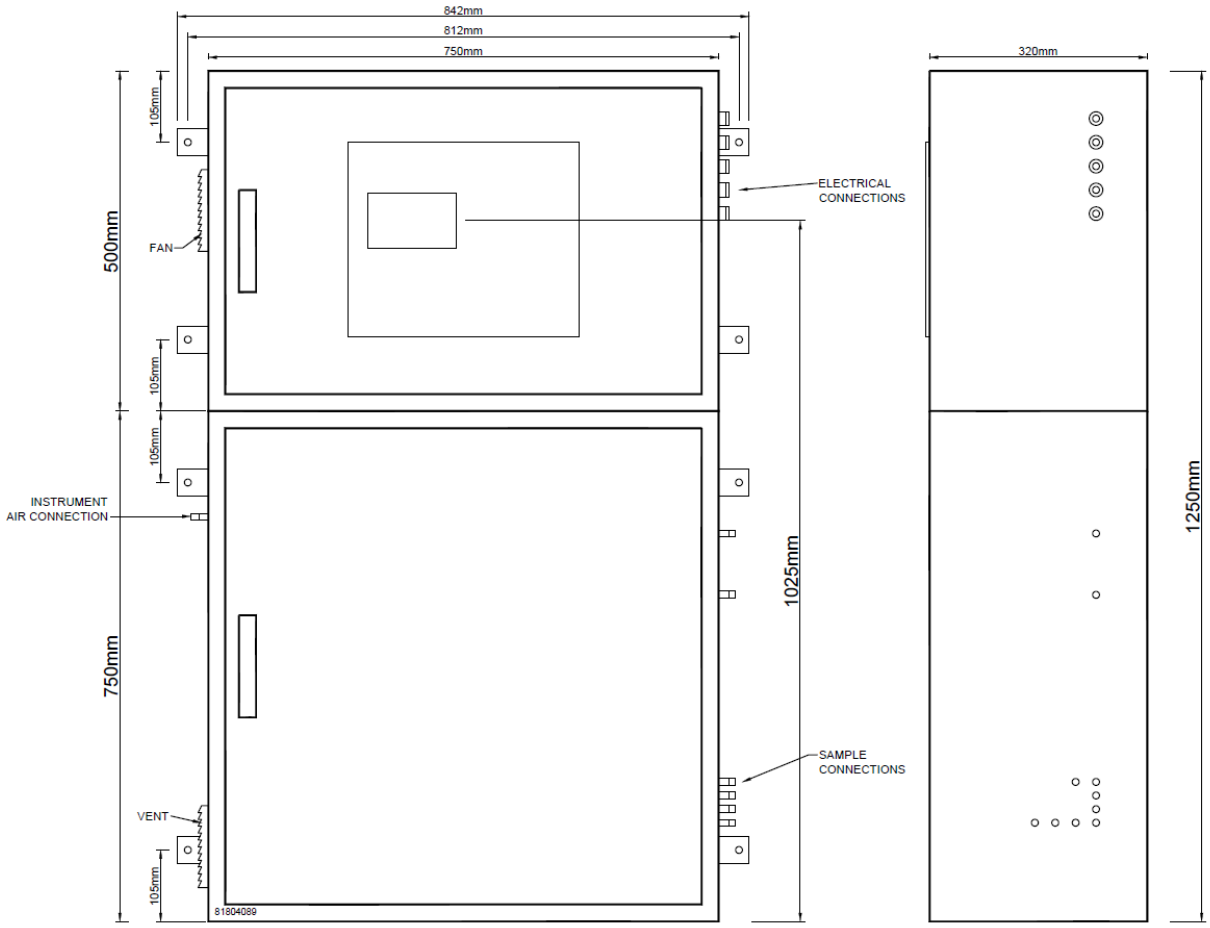
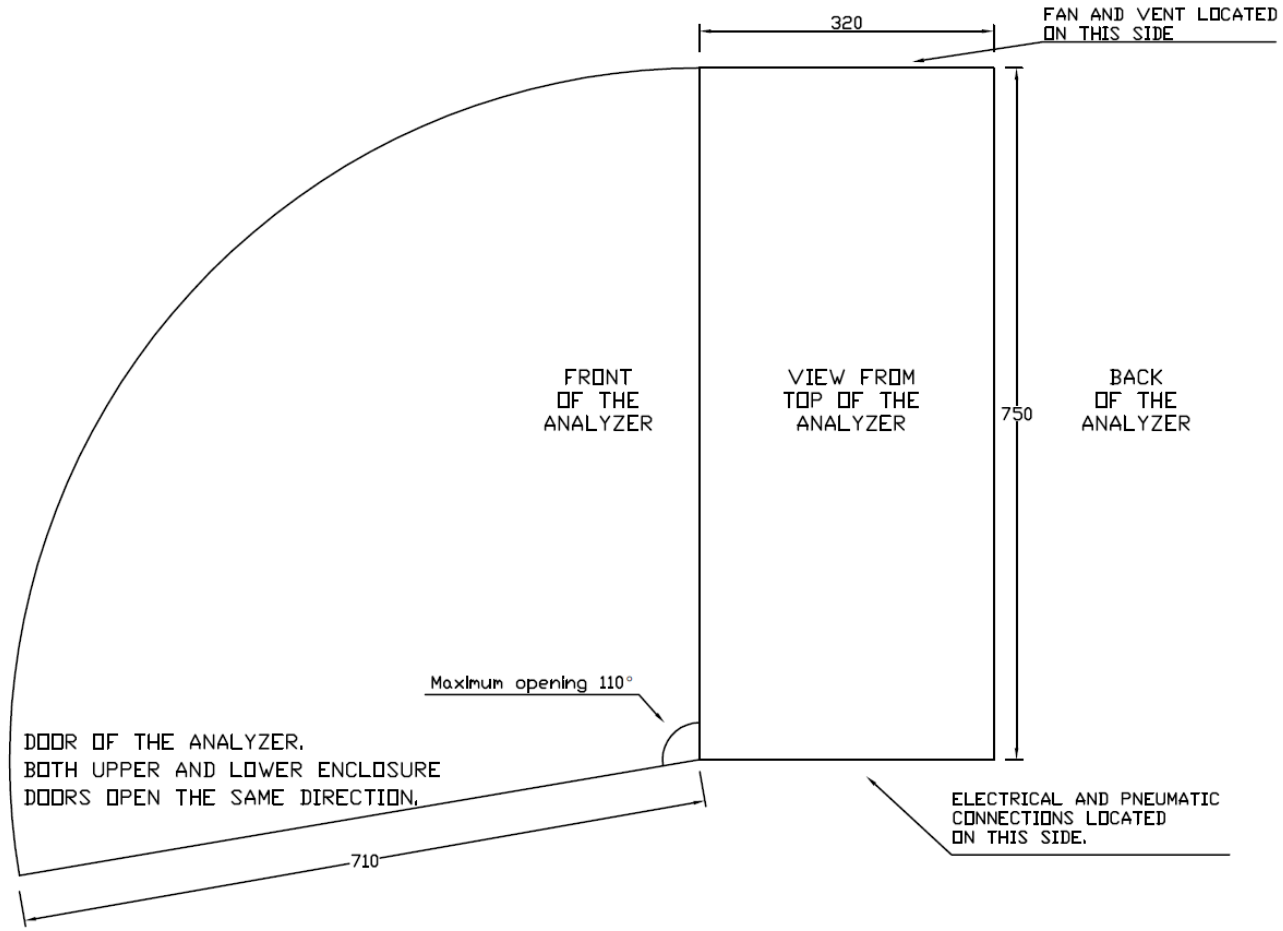


Table 5 Various BioTector Dimensions

	Height	Width	Height (LCD Screen)	Depth
BioTector TOC Analyzer	1250mm	750mm	1025mm	320mm
BioTector TOC Analyzer with extended lower enclosure	1500mm	750mm	1275mm	320mm

Figure 8 below illustrates the BioTector door clearance dimensions.

Figure 8 BioTector Door Clearance Dimensions



It is recommended that a clear space of 300mm is allowed around the BioTector in all directions. 1500mm should be free in front of the BioTector so that its access doors can easily be opened. Dimensions in mm.

- When BioTector is being mounted on a wall or a stand, the support has to be strong enough to carry typically four times of the weight of BioTector (~400 kg).
- The BioTector should be lifted applying a safe method in accordance with local regulations.
- The minimum size of the bolts used to hold the BioTector in place should be M8.

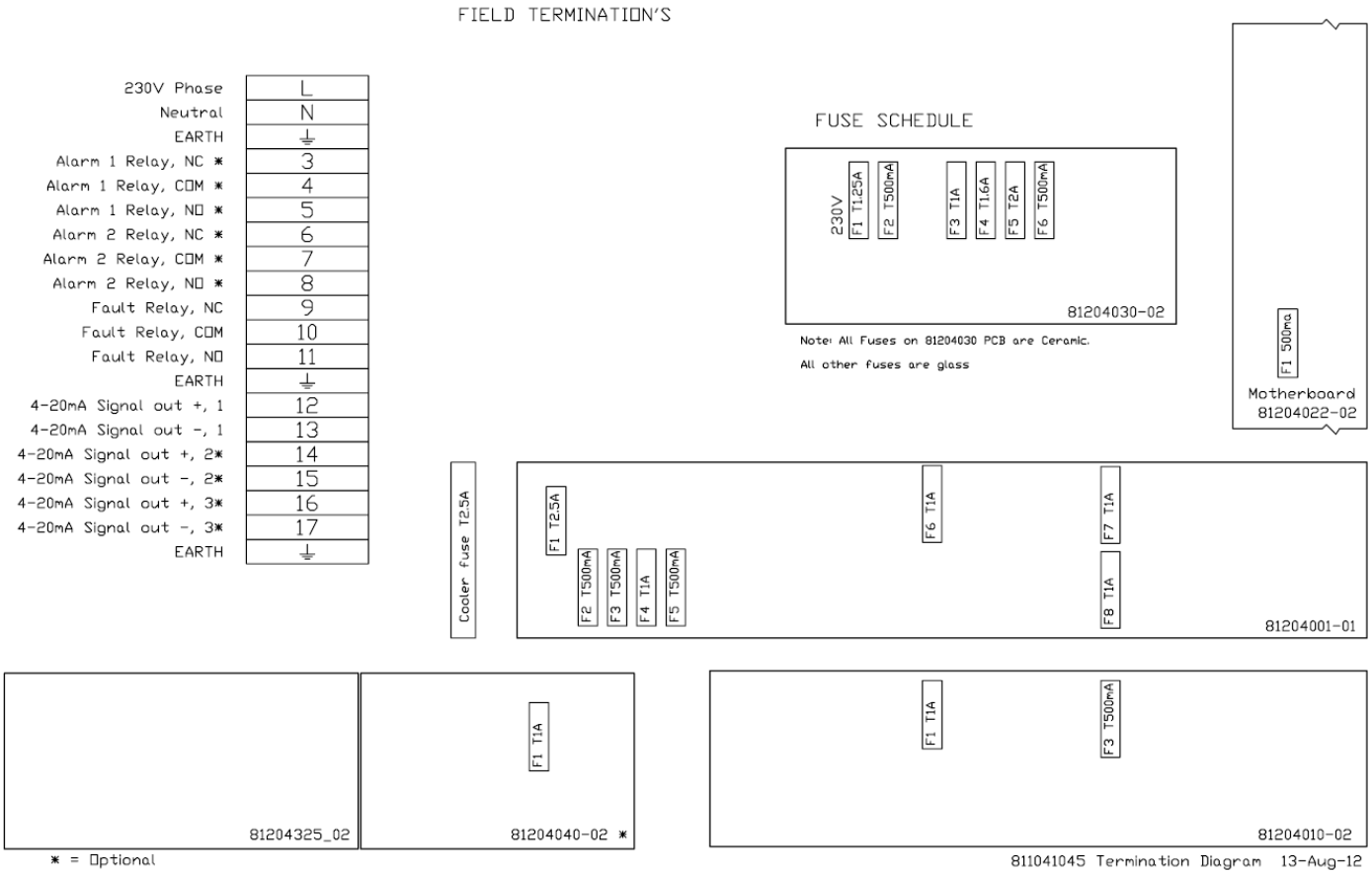
5.2.2 Wiring Power and Signal Terminals

BioTector contains electrical components operating under high voltages. Contact may result in electric shock and severe or fatal injury.

Figure 9 and figure 10 below show the typical mains (for both 230 and 115 volts systems respectively) and the 4-20mA signal connections in BioTector. The connection to mains power {230V or 115V AC (±10%), 50/60 Hz} should be carried out by a certified electrician, in accordance with site regulations. The mains wire specifications are 3 cores, 10 Amps minimum current rating and 1.50mm^2 minimum CSA (Cross Sectional Area). The mains cable should be screened and screen earthed to comply with the Electromagnetic Compatibility Directive (2004/108/EC).

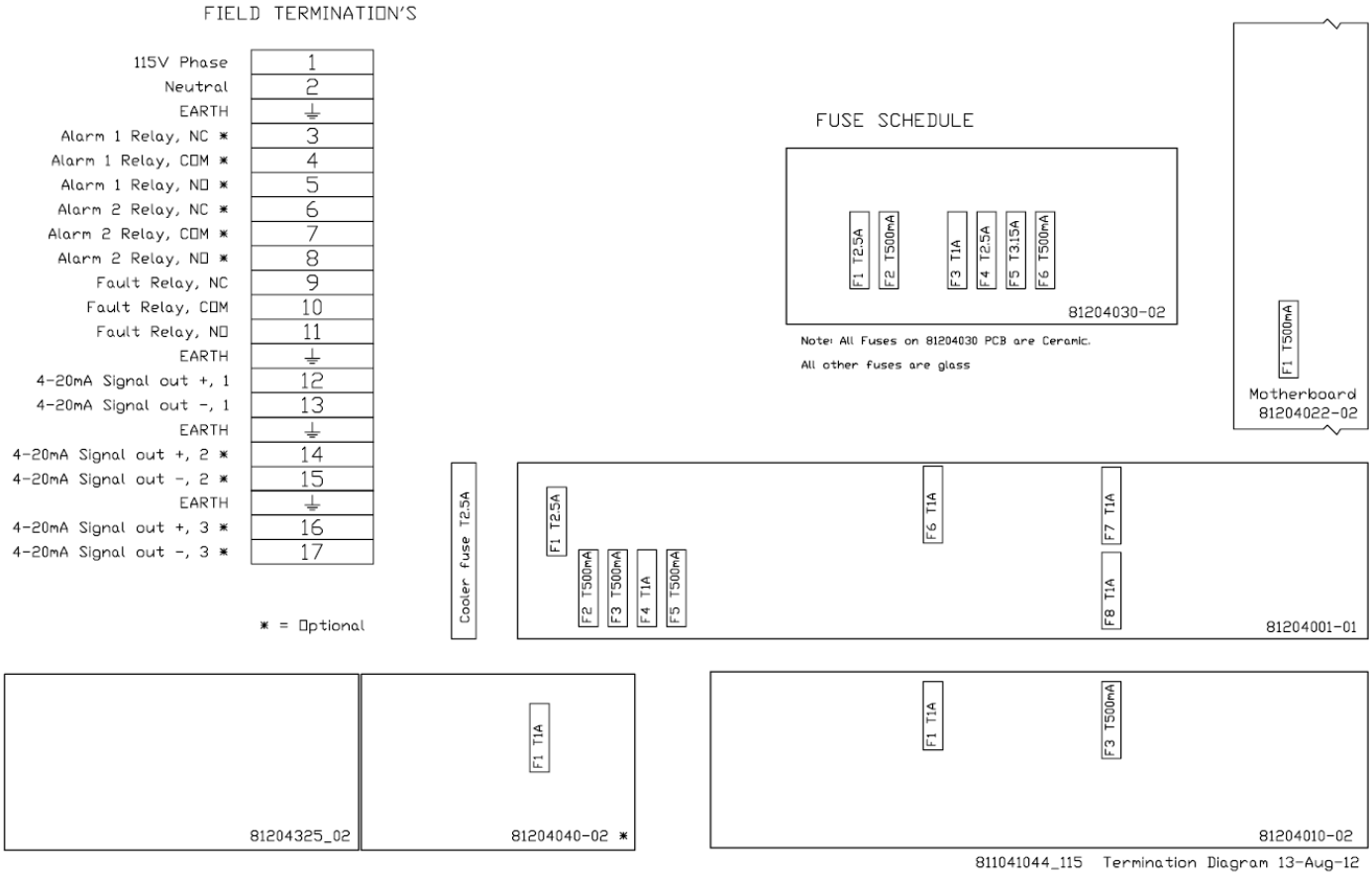
For 4-20mA and any other signal connections, only screened instrument cable, which comply with the EEC directive, should be used. The signal cable should also be screened, and the screen earthed. The specifications for the signal wire are 8 cores (+2 cores per additional signal), 1 Amp minimum current rating, 0.22mm^2 minimum CSA (Cross Sectional Area).

Figure 9 Mains and 4-20mA terminal diagram for 230 V systems



All electrical, sample, reagent, drain and exhaust connections should be carried out in accordance with the technical specifications and drawings given in this manual. Errors as a result of non-conformity to these specifications will not be covered by the warranty.

Figure 10 Mains and 4-20mA terminal diagram for 115 V systems



The wiring and earth connections to the analyzer should be carried out in accordance with local regulations, and securely terminated in the phase, neutral and earth terminals in the BioTector. Cable glands must be used to secure the cables when necessary.

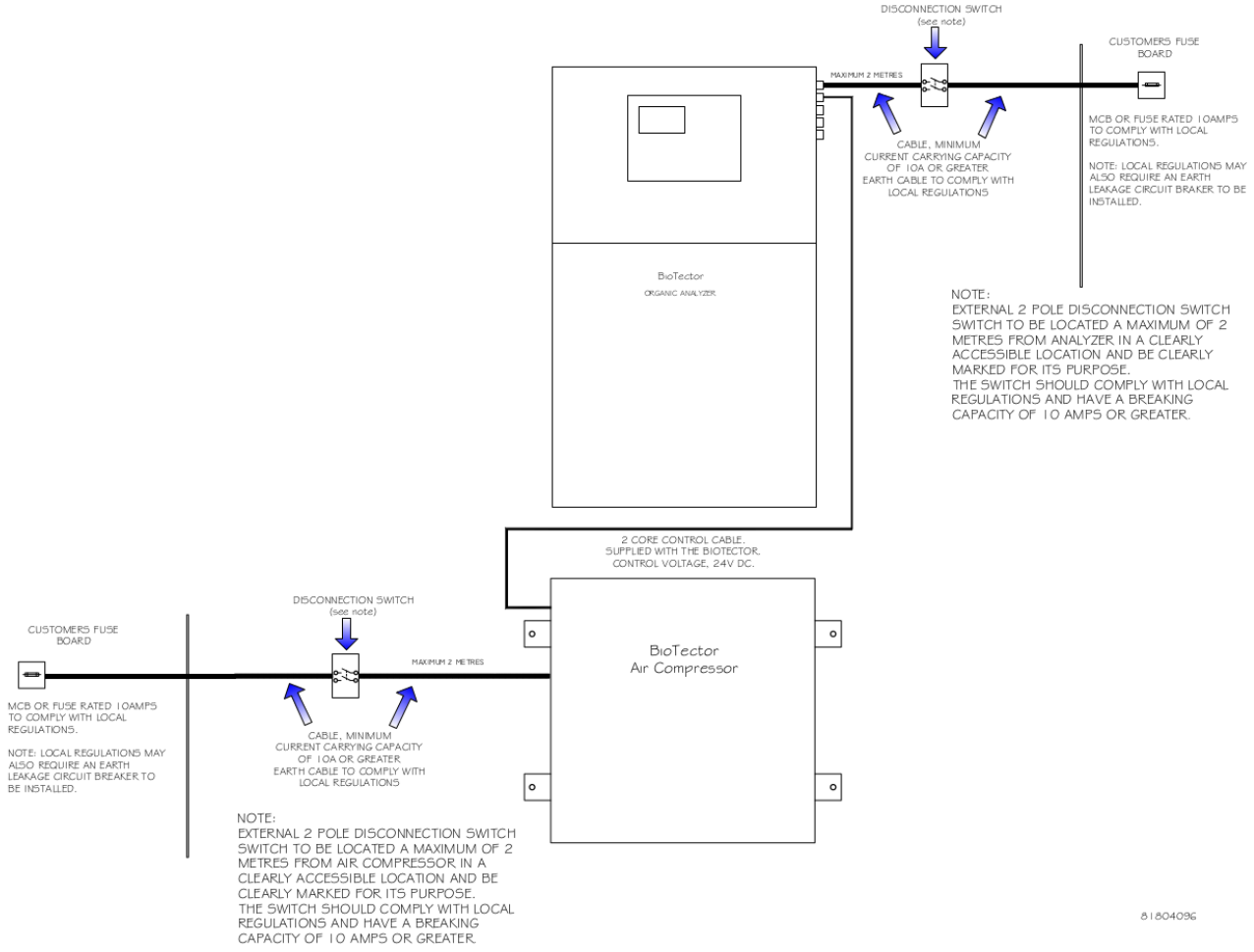
5.2.3 Wiring External Power Disconnection Switch

The mains power must be connected through an external 2-pole disconnection switch, so that the power to the analyzer can be isolated without opening the electronics enclosure.

- The external power disconnection switch must be located in an easily accessible location, with a maximum distance of 2 meters from the analyzer.
- The switch must be clearly marked for its purpose.
- The switch must comply with local electrical regulations, and have a breaking capacity of 10 Amps or greater.

Figure 11 below illustrates the positioning and the installation of the disconnection switch.

Figure 11 External Power Disconnection Switch



When the wiring of the system is completed, the power up of the system should be carried out in the order below:

i) While the external disconnection switch is powered off, power on the internal MCB (miniature circuit breaker) in the BioTector.
ii) Close BioTector electronics enclosure.
iii) Switch on the external disconnection switch.

The power off of the BioTector should be carried out by switching off with the external disconnection switch followed by the internal MCB.

5.2.4 System Fuse Specifications

Table 6 below summarizes the location and specification of the fuses used in BioTector. The locations of the fuses are also displayed in figure 9 and figure 10 above.

BioTector contains electrical components operating under high voltages. Contact may result in electric shock and severe or fatal injury.

All electrical work should be carried out by qualified electrical personnel only.

When any fuse replacement is required in the system, please refer to table 6 below.

Table 6 System Fuse Specifications

						230 V Systems	115 V Systems
Location Name	**PCB ID Number**	**Interrupt Rating**	**Type**	**Material**	**Fuse Number**	**Current Rating**	**Current Rating**
Power PCB (Mains PCB)	81204030-02	H-250V	Miniature 5x20mm	Ceramic	F1	T 1.25A	T 2.50A
					F2	T 500mA	T 500mA
					F3	T 1.00A	T 1.00A
					F4	T 1.60A	T 2.50A
					F5	T 2.00A	T 3.15A
					F6	T 500mA	T 500mA
Relay PCB	81204001-01	L-250V	Miniature 5x20mm	Glass	F1	T 2.50A	T 2.50A
					F2	T 500mA	T 500mA
					F3	T 500mA	T 500mA
					F4	T 1.00A	T 1.00A
					F5	T 500mA	T 500mA
					F6	T 1.00A	T 1.00A
					F7	T 1.00A	T 1.00A
					F8	T 1.00A	T 1.00A
Stream Expansion PCB	81204040-02	L-250V	Miniature 5x20mm	Glass	F1	T 1.00A	T 1.00A
Signal PCB	81204010-02	L-250V	Miniature 5x20mm	Glass	F1	T 1.00A	T 1.00A
					F3	T 500mA	T 500mA
Main Board (Motherboard)	81204022-04	L-250V	Miniature 5x20mm	Glass	F1	T 500mA	T 500mA
Cooler DIN Rail	Terminal 47	L-250V	Miniature 5x20mm	Glass	F1	T 2.5A	T 2.5A

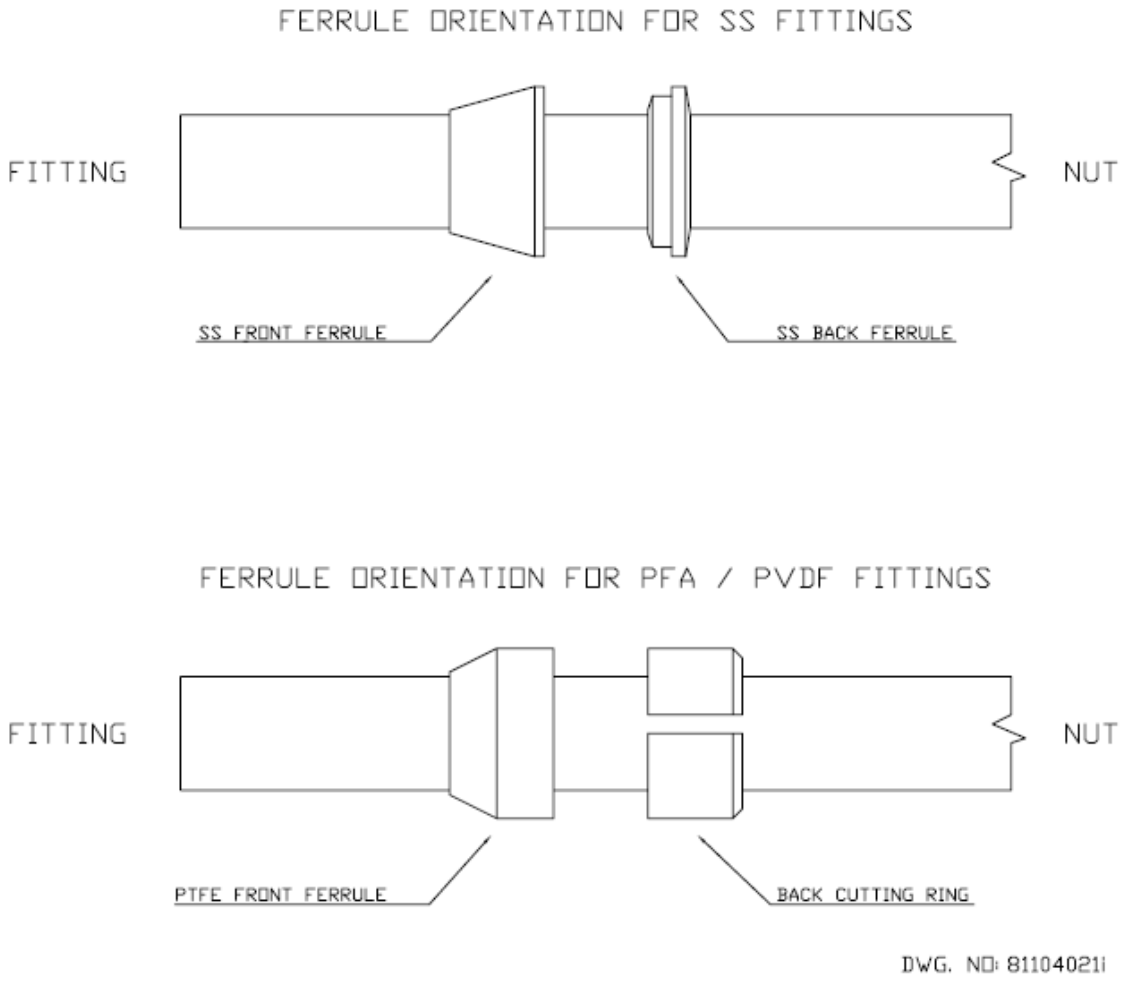
KEY **A:** Amperes **DIN**: German Institute for Standardization (Deutsches Institut für Normung e.V.)
F: Fuse **H:** High Interrupt **ID:** Identification **L:** Low Interrupt
mA: Milli-amperes **PCB**:Printed Circuit Board **T:** Time Lag (Time Delay)
V: Volts

5.3 Air Supply and Reagent Connections

The orientation of the ferrules inside each fitting of BioTector is critical for the correct operation of the system. Incorrect ferrule orientation may create gas/liquid leak and/or introduce air bubbles into the system lines. Therefore, the ferrules on all carrier gas, reagents, drain, exhaust and vent fittings have to be fitted with the correct orientation. Failure to do so will have an impact on the system operation and analysis responses.

Figure 12 shows the fitting side and the nut side of SS-316 (stainless steel), PFA and PVDF fittings and their corresponding correct ferrule orientation.

Figure 12 The correct ferrule orientation of SS-316, PFA and PVDF fittings on BioTector



When tightening brand new stainless steel fittings, first fully insert the tube into the fitting, tighten the nut initially finger tight, then tighten a further 1¼ turns using an appropriate size spanner or an adjustable wrench. Stainless steel fittings used on 1/8" PFA tubing should be tightened only a further ¾ turns after finger tight. When re-tightening stainless steel fittings, which were already tightened during reassembly or after service, initially tighten the nut up to the point it was tightened previously, then tighten slightly more using an appropriate size spanner or an adjustable wrench.

When tightening brand new PFA fittings, first fully insert the tube into the fitting, tighten the nut initially finger tight, then tighten a further ½ turn using an appropriate size spanner or an adjustable wrench. When re-tightening PFA fittings, which were already tightened during reassembly or after service, initially tighten the nut up to the point it was tightened previously, then tighten slightly more using an appropriate size spanner or an adjustable wrench.

5.3.1 Air Supply Connection

The recommended air quality for BioTector is -20°C dew point, free of water, oil and dust. A filter pack may be required to meet or exceed the air quality specification.

BioTector Air Compressor can be supplied by BioTector distributors as an option.

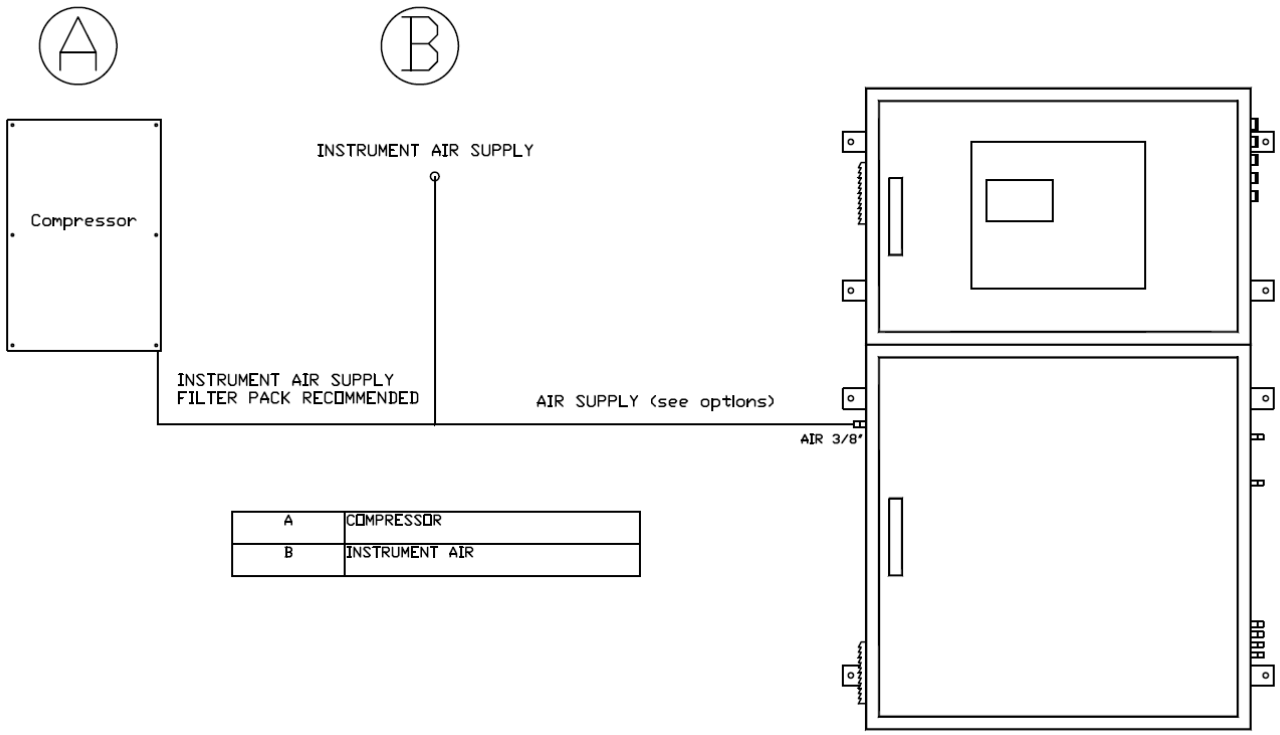
The air can be supplied to BioTector from:

A) An existing instrument air supply line
B) BioTector Air Compressor

The required instrument air supply pressure is 1.5 bars. The minimum air supply flow rate is 8.4 m^3/hour at 1.5 bar. The average air consumption is less than 5.4 m^3/hour, and typically 3.6 m^3/hour during online operation.

Figure 13 below illustrates the two options for air supply: A) from an existing instrument air supply line, B) from BioTector Air Compressor.

Figure 13 BioTector air supply options

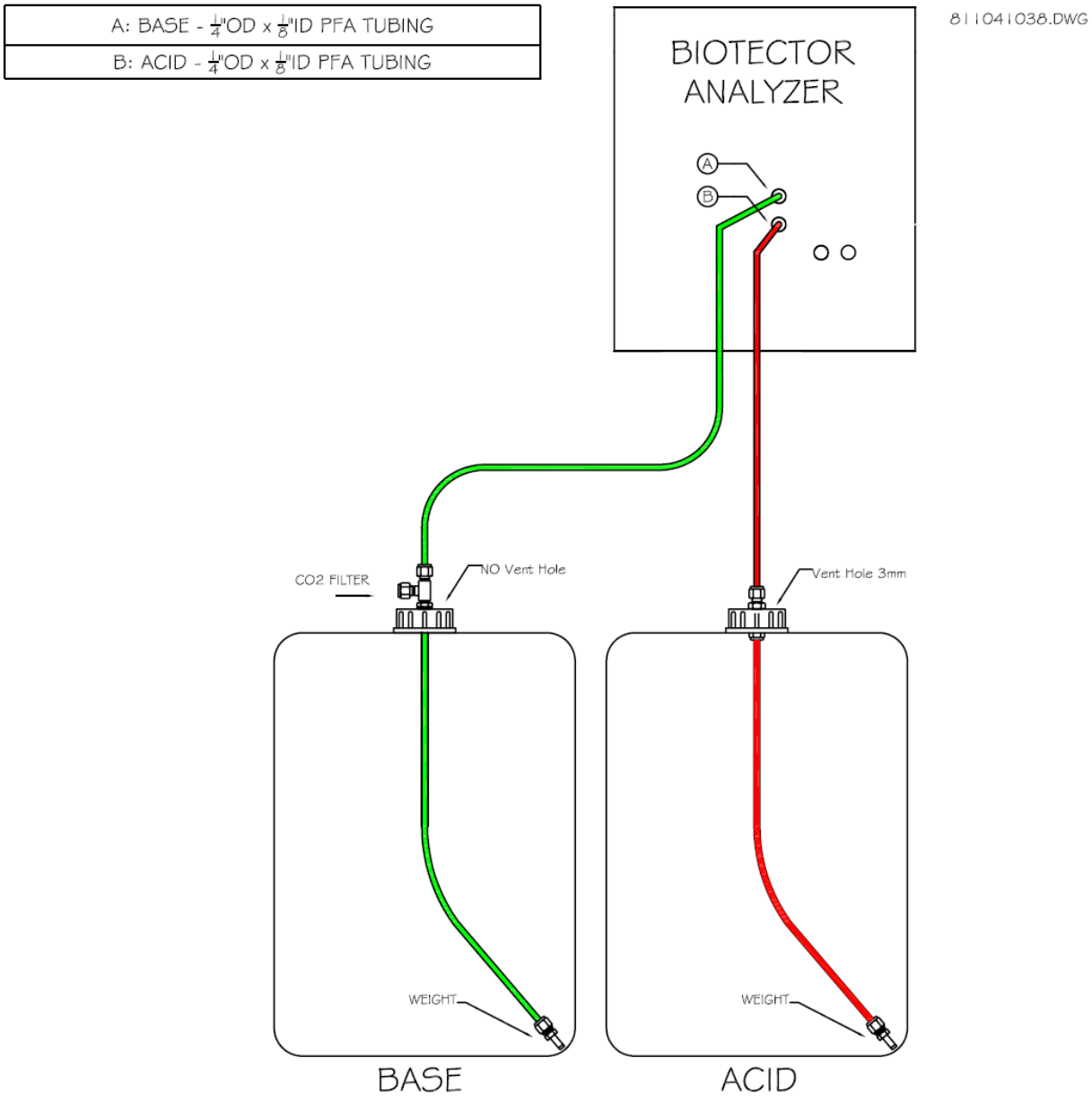


5.3.2 Reagent Connections

Special precautions are needed when working with chemical reagents, both when renewing reagents and when dealing with leaks or spills. Some reagents can cause chemical burns and may cause injury or death if swallowed. Please refer to the symbols and codes on the reagent containers.

Use of 25 liter containers is recommended for each BioTector reagents. Figure 14 below shows the correct setup and connection of BioTector reagents: Acid (1.8N Sulfuric Acid) and Base (1.2N Sodium Hydroxide). See Section 6 Reagents and Calibration Standards for further details.

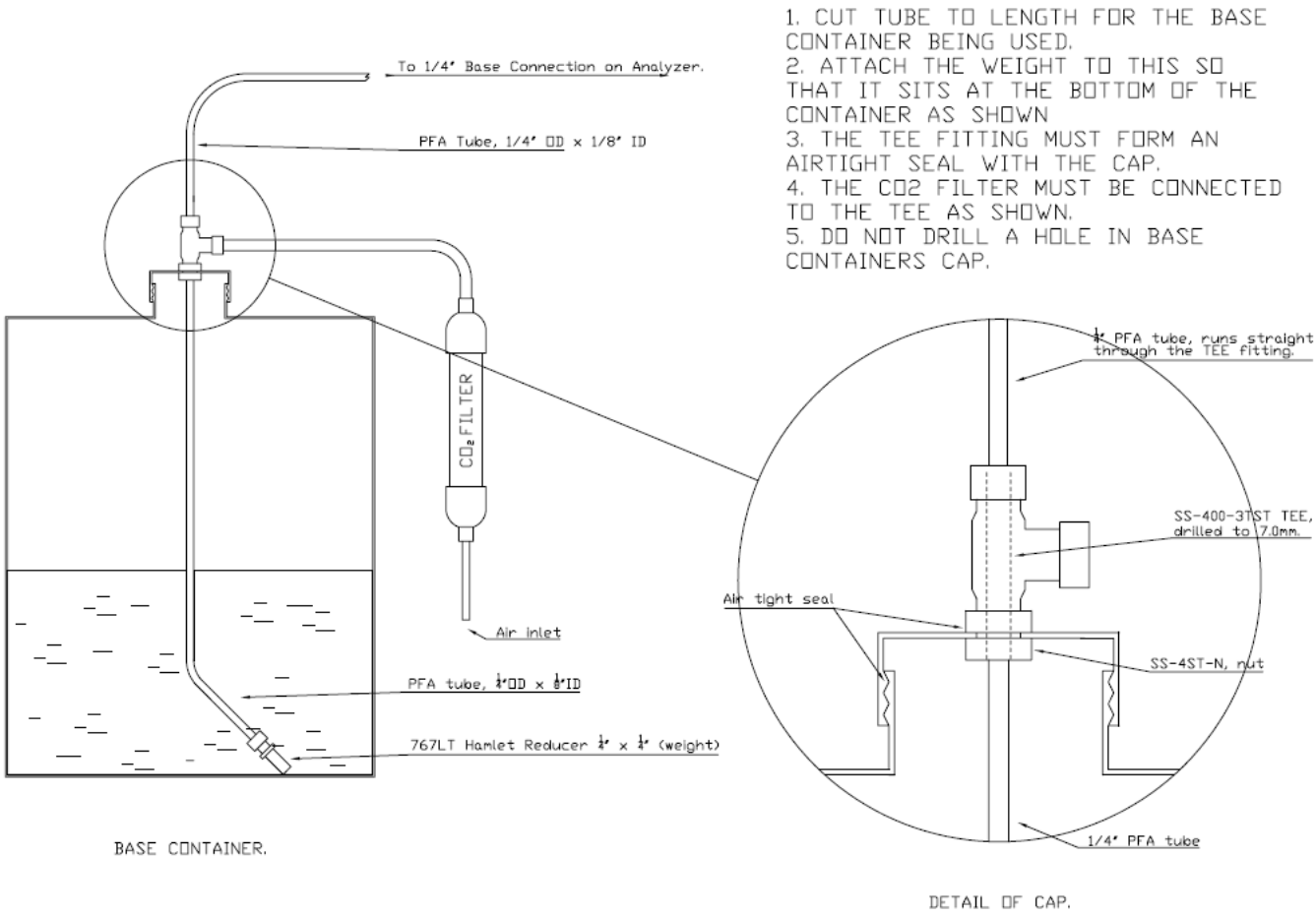
Figure 14 BioTector reagent setup and connections



As can be seen in the figure 14 above, unlike all other reagents, base reagent container does not contain any vent (breathing) hole. The breathing air into the base container is supplied through the CO_2 filter, which must be fitted on the base container lid.

Figure 15 below shows the detailed connections on BioTector base reagent. The purpose of the CO_2 filter is to prevent the base reagent coming in contact with atmospheric CO_2 present in the air. The soda lime inside the CO_2 filter absorbs the atmospheric CO_2 and prevents the base reagent getting contaminated. If any vent hole is accidentally drilled on the lid of the base container and if the fittings are not connected correctly on the base reagent, contamination will occur and the background CO_2 readings will increase.

Figure 15 BioTector base reagent dip tube setup



All other reagent containers' (except the base reagent container) lids must contain a 3mm vent hole. Failure to do so may cause the container to collapse and leak.

The length of the dip tubes in all reagent containers should be adjusted correctly for the optimum usage of the reagents. Stainless steel (SS-316) weights should not be used in any reagent which contains HCl acid. The recommended weights for such reagents are PFA.

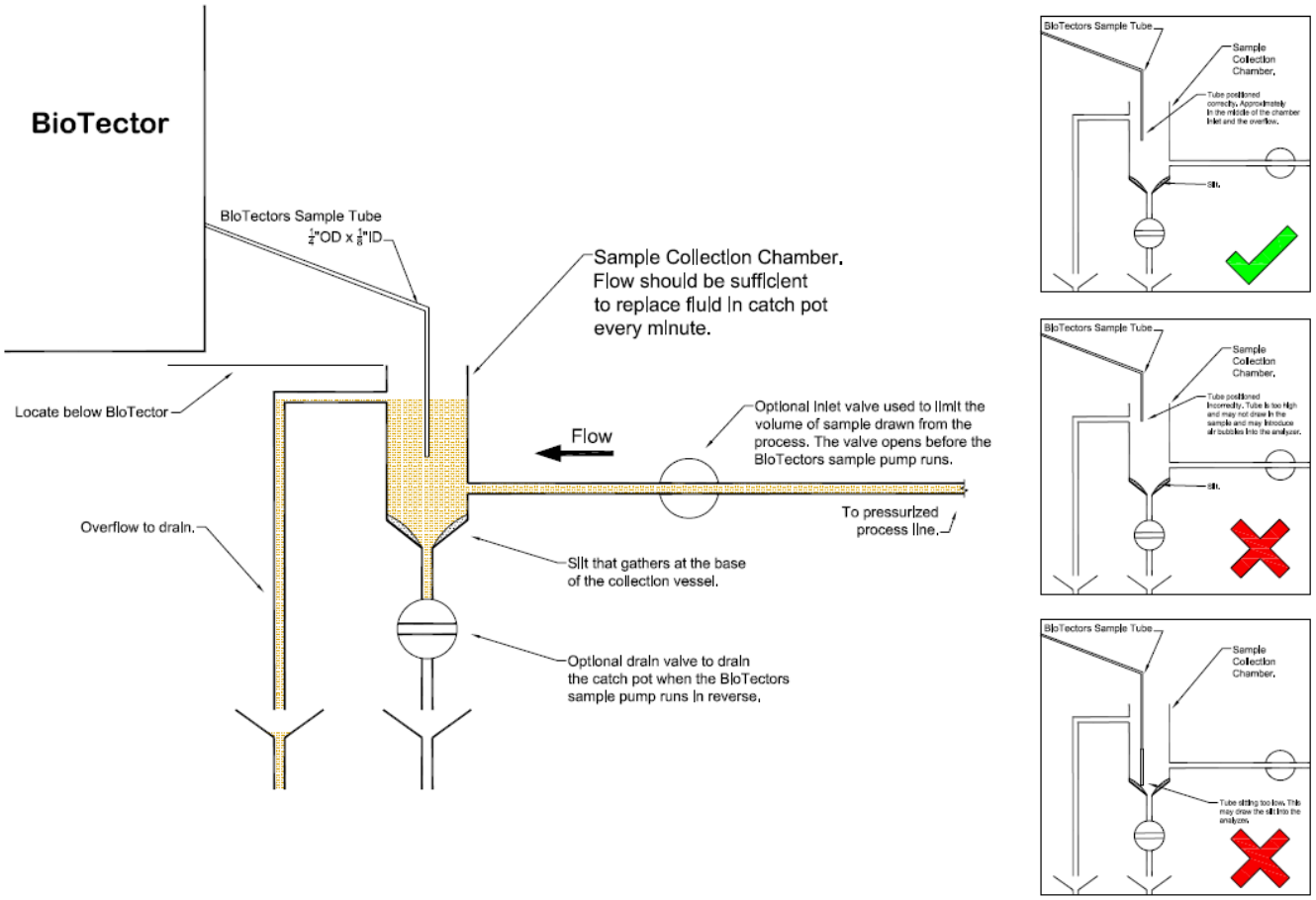
5.4 Sample, Drain and Exhaust Connections

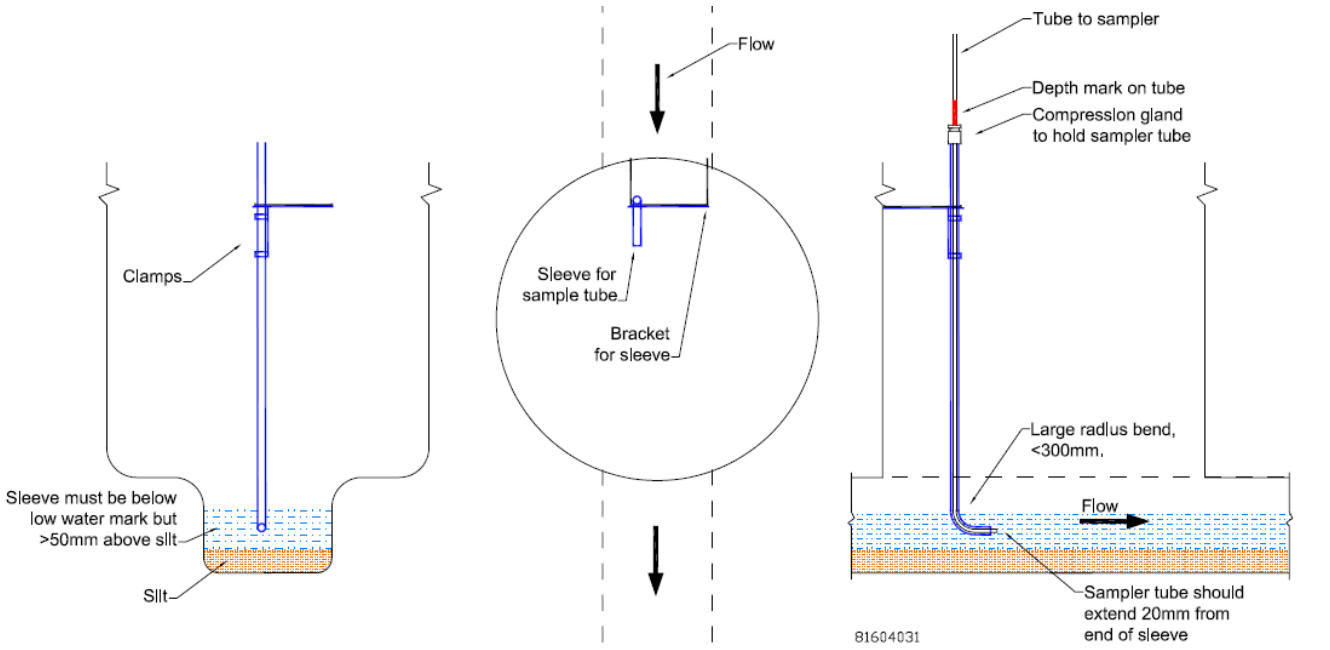
5.4.1 Sample Inlet Tube Position

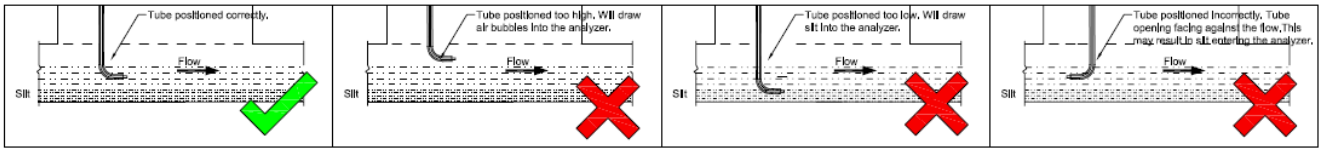
For the fittings to remain leak proof, they must be kept clean and should not be over tightened. Over tightening of the fittings will damage them and cause eventual leakage.

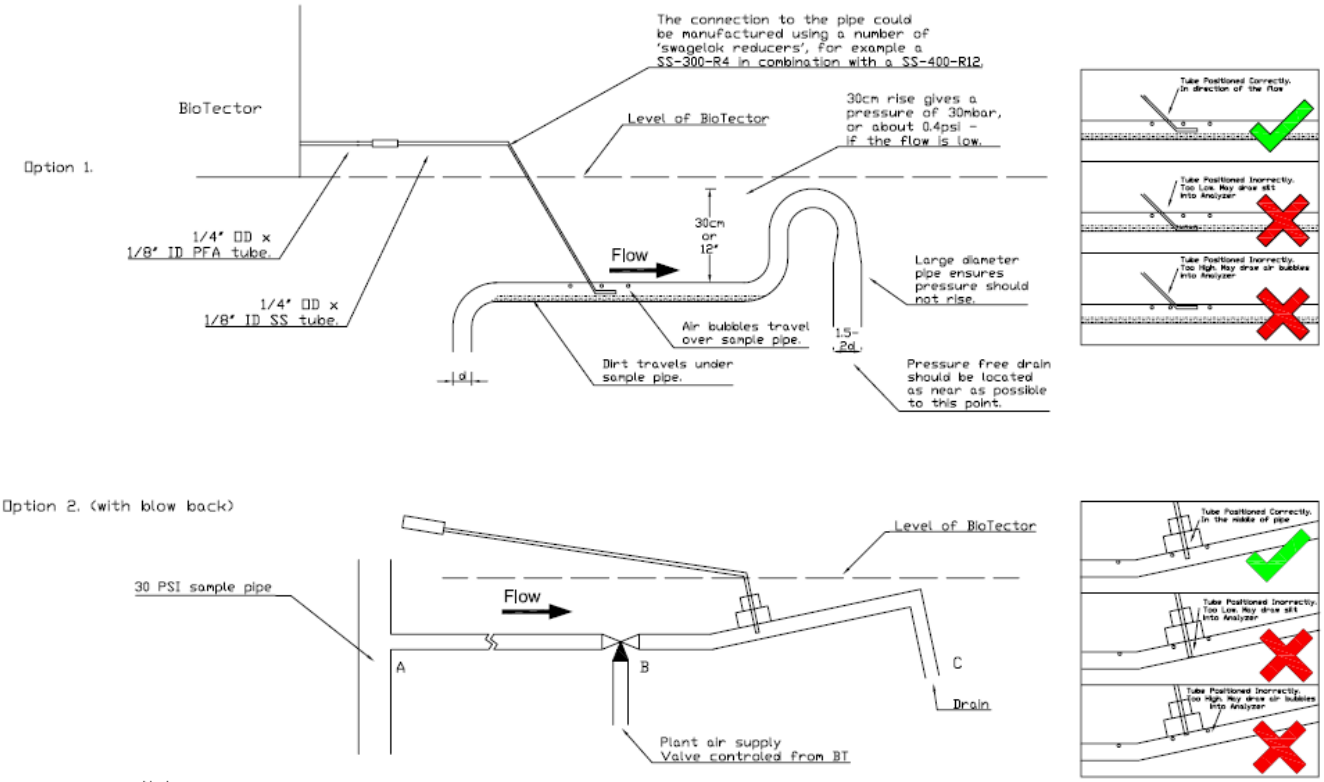
BioTector operates on unfiltered samples, the setup of the sampling point is important for the correct operation of the system. BioTector can handle soft particulates up to 2mm in diameter, however hard particulates (e.g. sand) will damage the analyzer and should be removed from the sample.
The vertical distance between the water surface at the sample intake and the bottom of the BioTector enclosure can be up to 4 meters. The overall length of the sample tube is typically 4 meters. BioTector in fact can draw samples from distances greater than 4 meters however, such distances may have an impact on the Sample Pump tubing life. The point where the sample is taken from should not be pressurized. The sample inlet and outlet should be at ambient pressure. The sample temperature should be between 2°C and 60°C (36°F - 140°F). The minimum sample flow rate is 100ml per sample. The sample bypass tube should be placed to a well ventilated area at ambient pressure and it should not be subjected to any back pressure as this may result in measurement errors. Figure 16 illustrates the correct positioning of the BioTector sample tube in various/optional sampling systems.

Figure 16 BioTector sample tube position in various sampling systems









Notes:
Blow back cleans pipe section A-B
B to C is not cleaned and should be as short as is possible

5.4.2 Drain, Bypass and Exhaust Connections

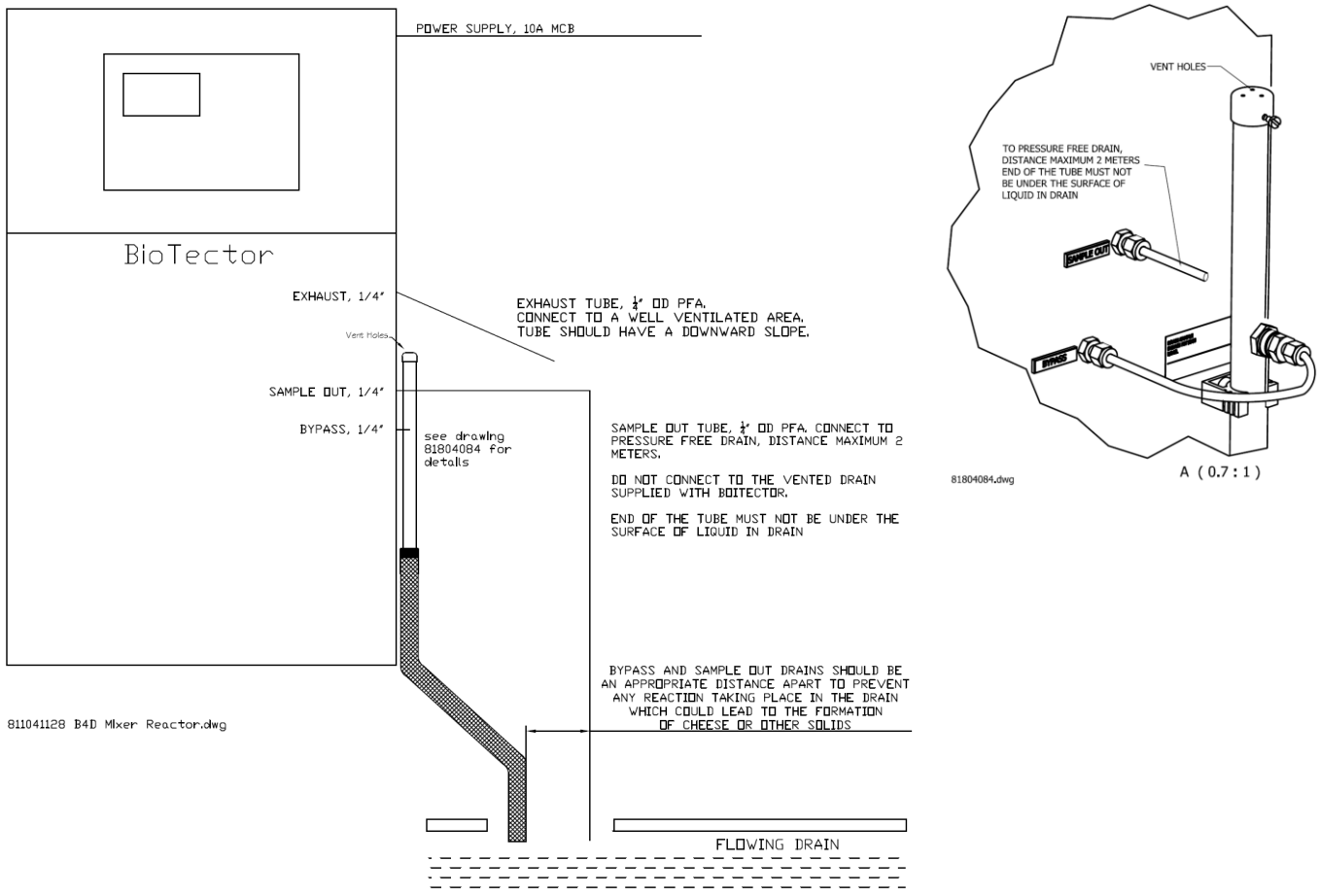
WARNING

The BioTector should be installed in a well-ventilated area with the exhaust port piped to an external vent. The installation should be carried out in accordance with Section 1 Safety Precautions.

All BioTector drain tubing must be positioned correctly so that any liquid pumped will drip freely into a larger drain chamber. The correct positioning and setup of the drain ports prevent liquid accumulation and measurement errors. All drain ports should be directed to a well ventilated area as oxygen and other gases may be released during the analysis. The drain tubes should be at atmospheric pressure and should not be subjected to any back pressure as this may result in measurement errors. The exhaust tube should be piped out to a well ventilated area as oxygen and other gases will be released during the analysis. The end of this tube should be positioned in a downward position so that water condensation and freezing will not occur during winter months. Figure 17 illustrates BioTector drains, sample bypass and exhaust connections.

The PVC-U Drain Pipe, installed outside the BioTector, is supplied for convenience. PVC-U is a durable material, which survives in environments containing acids, caustics, oxidizing agents etc. However, if the sample contains specific high concentration solvents such as Benzene, Toluene etc., it is recommended to check the compatibility of PVC-U tubing against the specific organic solvents present in the sample. If necessary, the drain pipe can be replaced with an alternative pipe. If such change is carried out, it is important that the sample bypass port is connected to the new pressure free drain pipe at the same height with the original pipe.

Figure 17 BioTector drain, sample bypass and exhaust connections



Section 6 Reagents and Calibration Standards

6.1 Reagents

BioTector TOC analyzer uses following reagents:

I. **Acid:** 1.8 N Sulfuric Acid (H_2SO_4) Reagent containing 80mg/l Manganese Sulfate Monohydrate
II. **Base:** 1.2 N Sodium Hydroxide (NaOH) Reagent

Reagents should not contain high levels of organics, nitrates and phosphates. Ideally, the level of organics, nitrates and phosphates should be less than 100 μg/l (ppb) in the deionized water used to prepare TOC analyzer reagents.

Acid and Base reagents are stable up to 1 year. Table 7 below summarizes the total days each BioTector TOC Analyzer reagent lasts at various system analysis range configurations:

Table 7 BioTector TOC Analyzer Reagent Consumption

REAGENTS	Container Size (Liters)	TOTAL DAYS REAGENT LASTS PER ANALYSIS RANGE		
		0-250 mgC/l	0-2000 mgC/l	0-20000 mgC/l
Acid	25	54	34	32
Base	25	53	33	31

Above table is derived from several operation parameters such as 100% online time. Recommended bunds (reagent spill trays) to contain above quantity reagents are 1x 50 Liters.

6.2 Calibration Standards

All hygroscopic chemicals in crystal form should be dried in an oven set at 105°C for 3 hours to remove any traces of absorbed water. All prepared solutions must be mixed thoroughly with a magnetic stirrer or inverted manually at least ten times or until all crystals are completely dissolved inside the solution.

The following compounds can be used to prepare calibration standard solutions in BioTector.

To prepare a 1000mgC/l Total Organic Carbon (TOC) standard solution, use one of the following:

- Potassium Hydrogen Phthalate, $C_8H_5KO_4$, 2.13g (99.9% purity) in one liter of deionized water. Water solubility: 80 g/L at 20°C.
- Acetic acid, $C_2H_4O_2$, 2.51g (99.8% purity) in one liter of deionized water. Water solubility: Miscible in all proportions.
- Glucose, $C_6H_{12}O_6$, 2.53g (99% purity) in one liter of deionized water. Water solubility: 512g/L at 25°C.

To prepare a 1000mgC/l Total Inorganic Carbon (TIC) standard solution, use one of the following:

- Sodium Carbonate, CNa_2O_3, 8.84g (99.9% purity) in one liter of deionized water.
- Sodium Hydrogen Carbonate, $CHNaO_3$, 7.04g (99.5% purity) in one liter of deionized water.
- Potassium Carbonate, CK_2O_3, 11.62g (99.0% purity) in one liter of deionized water.

The quantity of concentrated chemical required to prepare stock calibration solutions will change with the % purity of the chemical used. If the purity of the chemical is different than the figures displayed above, the necessary quantity needs to be recalculated from the purity of the chemical. See example in the following page.

Depending on the system analysis ranges (see System Range Data screen 2.2.3 System Range Data Screen for details), every BioTector requires specific calibration standard solutions. The required concentration of the calibration standard solutions can be identified in Span Calibration menu.
As the sample pressure normalization (line equalization function) is not activated for Calibration/Manual Valve, it is recommended that the calibration standard solution flask is placed at the same height with the Sample Pump.

The calculation of the quantities required to prepare Potassium Hydrogen Phthalate (KHP) standard solutions with various purities are given as an example below:

Name:	Potassium Hydrogen Phthalate		
Formula:	$C_8H_5KO_4$		
Carbon, 12	x8	=	96
Oxygen, 16	x4	=	64
Potassium, 39	x 1	=	39
Hydrogen, 1	x5	=	5
Total weight		=	204.22 g/mol

47% of KHP is Carbon. Purity of the KHP is 99.9%. Therefore, to prepare a 1000 mgC/l standard solution, add 2.13g of KHP in a flask and add enough deionized water to make it exactly 1 liter solution.

Note that the quantities required change with the % purity of the chemical used. Table 9 below gives the KHP quantities required at various % purity for the preparation of 1000mgC/l calibration standard.

Table 9 Quantity of KHP required to prepare 1000 mgC/l standard at various purities.

% Purity of KHP	Quantity of KHP (grams) to prepare 1000 mgC/l Standard
100	2.127
99.9	2.129
99.5	2.138
99.0	2.149
95.0	2.239
90.0	2.364

To prepare standard solutions containing more than 1000 mgC/l, the required solvent can be mixed directly with deionized water. Table 10 below gives the required quantity of KHP for various concentration standard solutions to be mixed with deionized water and added enough deionized water to make the solution exactly 1 liter.

Table 10 Quantity of KHP required to prepare various concentration TOC standard solutions.

TOC Standard Solution Concentration (mgC/l)	Quantity of 99.9% KHP (grams) to be added into 1 Liter DIW
1000	2.129
1250	2.661
1500	3.194
2000	4.258
5000	10.645
10000	21.290

Preparation of Calibration Standard Solutions:

Use eye protection and gloves.

Standards solutions greater than 1000mg/l can be prepared directly without any dilution by simply mixing the necessary quantity solvent or salt with deionized water. Standard solutions below 1000mg/l concentration should be prepared by dilution technique. First a 1000mg/l standard stock solution should be prepared, and then the required lower concentration standard solution should be prepared by applying the necessary dilution procedures:

- For example, to prepare a 50mgC/l TOC only standard solution, first weigh 50 grams of the 1000mgC/l stock standard. Add 50 grams of the 1000mgC/l standard into a one-liter flask and add enough deionized water to make the solution exactly 1 liter.
- For increased accuracy, standard solutions below 5mg/l (ppm) concentration should be prepared with two or more steps dilution. For example, to prepare a 1mgC/l standard, first prepare a 100mgC/l standard by adding 100 grams of the 1000mgC/l standard into a one-liter flask and by adding enough deionized water to make it exactly a 1 liter solution. Then add 10 grams of the 100mgC/l standard into a one-liter flask and add enough deionized water to make it exactly 1 liter.
- Standard solutions at µg/l (ppb) levels should be prepared with several dilution steps. For instance, a 1mgC/l (1000 µg/l) standard should be prepared with two or more steps dilution as described above. To prepare a 50µg/l standard, add 50 grams of the 1000µg/l standard into a one-liter flask, and add enough deionized water to make it exactly 1 liter.

Shelf Life and Storage of Calibration Standard Solutions:

- TOC standards prepared from Potassium Hydrogen Phthalate is typically stable for a month once it is kept in a closed glass container and refrigerated at 4°C.
- All other standards such as TOC prepared with Acetic Acid and TIC standards are recommended to be used within 48 hours of manufacture.

Section 7 Analyzer 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_2 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 air supply to the BioTector's AIR port. See figure 13 in Section 5.3.1 Air Supply Connection for details. The minimum air supply flow rate is 8.4 m^3/hour at 1.5 bar. The average air consumption is less than 5.4 m^3/hour, and typically 3.6 m^3/hour during online operation. When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar.

Option A: Instrument air. The set point pressure of the air, supplied from an existing instrument air supply line, should be 1.5 bar. The recommended air quality is -20°C dew point, free of water, oil and dust. _____

Option B: BioTector Compressor. The set point air pressure supplied from BioTector compressor should be 1.2 bar.

In BioTectors built with a vortex cooler, air should be supplied to the vortex cooler using a regulator, which is dedicated for the vortex cooler only.

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_2 filter. Fit the CO_2 filter to the Base container and seal the Base container tightly. See figure 14 and figure 15 in Section 5.3.2 Reagent Connections for details. _____

Connect the Acid (1.8N Sulfuric Acid, H_2SO_4, 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 16 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 16 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 17 in Section 5.4.2 Drain, Bypass and Exhaust Connections for details. _____

Confirm that the SAMPLE OUT port is connected to a well ventilated pressure free drain with ¼" PFA tube. The tube should be fitted so that it cannot freeze in cold weather. See figure 17 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 17 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. _____

Check the air supply pressure. The set point pressure should be 1.5 bar. When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar. Check the O2 PRESSURE SENSOR in O2-Controller Status menu. The pressure should be between 390 mbar and 400 mbar at the idle 1 l/h "Mass Flow Controller" MFC FLOW. At 60 l/h MFC SETPOINT flow, the pressure should not be less than 320 mbar. See Section 8.1.6 Oxygen Controller Status for details. _____

Oxygen Purity Test: Power up the system 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 2 and table 2 in Section 4.1.1 Analysis Enclosure) flow to 10 l/h and flow oxygen gas through the CO_2 analyzer for 5 minutes. At the end of this period, the CO_2 analyzer zero reading (ppm CO2) should be typically within ±0.5% of full scale of the CO_2 analyzer range. For instance, if the CO_2 analyzer range is 15000ppm, then the CO_2 analyzer zero reading should be typically within ±75ppm. Go to CO2 Analyzer menu (see section 8.3.10 CO2 Analyzer) to view the CO_2 Analyzer Range. _____
(If the CO_2 analyzer zero reading is outside the specifications, confirm that there is no CO_2 in the oxygen gas by connecting the CO_2 filter "used with the sodium hydroxide reagent container" between the Cooler and CO_2 analyzer inlet port and set the MFC to 10 l/h. As the size of the CO_2 filter is small, keep the 10 l/h gas flow running for at least for 5 minutes and record the CO_2 zero readings at the end of the 5 minute period. If the CO_2 zero readings do not drop significantly with the CO_2 filter in place, this will indicate that there is no CO_2 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. Activate the Acid Valve and 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. Activate the Base Valve and run the Base Pump in Simulate menu. 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 "I030. 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 (2.2.3System 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_2 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.)* _____

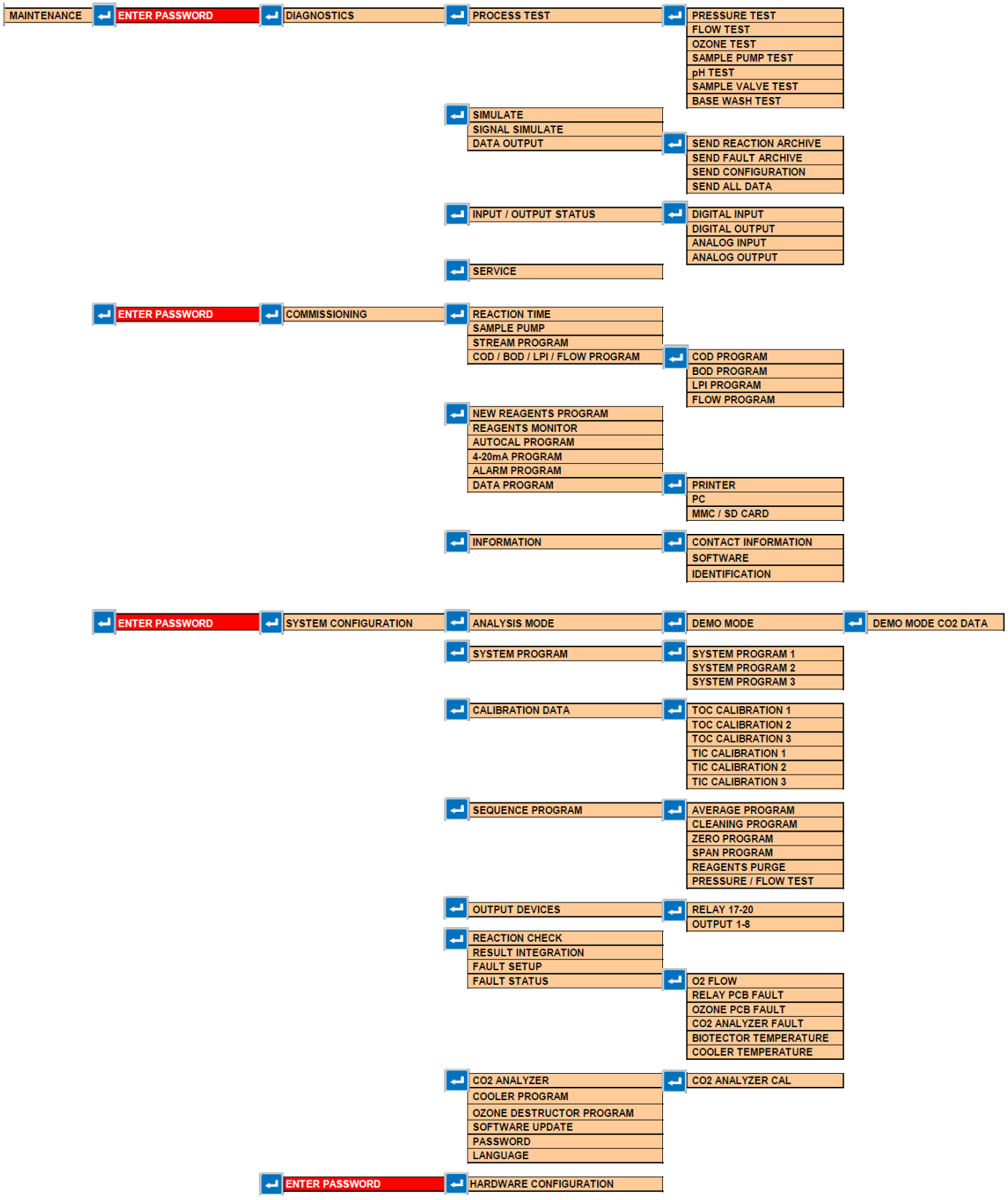
Connect the standard solution to the MANUAL/CALIBRATION port. If these ports are not available, use the SAMPLE 1 port. Avoid the manual purging of the calibration, manual grab sample and sample lines using the Simulate menu, because the system reactor may get contaminated during the automatic sample 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_2 peaks are correct. _____

Section 8 Maintenance Menu

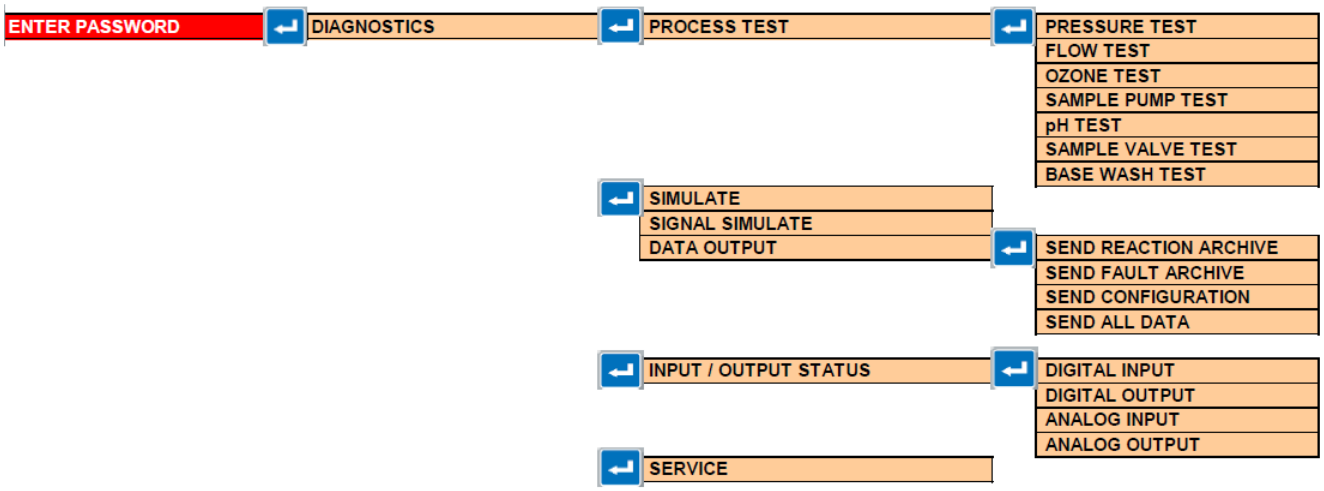
Maintenance Menu Diagram



8.1 DIAGNOSTICS MENU

This group of menu allows the user to access the Process Test, Simulate, Data Output, Input/Output Status and Service menus for diagnostic purposes.

Diagnostics Menu Diagram



8.1.1 Process Test

This group of menus allows the user to simulate the Pressure Test, Flow Test, Ozone Test, Sample Pump Test, pH Test and Sample Valve Test routines.

Detailed Process Test procedures are available in the MMC/SD card shipped with the BioTector. It is recommended to review these documents for troubleshooting purposes when necessary.

8.1.1.1 Pressure Test

```
PRESSURE TEST                    09:17:28  12-09-02

 1 < * PRESSURE TEST
 2     PRESSURIZE REACTOR




      TIME                       60s
      MFC SETPOINT               40.0l/h
      MFC FLOW                   03.3l/h
      STATUS                     TESTING

      PRESS ESC TO ABORT THE TEST
```

This menu enables the user to simulate the Pressure Test. The menu also shows the current status of the Mass Flow Controller. Any settings made by the user in this menu are automatically reset when the user exits this menu.

1. **Pressure Test.** Use this function to simulate the Pressure Test. When the Pressure Test is activated, an "*" will be shown, and a small menu will display the following data:
   - Time: The time for the pressure test is 60 seconds. This time shows the time left to the end of the test.
   - MFC Setpoint: This is the BioTector mass flow controller flow setting (40 l/hr by default) for the pressure test.
   - MFC Flow: This is the actual flow from the mass flow controller. Initially the setpoint and flow will match, and if there is no gas leak, after about 25 seconds the flow will fall to close to zero.
   - Status: At the end of the test, the status below is shown:
     - TESTING: Test in progress.
     - PASS: The Pressure Test finished its cycle with a flow below the Pass (Pressure Test Warning) level (4 l/hr by default).
     - WARNING: The Pressure Test finished its cycle with a flow above the Pass (Pressure Test Warning) level, but below the Fail (Pressure Test Fault) level (6 l/hr by default).
     - FAIL: The Pressure Test finished its cycle with a flow above the Fail (Pressure Test Fault) level (6 l/hr by default). See Section 8.3.4.6 Pressure/Flow Test Program for details.

2. **Pressurize Reactor.** This is similar to the Pressure Test above, but its time has been extended to 999s, allowing the user to locate any leak there may be on the system. Pass, Warning and Fail are automatically shown on the screen, depending on the status of the test.

8.1.1.2 Flow Test

```
FLOW  TEST                          09:17:28  12-09-02

 1 < * EXHAUST  TEST
 2     EXHAUST  FLOW
 3     SAMPLE  OUT  TEST
 4     SAMPLE  OUT  FLOW




      TIME                    30s
      MFC  SETPOINT           80.0l/h
      MFC  FLOW               78.3l/h
      STATUS                  TESTING

      PRESS  ESC  TO  ABORT  THE  TEST
```

This menu enables the user to simulate various Flow Tests through the system. The menu also shows the current status of the Mass Flow Controller. Any settings made by the user in this menu are automatically reset when the user exits this menu.

1. **Exhaust Test.** Use this function to simulate the flow through the Exhaust Valve. When the Exhaust Test is activated, an "*" will be shown, and a small menu will display the following data:
   - Time: The time for the flow test is 30 seconds. This time shows the time left to the end of the test.
   - MFC Setpoint: This is the BioTector mass flow controller flow setting (80 l/hr by default) for the flow test.
   - MFC Flow: This is the actual flow from the mass flow controller. If there is no blockage in the lines, then the setpoint should match the flow.
   - Status: At the end of the test, the status below is shown:
     - TESTING: Test in progress.
     - PASS: The Exhaust Test finished its cycle with a flow above the Pass (Flow Warning) level (72 l/hr by default). See Section 8.3.4.6 Pressure/Flow Test Program for details.
     - WARNING: The Exhaust Test finished its cycle with a flow below the Pass level (less than 72 l/hr), but above the Fail level (greater than 40 l/hr).
     - FAIL: The Exhaust Test finished its cycle with a flow below the Fail level (40 l/hr by default).

2. **Exhaust Flow.** This is similar to the Exhaust Test menu, but its time has been extended to 999s, allowing the user to locate any blockage in the system. Pass, Warning and Fail are automatically shown on the screen, depending on the status of the test.
3. **Sample Out Test.** This is similar to the Exhaust Test. This function allows the user to test the flow through the Sample Out Valve.
4. **Sample Out Flow.** This is similar to the Exhaust Flow. This function allows the user to test the flow through the Sample Out Valve.

8.1.1.3 Ozone Test

WARNING

The ozone test uses the procedure described in information sheet "*T021. Procedure to check the ozone level in BioTector with Mixer Reactor*", which is available in the MMC/SD card shipped with the BioTector. The user must read and understand the processes described in this sheet, and have all the correct parts listed before carrying out the test.

Ozone will be generated when the ozone generator is turned on.

General overview of the operation of the ozone test:

- **Phase 1:** Install the tester according to information sheet T021, and start the test from the menu.
- **Phase 2:** The BioTector carries out a pressure test, to ensure that the system is leak tight.
- **Phase 3:** The ozone generator is switched on, and when the o-ring in the tester breaks, press the stop test menu item.
- **Phase 4:** There is a purge period that purges any traces of ozone from the ozone tester, and the result of the test is shown on the screen.
- **Phase 5:** The purge of the tester is complete, and the result remains on the screen.

Ozone Test, Phase 1:

```
OZONE  TEST                          09:17:28  12-09-02

 1 < * START  TEST
 2     STOP  TEST
```

This menu enables the user to test the concentration of ozone generated by the BioTector.

1. **Start Test.** This starts the ozone test.

2. **Stop Test.** This stops the ozone test. It should be activated when the o-ring in the tester breaks, or at any time to stop the ozone test.

Ozone Test, Phase 2:

```
PRESSURE  TEST                       09:17:28  12-09-02

      TIME                    35 s
      MFC  SETPOINT           40.0 l/h
      MFC  FLOW               22.0 l/H
      STATUS                  TESTING


      PRESS  ESC  TO  ABORT  THE  TEST
```

This menu enables the user to monitor the progress of the ozone test. To abort the ozone test, press the ESCAPE key on the keyboard.

Ozone Test, Phase 3:

```
OZONE  TEST                          09:17:28  12-09-02

 1   * START  TEST
 2 <   STOP  TEST

       TIME                          5 s
       STATUS                        TESTING

       OZONE  GENERATOR  IS  ON!!!
       DO  NOT  OPEN  OZONE  TESTER
```

The ozone test has now started. DO NOT OPEN THE OZONE TESTER. The user should now move the cursor down to line 2, and press the ENTER key as soon as the o-ring in the ozone tester breaks. The time will be calculated automatically.

Ozone Test, Phase 4:

```
OZONE  TEST                          09:17:28  12-09-02

 1     START  TEST
 2 < * STOP  TEST

       TIME                          12 s
       STATUS                        PASS

       DO  NOT  OPEN  OZONE  TESTER  UNTIL
       PURGE  OF  OZONE  TESTER  COMPLETE
```

When the o-ring breaks, immediately select Stop Test and press the ENTER key. The ozone generator is now switched off, but there will still be traces of ozone in the tester. Therefore the BioTector will purge the tester for 30s to remove these traces of ozone. DO NOT OPEN THE OZONE TESTER until the warning message is removed.

The time for the o-ring to break is shown on the screen, as well as the PASS, LOW OZONE or FAIL message. Note that the maximum allowed time for the ozone test is 60s, after which the FAIL message is displayed.

Ozone Test, Phase 5:

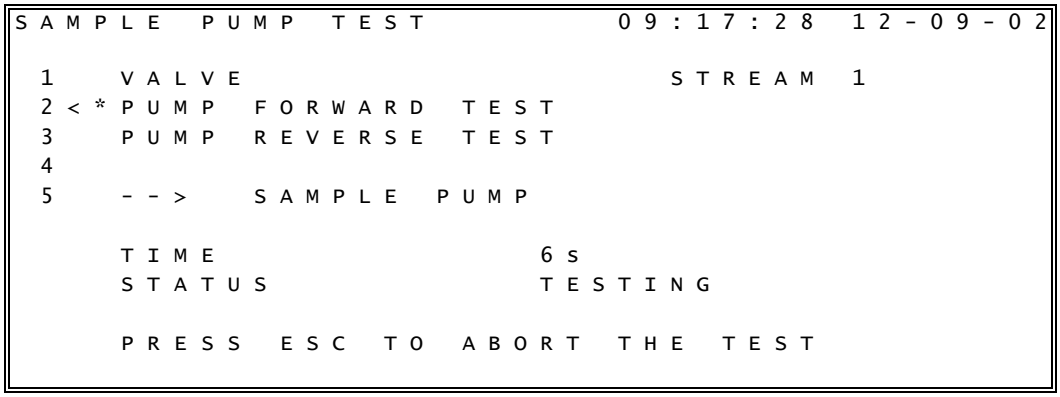
```
OZONE  TEST                          09:17:28  12-09-02

 1     START  TEST
 2 < * STOP  TEST


       TIME                          12 s
       STATUS                        PASS
```

The test is complete. The time for the o-ring to break is shown on the screen, as well as the PASS, LOW OZONE or FAIL message. The Pass, Low Ozone or Fail setting is factory set in the Fault Setup menu.

8.1.1.4 Sample Pump Test



This menu enables the user to test the Sample Pump forward and reverse times. Any settings made by the user in this menu are automatically reset when the user exits this menu.

1. **Valve.** Valve allows the user to select the stream or manual sample ports the Sample Pump Test is going to be carried out. The valve selection may have an effect on the Sample Pump forward time measured with the Pump Forward Test below, unless all sample lines are at the same length.

2. **Pump Forward Test.** This function starts the Sample Pump running in the forward direction. When the sample has been correctly transported to the BioTector, through the Sample (ARS) Valve and as far as the recommended sample transport point or until it drips out into the drain, press ESCAPE. This stops the timer, and provides the user the correct FORWARD times to be programmed for each stream and manual sample in the Sample Pump menu (see Section 8.2.2 Sample Pump for details).

3. **Pump Reverse Test.** This is the same as the Pump Forward Test above, only this time Sample Pump operates reverse to empty the sample lines and the oxidized sample catch-pot/cleaning vessel (if installed) back into the corresponding stream selected with the Valve above.

5. → **Sample Pump.** Sample Pump is a link to the Maintenance, Commissioning, Sample Pump menu (see Section 8.2.2 Sample Pump for details).

8.1.1.5 pH Test

The user must understand the procedure for testing the pH in the BioTector. Use eye protection and gloves. Have all the relevant parts for this test ready (primarily beaker and pH paper) before carrying out the test.

For the pH test to be accurate, the previous reaction should have finished normally, so that any liquid carried over from that reaction will not affect the pH test.
Significant volume of liquid loss, during the pH test phases 1, 2, 3 or 4 described below, have an impact on the consecutive pH tests. Therefore, it is strongly recommended that the test is stopped upon completion of each specific phase, where the volume of liquid is lost, and re-started from pH Test Phase 1 below. When the pH test is re-started, the corresponding pH measurements can be skipped for the previous valid tests.

General overview of the operation of the pH test:

The description below is for the TIC & TOC analysis mode. In systems built with TC and VOC analysis modes, BioTector automatically carries out the corresponding operation phases as described in Sections 4.2.4.2 TC Analysis and 4.2.4.3 VOC (POC) Analysis respectively.

Phase 1: Prepare the test equipment, and start the test.
Phase 2: The BioTector carries out a normal startup operation, including ozone purge, reactor purge, pressure test and flow test to ensure that the system is purged and leak tight.
Phase 3: The sample and TIC acid are added to the reactor, mixed and then the program pauses, to allow the pH to be tested.
Phase 4: The base is added to the solution in the reactor, and then the program pauses, to allow the pH to be tested.
Phase 5: The TOC acid is added to the solution in the reactor, and then the program pauses, to allow the pH to be tested.
Phase 6: The reactor and CO_2 analyzer are purged.

pH Test, Phase 1:

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST
```

This menu enables the user to test the pH in the BioTector.

1. **Range, Valve.** Select the range and the stream or manual sample point the pH test is going to run on. This function has an effect on the volume of sample, acid and base used for the test.

2. **Mode.** Depending on the analysis type of the BioTector, the test mode can be selected as TIC+TOC mode or TC mode. In TIC & TOC systems, the only available test mode is TIC & TOC. In TC systems, the only available test mode is TC. If the BioTector is a VOC system, the user can choose to run the test in either TIC+TOC or TC modes.

3. **Start Test.** This starts the pH test routine, which goes through the 6 phases described above.

4. **Take Sample.** Not applicable until the test is running.

5. **Continue to next phase.** Not applicable until the test is running.

6. **Stop Test.** When the test is running, activating this control will stop the test. Note that some phases have to be completed before the stop can be used.

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      CONFIRM  PREVIOUS  REACTION  FINISHED
      CORRECTLY.  PRESS  ENTER  TO  CONFIRM,
      ESC  TO  EXIT
```

For the pH test to be accurate, the previous reaction should have finished normally, so that any liquid carried over from that reaction will not affect the pH test. Therefore, when the start test menu item has been activated, a confirmation will be required. If the previous reaction did not finish normally, then liquid remaining in the reactor may interfere with the test and give incorrect pH test results.

pH Test, Phase 2:

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      TIME                    15s
      PHASE                   OZONE  PURGE
      MFC=  39.3l/h           CO2=   150.8ppM

      WAIT  TEST  PHASE  TO  COMPLETE
```

After the pH test has been started, the BioTector carries out a normal startup operation, including ozone purge, reactor purge, pressure test and flow test to ensure that the system is purged and leak tight. This phase cannot be stopped, and requires about 210 seconds to run.

pH Test, Phase 3:

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      TIME                        0 s
      PHASE                       PAUSED
      MFC=    0.0 l/h             CO2=    150.8 ppM

      TEST  TIC  pH.  EXPECTED  pH<2.
      WHEN  FINISHED,  SELECT  NEXT  ACTION
      FROM  MENU.
```

At this phase, the sample and TIC acid are added to the reactor and mixed together. The system then pauses to allow the pH to be tested. The user now has 3 options:

4. **Take Sample.** It can be difficult to take the sample, so to aid this, press this menu item once to pulse the Sample Out Valve for 0.5s. This will allow a small volume of sample to pass through the valve, and this can be tested with a pH paper. Several activations of the valve may be required to purge the Sample Out Valve of any old sample, and get a fresh sample for the test.

5. **Continue To Next Phase.** If this is selected, the program continues to the next phase.

6. **Stop Test.** If this is selected, the program jumps to the reactor purge phase.

pH Test, Phase 4:

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      TIME                        0 s
      PHASE                       PAUSED
      MFC=    0.0 l/h             CO2=    150.8 ppM

      TEST  BASE  pH.  EXPECTED  pH>12.
      WHEN  FINISHED,  SELECT  NEXT  ACTION
      FROM  MENU.
```

At this phase, the base is added to the solution in the reactor and mixed together. The program then pauses to allow the pH to be tested. The user now has 3 options, which are the same as in the previous phase.

pH Test, Phase 5:

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      TIME                      0s
      PHASE                     PAUSED
      MFC=    0.0l/h            CO2=    150.8ppM

      TEST  TOC  pH.  EXPECTED  pH<2.
      WHEN  FINISHED,  SELECT  NEXT  ACTION
      FROM  MENU.
```

At this phase, the TOC acid is added to the solution in the reactor and mixed together. The system then pauses to allow the pH to be tested. The user now has 3 options. Option 4 is used to take the sample as before, but both options 5 and 6 below will end the test, as the TOC acid check is the last phase in the cycle.

5. **Continue To Next Phase.** If this is selected, the program continues to the next phase, which is the reactor purge phase.

6. **Stop Test.** If this is selected, the program jumps to the reactor purge phase.

As the next phase is the reactor purge phase, the user is prompted to confirm that all tubes have been re-connected before the BioTector starts this phase.

```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      CONFIRM  ALL  TUBES  RE-CONNECTED
      CORRECTLY.  PRESS  RIGHT  ARROW  TO
      CONFIRM.
```

pH Test, Phase 6:

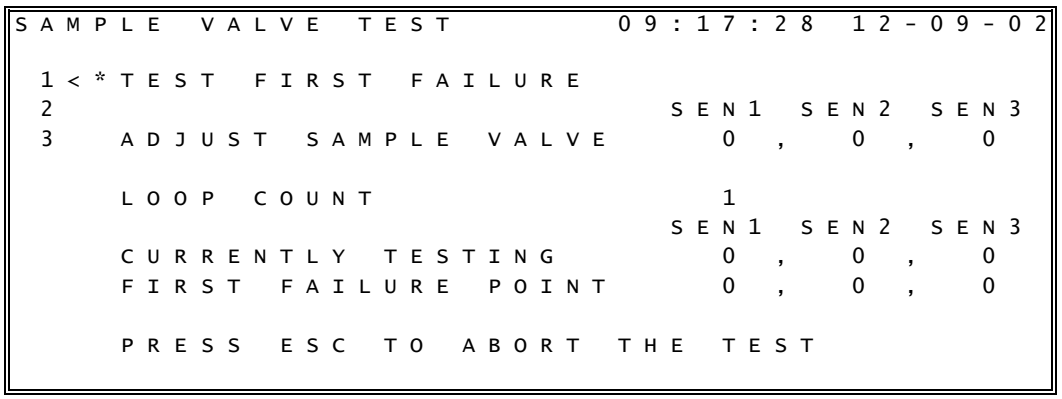
```
PH  TEST                              09:17:28  12-09-02

 1 <  RANGE,VALVE                        1  ,  STREAM  1
 2    MODE                               TIC+TOC
 3    START  TEST
 4    TAKE  SAMPLE
 5    CONTINUE  TO  NEXT  PHASE
 6    STOP  TEST

      TIME                      0s
      PHASE                     COMPLETE
      MFC=    0.0l/h            CO2=    150.8ppM
```

The pH test is complete. The BioTector will purge the reactor and the CO_2 analyzer. The user can either exit the menu or start the pH test again.

8.1.1.6 Sample Valve Test



This menu enables the user to test and to adjust the Sample Valve ball alignment with the Sample Valve ports.

1. **Test First Failure.** When Test First Failure function is activated, BioTector rotates the sample valve from sensor position 1 (SEN1) to sensor position 2 (SEN2) and to sensor position 3 (SEN3) automatically to identify the adjustment points, where the position of the valve is no longer detected at each sensor (i.e. when the first failure of the detection of the valve position occurs). The adjustment points are small time increments, implemented by the software, which delays the stopping of the ball valve and thus the physical stop position of the ball valve.

Loop Count:	Loop Count displays the number of loops (2 by default) the valve is rotated for each adjustment point for each sensor position during the test.
Currently Testing:	Currently Testing displays the adjustment points (the time delay implemented by the software) for each sensor during the test. The adjustment points are from 0 (minimum) to 15 (maximum) with 1 point increments.
First Failure Point:	First Failure Point displays the adjustment point at which the system fails to detect the position of the valve.

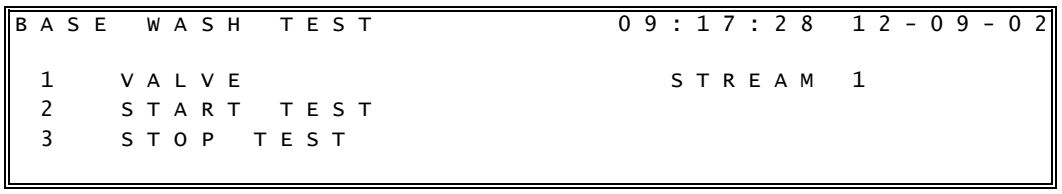
   When the test is completed, a “COMPLETE” message is displayed at the bottom of the screen.

3. **Adjust Sample Valve.** Adjust Sample Valve function allows the user to manually adjust the sample valve stop position to align the ball valve with the valve ports. When the adjustment values are entered in this menu, system displays the CURRENT VALVE POSITION (e.g. SEN1, SEN2 etc.). Follow the procedures and on screen instructions. If the adjustment values entered are too high, system displays an “INVALID ADJUSTMENT VALUE, VALUES HAVE TO BE 5 POINT BELOW FIRST FAILURE” warning with the latest first failure values for all sensor positions if it is available in the system. If the first failure values displayed below this warning is 0, 0, 0, run the TEST FIRST FAILURE above and when the test is complete, enter the adjustment values accordingly.

   The procedures described in information sheet “*M046. Sample Valve Adjustment and Sample Tube Positioning Guidelines*” should be followed when the sample valve is replaced. This document is available inside MMC/SD card shipped with the BioTector.

   In the event of a 17_SMPL VALVE NOT SYNC fault in the system, refer to information sheets “*T018. BioTector Sample Valve Not Synchronized Fault Troubleshooting after Valve Replacement*” and “*TT002. BioTector Sample Valve Not Sync Fault_Quick Troubleshooting*”, which are available inside MMC/SD card shipped with the BioTector.

8.1.1.7 Base Wash Test



This menu enables the user to test the Base Wash and Tubing Wash cycles.

1. **Valve.** Valve allows the user to select the stream or manual sample ports the Base Wash and Tubing Wash cycles going to be carried out.

2. **Start Test.** This starts the selected Base Wash or Tubing Wash tests.

3. **Stop Test.** This stops the selected Base Wash or Tubing Wash tests.

8.1.2 Simulate

```
SIMULATE                              09:17:28  12-09-02

     MFC=  10.0l/h                    CO2=      35.0ppm

  1 < * MFC                             10.0l/h
  2     OZONE  GENERATOR                OFF
  3     ACID  PUMP                      OFF        ,  1
  4     ACID  VALVE                     OFF
  5     BASE  PUMP                      OFF        ,  1
  6     BASE  VALVE                     OFF
  7     pH  ADJUST  VALVE               OFF
  8     SAMPLE  VALVE                   SEN1
  9     SAMPLE  PUMP                    OFF        ,  1
 10     INJECTION  VALVE                OFF
 11     REACTOR  MOTOR                  OFF
 12     SAMPLE  OUT  VALVE              OFF
 13     EXHAUST  VALVE                  OFF
  ▼
```

```
SIMULATE                              09:17:28  12-09-02

       MFC=10.0l/h                      CO2=      35.0ppm
  ▲
 14     CLEANING  VALVE                 OFF
 15     CALIBRATION  VALVE              OFF
 16     STREAM  VALVE                   OFF
 17     MANUAL  VALVE                   OFF
 18     COOLER                          AUTO       ,   5.0C
 19     FAN                             AUTO       ,  20.0C
 20     TEMP.  SWITCH                   AUTO
 21     SAMPLER  FILL                   OFF
 22     SAMPLER  EMPTY                  OFF
 23     SAMPLER  ERROR                  OFF
 24     SAMPLE  SENSOR                  OFF
 25     LEAK  DETECTOR                  OFF
 26     REACTOR  PURGE
 27     RUN  REAGENTS  PURGE
 28
 29     -->  INPUT/OUTPUT  STATUS
```

This menu enables the user to test system devices such as Pumps, Valves, MFC etc. installed and used in BioTector. The menu also shows the current status of all devices when the BioTector is running. Note that the Simulate screen may change slightly depending on system settings and system optional features. Any settings made by the user in this menu are automatically reset when the user exits this menu. The line below the time and date shows the MFC flow in l/h (liters/hour) and actual CO_2 analyzer reading in ppm (parts per million).

Each time a component is activated, the BioTector will interlock additional devices to ensure that the component being tested can be checked in a manner that will not cause consequential damage to the overall system. It is recommended that each test is evaluated carefully, for although the interlocks are extensive, it may still be possible to damage the system.

In simulate menus, most items require a minimum of 6 l/h oxygen flow set on the Mass Flow Controller (MFC) to operate. This is a system safety interlock, which is implemented to prevent the system from flooding.

When ESCAPE key is used to return to the Diagnostics menu, BioTector carries out an automatic pump synchronization process.

1. **MFC.** Use this function to set the MFC setpoint. Press the ENTER key, set the required setpoint (e.g. 100 l/hr), and press the ENTER key again. The actual flow is shown at the top of the screen. An "*" is shown when the MFC has been activated. If the flow is 0.0 l/h, then the MFC is switched off.

2. **Ozone Generator.** Use this function to test the ozone generator. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". As a safety feature, when the Ozone Generator is switched on, a Pressure Test procedure is executed automatically to detect any gas leakage in the system. If this test fails then the Ozone Generator will not be switched on. See Section 8.1.1.1 Pressure Test and Section 8.3.4.6 Pressure/Flow Test Program for details on Pressure Test.

Ozone will be generated when the ozone generator is turned on.

3. **Acid Pump.** Use this function to test the Acid Pump. To turn the pump on, press the ENTER key, and select ON. Press ENTER again, input the number of pulses (½ revolutions), press ENTER and the pump will run. When the Acid Valve is activated, the maximum allowable number of pulses, which can be programmed, is 20. When the pump is running the actual (outside brackets) and programmed pulse time (inside brackets) is shown. The pump will stop when the required number of pulses is complete, or to manually stop the pump, press ENTER, select OFF, and press ENTER again.

4. **Acid Valve.** Use this function to test the Acid Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". When Acid Pump is run while Acid Valve is activated, due to system interlock to prevent reactor flooding, "REACTOR PURGE" function below may be required for successive Acid Pump testing.

5. **Base Pump.** Use this function to test the Base Pump. To turn the pump on, press the ENTER key, and select ON. Press the ENTER key again, input the number of pulses (½ revolutions), press the ENTER key and the pump will run. The maximum allowable number of pulses, which can be programmed, is 20. When the pump is running the actual (outside brackets) and programmed pulse time (inside brackets) is shown. The pump will stop when the required number of pulses is complete, or to manually stop the pump, press the ENTER key, select OFF, and press the ENTER key again. Due to system interlock to prevent reactor flooding, "REACTOR PURGE" function below may be required for successive testing.

6. **Base Valve.** Use this function to test the Base Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". When Acid Pump is run while Base Valve is activated, due to system interlock to prevent reactor flooding, "REACTOR PURGE" function below may be required for successive Acid Pump testing.

7. **pH Adjust Valve (if configured in the system).** Use this function to test the pH Adjust Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

8. **Sample Valve.** Use this function to test the Sample Valve (ARS-Automatic Range Selection Valve). The valve has three positions, SEN1 (Sample Pump to Bypass), SEN2 (Sample Pump to Reactor), and SEN3 (TIC Acid/TC Base to Reactor). To position the valve in different positions, press the ENTER key, select the required position, and press the ENTER key again. While the valve is moving the sensor, the system marks this menu item with an "*".

9. **Sample Pump.** Use this function to test the Sample Pump. The pump has four operating states: FWR (forward), REV (Reverse), P-FWR (run under pulse control forward), P-REV (run under pulse control in reverse). To run the pump in the required mode, press the ENTER key, and select that mode. If P-FWR or P-REV is selected, enter the number of pulses (½ revolutions), press the ENTER key and the pump will run. When the pump is running the actual (outside brackets) and programmed pulse time (inside brackets) is shown. The pump will stop when the required number of pulses is complete, or to manually stop the pump, press the ENTER key, select OFF, and press the ENTER key again.

10. **Injection Valve.** Use this function to test the Injection Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

11. **Reactor Motor.** Use this function to test the Reactor Motor. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

12. **Sample Out Valve.** Use this function to test the Sample Out Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

13. **Exhaust Valve.** Use this function to test the Exhaust Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

14. **Cleaning Valve (if configured in the system).** Use this function to test the Cleaning Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

15. **Calibration Valve (if configured in the system).** Use this function to test the Calibration Valve. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

16. **Stream Valve (if configured in the system).** Use this function to test the Stream Valves. To test a Stream Valve, press the ENTER key and select the number of the valve to be tested. Press the ENTER key again and the valve will be activated. To turn the valve off, select OFF. These valves can be driven either from programmable relays or from the Stream Expansion (Auxiliary) PCB. Note that only one Stream Valve can be switched on at any given time.

17. **Manual Valves (if configured in the system).** Use this function to test the Manual Valves. To test a Manual Valve, press the ENTER key and select the number of the valve to be tested. Press the ENTER key again and the valve will be activated. To turn the valve off, select OFF. Note that only one Manual Valve can be switched on at any given time.

18. **Cooler.** This device is normally automatically controlled by the system. To test the Cooler relay, press the ENTER key and select device state option: ON, OFF, AUTO. If the device is on, it will be marked with an "*". The actual cooler temperature in degrees Centigrade (°C) is also shown in this menu.

19. **Fan.** This device is normally automatically controlled by the system. To test the Fan relay, press the ENTER key and select device state option: ON, OFF, AUTO. When the device is on, it will be marked with an "*" and the fan will be forced to run. The actual BioTector temperature in degrees Centigrade (°C) is also shown in this menu. In AUTO mode, if the temperature of the system is below the default set point temperature, which is 25°C, BioTector switches the fan off in order to stabilize the temperature using its own internal heat. If the temperature is above the set point temperature, fan keeps operating continuously.

20. **Temp. Switch** The Temperature Switch output is automatically controlled by the system depending on the system temperature control setting (System Fan Control), which is programmed as 20°C by default. To test the Temperature Switch, press the ENTER key and select device state option: ON, OFF, AUTO. When the device is on, it will be marked with an "*".

21. **Sampler Fill (if configured in the system).** Signal to fill the BioTector sampler. To test the Sampler Fill signal, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". This signal remains on until turned off.

22. **Sampler Empty (if configured in the system).** Signal to empty the BioTector sampler. This signal is a 5 second pulse. To test the Sampler Empty signal, press the ENTER key to set the device ON.

23. **Sampler Error (if configured in the system).** Signal sent from the BioTector sampler indicating that there is an error in the sampler. To test the Sampler Error signal, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

24. **Sample Sensor (if configured in the system).** This device is input only and therefore its state cannot be changed from this menu. It only indicates the state of the Sample Sensor.

25. **Leak Detector (if configured in the system).** This device is input only and therefore its state cannot be changed from this menu. It only indicates the state of the BioTector Liquid Leak Detector alarm input.

26. **Reactor Purge.** This function purges the Mixer Reactor. When activated, system automatically displays the Reactor Purge menu, which contains the relevant reactor purge parameters.

27. **Run Reagents Purge.** This function primes all reagents in the BioTector.

29. → **Input/Output Status.** Input/Output Status is a link to Maintenance, Diagnostics, Input/Output Status menu (see Section 8.1.5 Input/Output Status).

8.1.3 Signal Simulate

```
SIGNAL  SIMULATE                09:17:28  12-09-02

  1 < * CHANNEL  1-6                    4.0mA
  7     ALARM  1-6                      OFF
 13     CO2  ALARM  1-6                 OFF
 19     SYNC  RELAY                     OFF
 20     SAMPLE  STATUS  1-6             OFF
 26     SAMPLE  FAULT  1-6              OFF
 32     CAL  SIGNAL                     OFF
 33     MAINT  SIGNAL                   OFF
 34     REMOTE  STANDBY                 OFF
 35     STOP                            OFF
 36     NOTE                            OFF
 37     WARNING                         OFF
 38     FAULT                           OFF
  ▼
```

```
SIGNAL  SIMULATE                09:17:28  12-09-02
  ▲
 39     MAN  MODE  TRIG                 OFF
 40     4-20mA  CHNG                    OFF
 41     4-20mA  CHNG  1-6               OFF
 47     4-20mA  READ                    OFF
 48
 49     -->  I/O  STATUS
```

This menu enables the user to test the Common Fault relay, the available 4-20mA outputs, the programmed output signals and if installed, the Stream Alarm relays and any other optional outputs in the BioTector. Any settings made by the user in this menu are automatically reset when the user exits this menu.

1. - 6. Channel 1-6. This allows the user to test the function of each 4-20mA channel. Press the ENTER key, use the arrow keys to set the required 4-20mA signal, and press the ENTER key again to test the 4-20mA signal.

7. - 12. Alarm 1-6 (if configured in the system). This allows the user to test the function of the stream specific alarms if they are programmed in Output Devices menu. See Section 8.3.5 Output Devices for details. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

13. - 18. CO2 Alarm 1-6 (if configured in the system). This allows the user to test the function of the stream specific CO2 Alarms if they are programmed in Output Devices menu. See Section 8.3.5 Output Devices for details. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".

19. Sync Relay (if configured in the system). Use this function to test the Synchronization relay. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

20. - 25. Sample Status 1-6 (if configured in the system). Use this function to test the Sample Status output signal for each specific stream. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

26. - 31. Sample Fault 1-6 (if configured in the system). Use this function to test the Sample Fault output signal for each specific stream. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

32. **Cal Signal (if configured in the system).** Use this function to test the Calibration Signal output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

33. **Maint Signal (if configured in the system).** Use this function to test the Maintenance Signal output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

34. **Remote Standby (if configured in the system).** Use this function to test the Remote Standby output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

35. **Stop (if configured in the system).** Use this function to test the Stop output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

36. **Note (if configured in the system).** Use this function to test the system Notification output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

37. **Warning (if configured in the system).** Use these functions to test the Warning output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

38. **Fault (if configured in the system).** Use this function to test the Fault output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".See Section 8.3.5 Output Devices for details.

39. **Man Mode Trig (if configured in the system).** Use this function to test system Manual Mode Trigger output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

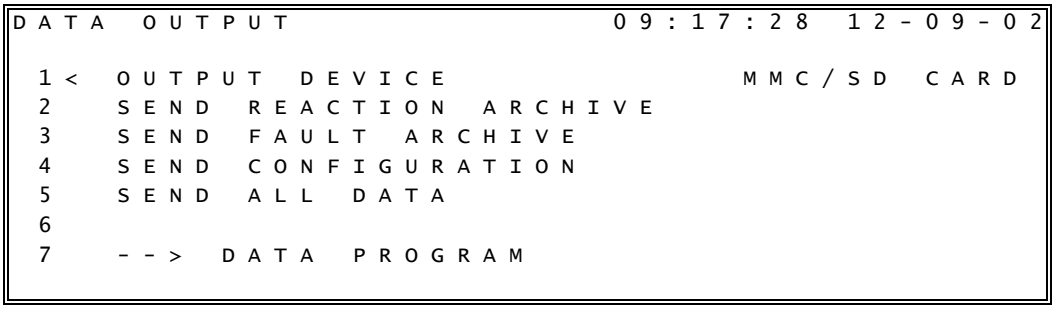
40. **4-20mA Chng (if configured in the system).** Use this function to test system generic 4-20mA Change output signal. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

41. **- 46. 4-20mA Chng 1-6 (if configured in the system).** Use this function to test system 4-20mA Change output signal for stream specific channels from Channel 1 to Channel 6. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*". See Section 8.3.5 Output Devices for details.

47. **4-20mA Read (if configured in the system).** Use this function to test system 4-20mA Read output. To change the state of the device, press the ENTER key, set the device to ON/OFF, and press the ENTER key again. If the device is on, it will be marked with an "*".See Section 8.3.5 Output Devices for details.

49. → **Input/Output Status.** Input/Output Status is a link to Maintenance, Diagnostics, Input/Output Status menu (see Section 8.1.5 Input/Output Status for details).

8.1.4 Data Output



This menu enables the user to select the communication port and to download the contents of the system reaction, fault archives, system specific configuration and all data for diagnostics purposes.

1. **Output Device.** This item allows the user to select communication port configuration profile. Available options are PRINTER, PC and MMC/SD CARD. See Data Program menu 8.2.10 Data Program for specific output device settings. In order to receive data from BioTector, see Section 13 Appendices for the instructions on connecting the output devices to BioTector.

2. **Send Reaction Archive.** Sub menu used to download the reaction archive to the selected output device.

3. **Send Fault Archive.** Sub menu used to download the fault archive to the selected output device.

4. **Send Configuration.** Sub menu used to download the system configuration to the selected output device.

5. **Send All Data.** Sub menu used to download system all data, which includes system configuration, fault archive, reaction archive and system diagnostics information.

7. → **Data Program.** Data Program is a link to Maintenance, Commissioning, Data Program menu (see Section 8.2.10 Data Program for details).

When external MMC/SD memory card is used as the output device, the data is downloaded into the card in text format. Note that;

- Any text data (reaction and fault archive, configuration and all data) can be downloaded into the card while BioTector is running.
- The card can be removed when BioTector is running.
- The card should not be removed before the data transfer is completed.
- If the data download into the card is successful, the files, which can be accessed in the memory card in text format, are reaction archive, fault archive, configuration and/or all data.
- Other files which are located in the in system's external memory card by default are system firmware (sysfrmw.hex) and system configuration (syscnfg.bin) both of which are in binary formats. Binary files can only be opened and viewed by specific computer programs. Therefore the user should not attempt to open or access these files.
- The memory card used in BioTector can be an MMC/SD card formatted with FAT, FAT12/16 or FAT32 file systems. Most SDHC cards are also supported and can also be used.

8.1.4.1 Send Reaction Archive

```
SEND  REACTION  ARCHIVE    09:17:28  12-09-02

 1 <  START  DATE                        01-09-02
 2    NUMBER  OF  EVENTS                   123
 3    START  SENDING
 4    PAUSE  SENDING
 5  * STOP  SENDING

      OUTPUT  #123    ITEMS
```

This menu is used to download the reaction archive. The communication port parameters used are those set up in the Data Program menu.

1. **Start Date.** This is the start date of the first item to be downloaded. The default date is the current date on the BioTector, which can be changed by the user. The newest event is downloaded first when downloading data.

2. **Number of Events.** This is the number of events to be downloaded. The default is the number of events in the reaction archive, which can be edited by the user.

3. **Start Sending.** Press the ENTER key to start downloading the data.

4. **Pause Sending.** Press the ENTER key to interrupt the downloading of data. Press again to continue downloading. If the downloading is interrupted for more than 60 seconds, then the downloading is automatically resumed.

5. **Stop Sending.** Press the ENTER key to stop downloading the data.

OUTPUT ITEMS is the number of events currently downloaded. The maximum amount of events is 9999.

When external MMC/SD memory card is being used as the output device, the reaction archive will be saved into the card in text format and named as “RARCH.TXT” by default. The meaning of the abbreviations used in the downloaded analysis data in both standard and engineering modes (see Print Mode in Data Program menu 8.2.10 Data Program for details) are as follows:

Standard mode:

TIC & TOC Analysis:

TIME	The time the reaction started.
DATE	The date the reaction started.
S1:2	Stream type and analysis range.
TIC [mgC/l]	The calibrated TIC value in mgC/l.
TOC [mgC/l]	The calibrated TOC value in mgC/l (TOC represents NPOC).
COD/BOD[mgO/l]	The calculated COD and/or BOD value in mgO/l (if activated in COD/BOD Program menu).
LPI [%]	Percent Lost Product Index value in % (if activated in LPI Program menu).
LP [l/h]	The Lost Product value in l/h (if activated in LPI Program and Flow Program menus).
Flow [m^3/h]	The recorded Sample Flow value in m^3/h (if activated in Flow Program menu).
TOC [kg/h]	The TOC value in kg/h (if activated in Flow Program menu).

TC Analysis:

TIME	The time the reaction started.
DATE	The date the reaction started.
S1:2	Stream type and analysis range.
TCmgC/l	The calibrated TC value in mgC/l (TC represents TIC + NPOC + POC).
COD/BOD[mgO/l]	The calculated COD and/or BOD value in mgO/l (if activated in COD/BOD Program menu).
…	…

VOC Analysis:

TIME	The time the reaction started.
DATE	The date the reaction started.
S1:2	Stream type and analysis range.
TCmgC/l	The calibrated TC value in mgC/l (TC represents TIC + NPOC + POC).
TICmgC/l	The calibrated TIC value in mgC/l.
TOCmgC/l	The calculated TOC value in mgC/l (TOC is calculated as TC – TIC).
VOCmgC/l	The calculated VOC value in mgC/l (VOC is calculated as TC – TIC – NPOC).
COD/BOD[mgO/l]	The calculated COD and/or BOD value in mgO/l (if activated in COD/BOD Program menu).
…	…

Engineering mode (TIC & TOC Analysis):

TIME	The time the reaction started.
DATE	The date the reaction started.
S1:2	Stream type and analysis range.
CO2z	CO_2 analyzer zero adjust for the current reaction.
TICmgu	The un-calibrated TIC value in mgC/l.
TICmgc	The calibrated TIC value in mgC/l.
CO2p	The height of the TIC CO_2 peak.
TOCmgu	The un-calibrated TOC value in mgC/l.
TOCmgc	The calibrated TOC value in mgC/l (TOC represents NPOC).
CO2p	The height of the TOC CO_2 peak.
COD/BODmgc	The calculated COD and/or BOD value in mgO/l (if activated in COD/BOD Program menu).
LPI [%]	Percent Lost Product Index value in % (if activated in LPI Program menu).
LP [l/h]	The Lost Product value in l/h (if activated in LPI Program and Flow Program menus).
Flow [m^3/h]	The recorded Sample Flow value in m^3/h (if activated in Flow Program menu).
TOC [kg/h]	The TOC value in kg/h (if activated in Flow Program menu).
DegC	BioTector temperature in Degrees Centigrade (°C).
Atm	Atmospheric pressure in kPa.
SAMPLE	Sample quality (%) from Sample Sensor signal, which is used to activate SAMPLE STATUS output.
SMPL PUMP	The five items, which are number coded or a number data, gives information on the Sample Pump: 1) operation mode (0=time mode or 1= pulse mode), 2) number of pulses during operation such as injection, 3) total time (milliseconds) taken for total number of pulse operation (see point 2 above), 4) the time (milliseconds) taken for the last pulse operation (see point 2 above), 5) error counter (ranges from 0 to 6). When a pulse is missed or not detected, the pump switches into time mode for that specific operation (for instance, injection, synchronization, etc). System only generates a pump warning and logs into fault archive if there are 6 consecutive failures.
ACID PUMP	Similar information on Acid Pump operation (see five items listed for SMPL PUMP above).
BASE PUMP	Similar information on Base Pump operation (see five items listed for SMPL PUMP above).
COOLER	The status of the Cooler. When the Cooler is off, “OFF” is printed in the reaction archive data.
O3 HEATER	The status of the Ozone Destructor Heater. When the heater is off, “OFF” is printed in the data.

Note that the COD, BOD, LPI, LP and/or Flow & e.g. TOC (in kg/h) results are added into the reaction screens and reaction archives when the relevant parameters are activated in the COD/BOD/LPI/FLOW Program menus. See Section 8.2.4 COD/BOD/LPI/FLOW Program for details.

Engineering mode (VOC Analysis):

TIME	The time the reaction started.
DATE	The date the reaction started.
S1:2	Stream type and analysis range.
CO2z	CO_2 analyzer zero adjust for the current reaction.
TCmgu	The un-calibrated TC value in mgC/l (measured value from the TC analysis).
TCmgc	The calibrated TC value in mgC/l (measured value from the TC analysis).
CO2p	The height of the TC CO_2 peak.
TICmgu	The un-calibrated TIC value in mgC/l (measured value from the TIC&TOC analysis).
TICmgc	The calibrated TIC value in mgC/l (measured value from the TIC&TOC analysis).
CO2p	The height of the TIC CO_2 peak.
NPOCmgu	The un-calibrated NPOC value in mgC/l (measured value from the TIC&TOC analysis).
NPOCmgc	The calibrated NPOC value in mgC/l (measured value from the TIC&TOC analysis).
CO2p	The height of the NPOC CO_2 peak.
TOCmgc	The calculated TOC value in mgC/l (TOCmgc is calculated as TCmgc – TICmgc).
VOCmgc	The calculated VOC value in mgC/l (VOCmgc is calculated as TCmgc – TICmgc – NPOCmgc).
COD/BODmgc	The calculated COD and/or BOD value in mgO/l (if activated in COD/BOD Program menu).
LPI [%]	Percent Lost Product Index value in % (if activated in LPI Program menu).
LP [l/h]	The Lost Product value in l/h (if activated in LPI Program and Flow Program menus).
Flow [m^3/h]	The recorded Sample Flow value in m^3/h (if activated in Flow Program menu).
TOC [kg/h]	The TOC value in kg/h (if activated in Flow Program menu).
DegC	BioTector temperature in Degrees Centigrade (°C).
Atm	Atmospheric pressure in kPa.
SAMPLE	Sample quality (%) from Sample Sensor signal, which is used to activate SAMPLE STATUS output.
SMPL PUMP	The five items, which are number coded or a number data, gives information on the Sample Pump: 1) operation mode (0=time mode or 1= pulse mode), 2) number of pulses during operation such as injection, 3) total time (milliseconds) taken for total number of pulse operation (see point 2 above), 4) the time (milliseconds) taken for the last pulse operation (see point 2 above), 5) error counter (ranges from 0 to 6). When a pulse is missed or not detected, the pump switches into time mode for that specific operation (for instance, injection, synchronization, etc). System only generates a pump warning and logs into fault archive if there are 6 consecutive failures.
ACID PUMP	Similar information on Acid Pump operation (see five items listed for SMPL PUMP above).
BASE PUMP	Similar information on Base Pump operation (see five items listed for SMPL PUMP above).
COOLER	The status of the Cooler. When the Cooler is off, “OFF” is printed in the reaction archive data.
O3 HEATER	The status of the Ozone Destructor Heater. When the heater is off, “OFF” is printed in the data.

Note that the COD, BOD, LPI, LP and/or Flow & e.g. TOC (in kg/h) results are added into the reaction screens and reaction archives when the relevant parameters are activated in the COD/BOD/LPI/FLOW Program menus. See Section 8.2.4 COD/BOD/LPI/FLOW Program for details.

8.1.4.2 Send Fault Archive

This menu is used to download the fault archive. The communication port parameters used are those set up in the Data Program menu. All items in the fault archive will be downloaded unless the user interrupts the downloading with the Pause Sending or Stop Sending functions.

1. **Start Sending.** Press the ENTER key to start downloading the data.
2. **Pause Sending.** Press the ENTER key to interrupt the downloading of data. Press again to continue downloading. If the downloading is interrupted for more than 60 seconds, then the downloading is automatically resumed.
3. **Stop Sending.** Press the ENTER key to stop downloading the data.

OUTPUT ITEMS is the number of events currently downloaded. The maximum number of events in the fault archive is 99.

When external MMC/SD flash memory card is being used as the output device, the fault archive will be saved into the card in text format and named as “FARCH.TXT” by default.

8.1.4.3 Send Configuration

This menu is used to download the configuration data in the BioTector. The communication port parameters used are those set up in the Data Program menu. All the configuration data will be downloaded unless the user interrupts the downloading with the Pause Sending or Stop Sending functions.

1. **Start Sending.** Press the ENTER key to start downloading the data.
2. **Pause Sending.** Press the ENTER key to interrupt the downloading of data. Press again to continue downloading.
   Note: If the downloading is interrupted for more than 60 seconds, then the downloading is automatically resumed.
3. **Stop Sending.** Press the ENTER key to stop downloading the data.

OUTPUT ITEMS is the number of events currently downloaded.

When external MMC/SD flash memory card is being used as the output device, the system configuration will be saved into the card in text format and named as “CNFG.TXT” by default.

8.1.4.4 Send All Data

This menu is used to download all data (i.e. Reaction Archive, Fault Archive, Configuration and System Diagnostics) in one simple operation. The communication port parameters used are those set up in the Data Program menu. All the diagnostic data will be downloaded unless the user interrupts the downloading with the Pause Sending or Stop Sending functions.

Unlike individual data download (e.g. reaction archive, fault archive and configuration), which are downloaded in the selected system language, all data is downloaded in English language only.

1. **Start Sending.** Press the ENTER key to start downloading the data.
2. **Pause Sending.** Press the ENTER key to interrupt the downloading of data. Press again to continue downloading. If the downloading is interrupted for more than 60 seconds, then the downloading is automatically resumed.
3. **Stop Sending.** Press the ENTER key to stop downloading the data.

OUTPUT ITEMS is the number of events currently downloaded.

When external MMC/SD flash memory card is being used as the output device, the all data will be saved into the card in text format and named as “ALLDAT.TXT” by default.

8.1.5 Input/Output Status

Input/Output Status menus are used for monitoring the analog and digital inputs and outputs for advanced diagnostics purposes.

Digital Input

The Digital Input menu allows the engineer to monitor the system digital inputs. This feature is useful for the system trouble-shooting or diagnostics. On the screen the digital inputs are organized in columns and rows with their code, logical states and function. Each input name is composed of the “DI” prefix and two-decimal index, which identifies the input. For example, the digital input named “DI09” is digital input 9, which is the ENTER key. Its logical state is shown as 0, therefore the ENTER key is not pressed or activated. When ENTER key is pressed, its logical state will be shown as 1.

In the idle or open circuit state, all the system digital inputs are set to logical state 0. The active or closed circuit state is logical state 1. The programmable digital inputs are marked as [PROGRAMMABLE] in this menu.

Digital Output

The Digital Output menu allows the engineer to monitor the system digital outputs. This feature is useful for the system trouble-shooting or diagnostics. On the screen the digital outputs are organized in columns and rows with their code, logical states and function. Each output name is composed of the “DO” prefix and two-decimal index, which identifies the output. For instance, the digital output named “DO21” is digital output 21, which is used to control the Cooler. Its logical state is shown as both 0 and 1, which stands for OFF and ON respectively as the cooler operates in an alternating mode (~3 seconds on and 7 seconds off). Upon system power up or reset, all system digital outputs are set to logical state 0.

The programmable digital outputs are marked as [PROGRAMMABLE] in this menu.

Analog Input

The Analog Input menu allows the user to monitor the system analog inputs. This feature is useful for the system trouble-shooting or diagnostics. On the screen the analog inputs are organized in columns and rows. Each analog input has three parameters. The first is ADC converter digital value, the second is the input voltage measured in volts and the third is the function. The BioTector uses a 12-bit ADC, therefore the range of the digitized inputs are 0-4095. The voltage range is 0 to 5.00 volts.

Analog Output

The Analog Output menu allows the user to monitor the system analog outputs. This feature is useful for the system trouble-shooting or diagnostics. On the screen, each analog output has three parameters. The first is DAC converter digital value, the second is output voltage measured in volts and the third is the function. The BioTector uses a 12-bit DAC, therefore the range of the digitized outputs are 0-4095. The voltage range is 0 to 10.00 volts.

8.1.6 Oxygen Controller Status

```
O2-CTRL STATUS                    09:17:28  12-09-02

  1 <  IDENTIFICATION               #c3000019
  2    VERSION                      03.00
  3    MODE                         MFC/O2
  4    TEMPERATURE SENSOR             25.0C    ,  1.24V
  5    AIR PRESS SENSOR             1500mbar,  4.45V
  6    O2 PRESS SENSOR                400mbar,  2.24V
  7    VALVE 1,2,3                  1   ,  0   ,  0
  8    ROTARY VALVE                 FORWARD
  9    ROTARY VALVE SENSOR          0
 10    MFC SETPOINT                   20.0l/h
 11    MFC FLOW                       19.9l/h,  1.78V
```

The O2-CTRL STATUS (Oxygen Controller Status) menu displays the system air supply, oxygen supply, gas flow, pressure and temperature related parameters. In BioTector, when the user enters the Oxygen Controller Status menu or any menu, where the oxygen gas flow will be required, the oxygen concentrator starts to operate automatically.

1. **Identification.** Identification is the specific identification number for the Oxygen Controller Board.

2. **Version.** This menu item specifies the software version of the Oxygen Controller Board.

3. **Mode.** This menu item allows the Oxygen Controller Board to operate the Mass Flow Controller (MFC) only, the Oxygen (O2) Concentrator only, or both.

4. **Temperature Sensor.** This is the BioTector temperature sensor, located on the Oxygen Controller Board, which displays the system temperature. The voltage (V) readings as obtained from the temperature sensor are displayed in real time.

5. **Air Pressure Sensor.** This menu item displays the air inlet pressure for the oxygen concentrator. The pressure (mbar) and the voltage (V) readings as obtained from the Air Pressure Sensor are displayed in real time.

6. **O2 Pressure Sensor.** This menu item displays the oxygen inlet pressure for the Mass Flow Controller. The pressure (mbar) and the voltage (V) readings as obtained from the Oxygen Pressure Sensor are displayed in real time. The oxygen pressure is typically 400 mbar (±10 mbar) at 20 l/h MFC flow.

7. **Valve 1, 2, 3.** This item displays the Oxygen Controller valve outputs for valves 1, 2 and 3. Valve 1 is the Air Isolation Valve. See figure 1 in Section 4.1.1 Analysis Enclosure for details. Valve 2 and 3 are reserved. When Valve 1 is activated, the displayed value is “1”. When Valve 1 is deactivated, the displayed value is “0”.

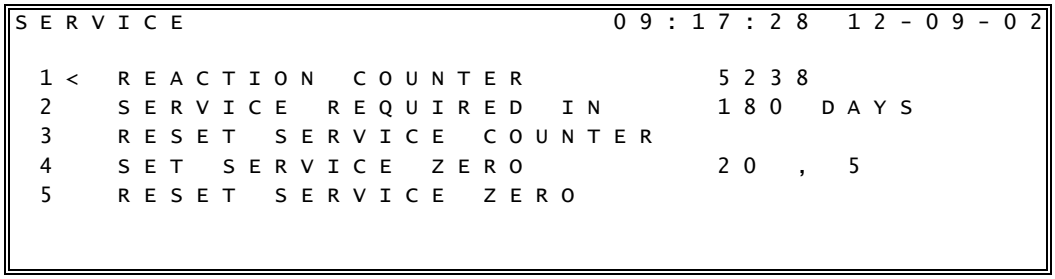
8. **Rotary Valve.** This menu item displays the operation (Forward, Reverse and Stop) of the Rotary Valve.

9. **Rotary Valve Sensor.** This menu item shows the sensor position of the Rotary Valve. If the Rotary Valve is on the sensor, the displayed value is “1”. If the valve is not on the sensor, the displayed value is “0”.

10. **MFC Setpoint.** This menu item allows the user to test the Mass Flow Controller. Use this function to set the MFC setpoint. Press the ENTER key, set the required setpoint (e.g. 60 l/h), and press the ENTER key again. The actual flow is shown at the top of the screen. An “*” is shown when the MFC has been activated. If the flow is 0.0 l/h, then the MFC is switched off.

11. **MFC Flow.** When MFC Setpoint is programmed above, this menu item displays the actual flow and the corresponding voltage on the MFC. When BioTector is not running, that is, when it is powered up and stopped, or when it is in standby state, as the MFC Setpoint is 1 l/h, the MFC Flow displays the 1 l/h flow.

8.1.7 Service



The Service menu displays the system service information. It is also used to reset the service counter and activate zero calibration cycles after the service is carried out.

1. **Reaction Counter.** This is the number of reactions performed by the BioTector.

2. **Service Required In.** This menu item specifies the number of days left before service is required. Note that the factory setting for this counter is typical for normal site conditions, and the service interval may have to be adjusted depending on site conditions. See Section 8.3.8 Fault Setup for details. When the BioTector is powered up, the number of days counter of the Service Required In function keeps operating regardless of the system is running or stopped.

3. **Reset Service Counter.** This menu item allows the user reset the service counter after the service has been completed.

4. **Set Service Zero.** During the service of some critical component parts in the BioTector (e.g. Mixer Reactor), there is a possibility for contamination of such components and this may create an unacceptable TOC offset (particularly in low range analyzers). Zero calibration may therefore be required after the BioTector removes contamination as it operates. If this occurs the zero calibration can be automatically initiated using the “Set Service Zero” function. When initiated, BioTector automatically runs a total of 5 zero calibration cycles during the following 100 online measurements (default values) and automatically adjusts the zero offset values to compensate for the removal of the contamination. It will therefore not be necessary to revisit the BioTector after the service or to repeat the zero calibration cycle.

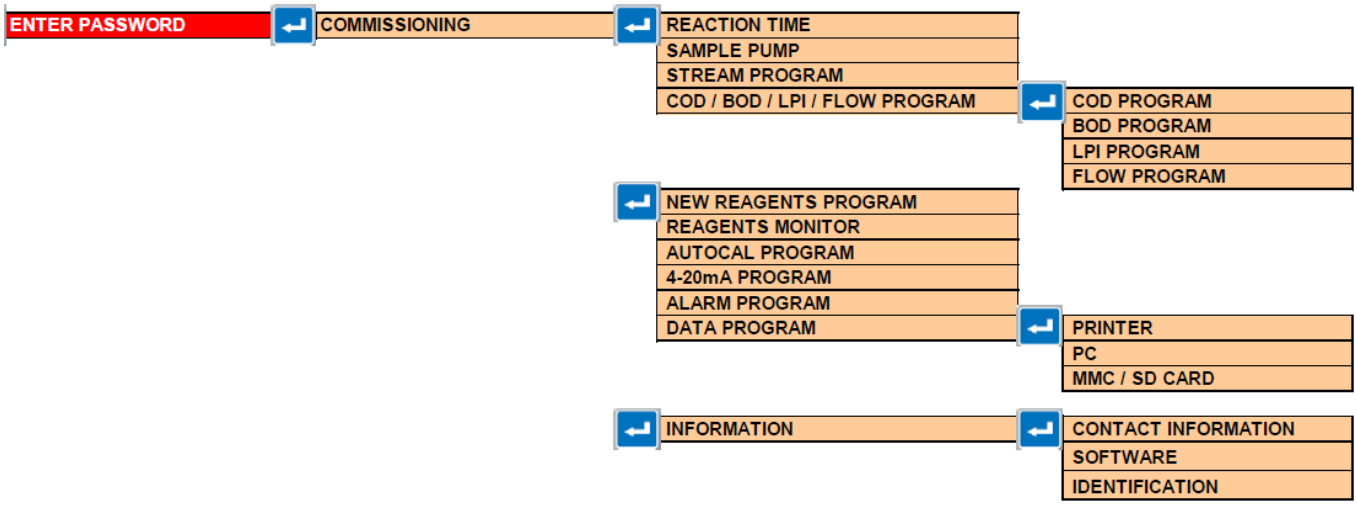
   “Set Service Zero” function can be activated while the BioTector is running or stopped. An asterisk “*” mark is displayed to indicate that this function is activated. If the BioTector is stopped, the service zero calibration cycle begins when the system is started. BioTector returns online operation when the service zero calibration cycle is completed. In the example Service menu displayed above, the first number entry “20” displays the number of online reactions, which will be carried out before each service zero calibration cycle. The second number entry “5” displays the total number of zero calibration cycles.

5. **Reset Service Zero.** This menu item allows the user to deactivate or to stop the service zero calibration cycle. See “4. Set Service Zero” function above. When the Reset Service Zero function is selected, the asterisk “*” mark, which indicates the activation of Set Service Zero function, is removed. If Reset Service Zero function is selected during one of the zero calibration cycles, BioTector returns online operation after completing the current zero calibration cycle.

8.2 COMMISSIONING MENU

The Commissioning menus are used during the commissioning and startup of the analyzer. The functions in the menus are used to program system site specific settings.

Commissioning Menu Diagram



8.2.1 Reaction Time

REACTION TIME	6m52s	▪ REACTION TIME displays the total reaction time (in minutes and seconds) for range 1, based on all programmed settings in System Program, System Program 1 menu.
INTERVAL	0m	▪ INTERVAL is the time (0 minutes by default) added between each reaction. Interval can be programmed on site if frequent analysis is not necessary. The longest interval time, which can be programmed, is 1440 minutes (or 1 day). A programmed interval time would reduce the reagent usage significantly. ▪ When BioTector automatically extends the reaction time due to high level of TIC and/or TOC in the sample, if any INTERVAL time is programmed, the extended reaction time is taken out from the interval time. ▪ BioTector automatically generates an INTERVAL time when the user programs any SAMPLER, FORWARD and/or REVERSE times, which exceeds the maximum allowable time in the Sample Pump menu below. The system determines the maximum allowable time from the System Program 1 settings in System Program menu.
TOTAL	6m52s	▪ TOTAL displays the total reaction time including the interval time if programmed.

8.2.2 Sample Pump

	SAMPLER	FORWARD	REVERSE
STREAM 1	100s	60s	75s
STREAM 2	100s	60s	75s
STREAM 3		45s	60s
.....			
MANUAL 1		50s	0s
MANUAL 2			
MANUAL 3			
.....			
CALIBRATION		50s	
SAMPLE FETCH REV			10s

- BioTector Sample Pump runs forward for the FORWARD time to bring a fresh sample from the STREAM, MANUAL and/or CALIBRATION points to the Sample (ARS) Valve. This time should be long enough to guarantee a fresh sample is injected into the reactor and any old samples and bubbles are completely removed from the sample lines.
- BioTector Sample Pump runs in reverse for the REVERSE time so as to wash and empty the sample lines prior to the next reaction. The build up of dirt in sample lines is prevented by the self-cleaning technology, where the sample lines are washed with the acidic liquid from the previous reaction in all systems fitted with Cleaning Valve and if the Reverse Cleaning cycle is activated. The recommended time for REVERSE is approximately FORWARD time plus 15 seconds. See Section 8.1.1.4 Sample Pump Test to test Sample Pump operation times.
- The REVERSE time for a Manual Valve can only be activated if a Manual Bypass Valve is installed in the system. Manual Bypass Valve is used to return the previous sample and the acidic cleaning liquid into drain.
- If a Sampler is programmed in Stream Program menu, system automatically shows the Sampler time in this menu. The sampler time should also be long enough to guarantee that the sampler chamber is filled with fresh sample.
- When the user programs any SAMPLER, FORWARD and/or REVERSE times, which exceeds the maximum allowable time, BioTector generates the required INTERVAL time automatically in the Reaction Time menu above. The maximum allowable time is determined by the system from the System Program 1 settings in System Program menu.
- SAMPLE FECTH REVERSE, if displayed in this menu, defines the sample pump reverse operation time in seconds. When programmed, sample pump runs in reverse direction for the programmed time, just before the Sample Pump forward operation, to empty the sample lines and to remove any possible liquid or material sitting at the end of the sample tubing at the sample source.

8.2.3 Stream Program

SAMPLER	NO	▪ If a sampler is used with the BioTector, SAMPLER is programmed (YES). When activated in this menu, the programmable Sampler time will be displayed automatically in the Sample Pump menu above.
CONTROL	BIOTECTOR	▪ In multi-stream systems, CONTROL determines the multi-stream valve sequence to be controlled by either BIOTECTOR, or by an EXTERNAL device, or by external STREAM INPUT signals. ▪ If the CONTROL is programmed as EXTERNAL, then both multi-stream valve sequence and operation ranges have to be controlled by an external device. ▪ If the CONTROL is programmed as STREAM INPUT, then the multi-stream valve sequence is controlled automatically by the Stream Input signals sent from an external device. For further details, see information sheet "O019. BioTector Remote Control Options and Operation", which is available in the MMC/SD card shipped with the BioTector.
START-UP RANGE	3	▪ START-UP RANGE (3 by default) defines the range BioTector will use at the first reaction it starts up with. ▪ When the COTROL above is programmed as BIOTECTOR in multi-stream systems, this function is automatically hidden by the system, if the first RANGE setting for a particular STREAM is not programmed as AUTO below.
RANGE LOCKED	NO	▪ If RANGE LOCKED (NO by default) is programmed as YES, BioTector locks the operation range at the defined RANGE above. In other words, the automatic range change function is disabled with the YES setting. ▪ In multi-stream systems, if none of the RANGE setting for stream sequence below is programmed as AUTO, this function is automatically hidden by the system.
PROGRAMMED STREAMS	3	▪ PROGRAMMED STREAMS displays the number of streams installed and programmed in Output Devices menu.
STREAM 1 , 2 STREAM 2 , 1 STREAM 3 , 4 STREAM - , - …… ……	RANGE 3 RANGE 3 RANGE 3 RANGE - …… …	▪ If the CONTROL is programmed as BIOTECTOR, the multi-stream valve sequence operates according to the STREAM and RANGE settings defined in this menu. ▪ In STREAM 1 , 2 setting, the first setting "1" represents the multi-stream valve number (e.g. Stream Valve 1), and the second setting "2" represents the number of reactions to be carried out at this stream before switching to the next stream. ▪ RANGE defines the operation range for each stream. In a multi-stream system, the ranges are locked to Range 3 by default in the factory. It is recommended to lock each stream to a particular range (e.g. 1, 2 or 3), which is appropriate to the concentration levels of the sample, in multi-stream systems. ▪ When a specific stream is programmed as "- , - - -, RANGE -", the analysis on that stream does not take place. ▪ The AUTO (AUTOMATIC) range change function is disabled in multi-stream systems by default. If it is necessary to run any of the streams with AUTO range change function, please contact your local distributor or the manufacturer. When AUTO range change function is used, a minimum of five analysis reactions is recommended as BioTector needs to find the optimum operation range automatically. Therefore, depending on the system response, it may be necessary to discard the first two or three analysis results, when the AUTO range change function is selected for a specific stream.

8.2.4 COD/BOD/LPI/FLOW Program

DISPLAY	NO	▪ DISPLAY function, which is programmed as "NO" by default, allows the user to program COD, BOD, LPI and/or FLOW & e.g. TOC in kg/h parameter results to be displayed by the system with the "YES" setting. When activated, the system sends the relevant 4-20mA signals for COD, BOD (in mgO/l), LPI (in %), and/or FLOW (in m^3/h) & e.g. TOC (in kg/h) to the relevant result output channels if programmed. See Section 8.2.8 4-20mA Program for details.
COD/BOD PROGRAM STREAM 1 1.0 0.0 TOC FACTOR 1.0 STREAM 2 1.0 0.0 TOC FACTOR 1.0 STREAM 3 1.0 0.0 TOC FACTOR 1.0 .... STREAM 6 1.0 0.0 TOC FACTOR 1.0		▪ In Stream 1 1.0 0.0 setting, the first setting "1.0" acts as the "OVERALL FACTOR" and the second setting acts as the "OFFSET FACTOR" in the following equation: ▪ COD (and/or BOD) = [Overall Factor * (TOC Factor * TOC)] + Offset Factor ▪ In TC analysis mode, instead of the TOC FACTOR, the TC FACTOR is displayed in this menu and used in above equation. ▪ If the DISPLAY is programmed as COD and/or BOD above, the system multiplies the TOC result of the corresponding stream (STREAM 1-6) with the TOC FACTOR and with the OVERALL FACTOR and adds the OFFSET FACTOR to calculate the COD and/or BOD value. ▪ The STREAM FACTOR for each stream is obtained following the procedures described in information sheet "*I030. TOC to COD or BOD Correlation Method*", which is available in the MMC/SD card shipped with the BioTector. ▪ Stream 1 factor is used for manual samples and calibration standards.
LPI PROGRAM STREAM 1 LPI VALUE 0.0mgC/l STREAM 2 TOC FACTOR 0.0mgC/l STREAM 3 TOC FACTOR 0.0mgC/l .... STREAM 6 TOC FACTOR 0.0mgC/l		▪ LPI Value (Lost Product Index Value) is the application dependent TOC value for the target lost product. For example the LPI value for milk in a dairy plant can be determined and installed as 60000 mgC/l. ▪ When the display of the LPI values is activated with the DISPLAY function above, BioTector calculates the % LPI values using the measured TOC result and the site specific LPI value programmed in this menu as follows: LPI (%) = [(TOC Result) / (LPI VALUE) * 100] ▪ When activated, the % LPI values are displayed in analysis result screen and in the reaction archive menus. ▪ If the DISPLAY of the Flow Program is activated in systems built with the sample flow analog input signal option, in addition to the % LPI value, BioTector calculates the LP Value (Lost Product in l/h) using the measured TOC result, the specific LPI Value and the recorded stream specific Sample Flow value as follows: LP (l/h) = [(TOC Result) / (LPI VALUE) * Sample Flow * 1000] ▪ When activated, the LP values in l/h are displayed in analysis result screen and in the reaction archive menus.

FLOW PROGRAM HEADING TOC kg/h DET. TIME 25s STREAM 1 0.00m3/h, 1.00 STREAM 2 0.00m3/h, 1.00 STREAM 3 0.00m3/h, 1.00	▪ HEADING function determines the label for the total product loss, total waste, etc. result based on the externally measured sample flow input value, which is sent to the BioTector as an analog input signal, if this option is installed into the system. This parameter is an editable text with a maximum size of 8 characters. The default text for HEADING is "TOC kg/h". ▪ DETECTION TIME function defines the time (25s by default) system calculates the "Exponentially Weighted Moving Average" value of sample flow input, just before the sample injection into the reactor. ▪ The first parameters of STREAM 1-3 functions define the full scale (in m^3/h) of the sample flow meter analog input signals for streams from 1 to 3 in systems built with this option. The second parameters (1.00 by default) are the stream specific FACTORS. For instance, if the TOC FACTOR is programmed as "3" for STREAM 1 in COD Program menu, and the preferred HEADING to be displayed and sent as 4-20mA signal is COD in kg/h, the stream specific FACTOR can be programmed as "3" for STREAM 1 in the Flow Program menu. ▪ When the display of the Flow Program is activated with the DISPLAY function above, BioTector calculates the programmed total product loss, total waste, etc. value (e.g. TOC in kg/h) using the measured TOC result and the recorded stream specific Sample Flow value as follows: TOC "kg/h" = [(TOC Result "mgC/l") * (Sample Flow "m^3/h") / 1000] * FACTOR ▪ When activated, the recorded sample flow values (FLOW in m^3/h) and the calculated total product loss, total waste, etc. values (e.g. TOC in kg/h) are displayed in analysis result screen and in the reaction archive menus.

8.2.5 New Reagents Program

SPAN CALIBRATION	NO	▪ SPAN CALIBRATION (NO by default) defines if the Span Calibration reactions are part of the Install New Reagents procedure in Reagents Setup menu. ▪ If SPAN CALIBRATION is activated (YES), the standard solution needs to be connected to the Calibration/Manual port of the BioTector as part of the Install New Reagents procedure. See concentrations of the TOC STANDARD defined in Span Calibration menu (see Section 2.3.2 Span Calibration for details).
SPAN CHECK	NO	▪ SPAN CHECK (NO by default) defines if the Span Check reactions are part of the Install New Reagents procedure in Reagents Setup menu. ▪ Note that both SPAN CALIBRATION and SPAN CHECK functions cannot be selected as YES simultaneously and cannot occur together in the Install New Reagents procedure.
AUTOMATIC RE-START	YES	▪ AUTOMATIC RE-START (Yes by default) defines BioTector to return automatically online operation having completed the Install New Reagents cycle.

8.2.6 Reagents Monitor

REAGENTS MONITOR	YES	▪ When REAGENTS MONITOR is activated (YES), the system creates a new Reagent Status screen which displays the amount of reagents and the estimated number of days left for each reagent to last. The Reagent Status screen is displayed for a period of 15 minutes and the system automatically reverts back to the default Reaction Result screen. ▪ BioTector calculates the reagent usage and the days remaining based on the average reagent usage from the reaction archive. If there are no reactions available in the archive, BioTector calculates the reagent usage using the operation range information in the system program menus and updates the reagent status figures accordingly. ▪ Note that when one or more reagent volumes are updated in this menu, system automatically resets the new reagents volumes in Install New Reagents menu and also updates the figures displayed in the main Reagents Status screen.
LOW REAGENTS	NOTE	▪ LOW REAGENTS, which is programmed as NOTE (notification) by default, will activate a relay specifically programmed for notification events. ▪ When LOW REAGENTS is programmed as WARNING, and if reagents run low, system generates an "85_LOW REAGENTS" warning and activates a relay specifically programmed for warning events.
LOW REAGENTS AT	5 DAYS	▪ LOW REAGENTS AT specifies the number of days (5 days by default), before the system generates an "85_LOW REAGENTS" warning or notification, depending on the LOW REAGENT setting above. ▪ This function can be used by the user as an early warning or notification of system low reagents so that the required reagents can be prepared or ordered in time.
NO REAGENTS	WARNING	▪ NO REAGENTS programmed as a WARNING event by default, can also be set as a FAULT event. When system calculates no reagents, the fault relay is activated and system generates a "20_NO REAGENTS" fault or warning. ▪ NO REAGENTS can also be programmed as NOTE (notification) where only a relay programmed as notification operates in the event of no reagents.
ACID VOLUME	25.0l ~ 77 DAYS	▪ ACID VOLUME allows the user to enter the volume of the acid reagent. When the volume is programmed, system automatically calculates the number of days acid reagent will last.
BASE VOLUME	25.0l ~ 74 DAYS	▪ BASE VOLUME allows the user to enter the volume of the base reagent. When the volume is programmed, system automatically calculates the number of days base reagent will last. ▪ It is strongly recommended that each time acid and/or base reagents are replaced or topped up, a Zero Calibration cycle is activated using the Start New Reagent Cycle function in Install New Reagents menu or using the Run Zero Calibration function in Zero Calibration menu.

8.2.7 Autocal Program

TIME		00:00
MONDAY	S	CHECK
TUESDAY	Z	CAL
WEDNESDAY	ZS	CAL
THURSDAY	--	--
FRIDAY	--	--
SATURDAY	--	--
SUNDAY	--	--

- TIME (00:00 by default) schedules the Zero & Span Calibration or Check reactions time (in HR:MIN) for the weekdays if any is programmed below.
- In this menu, Zero and/or Span Calibration reactions and/or Check reactions are scheduled if programmed on a particular day of the week. Note that by default, there will be no scheduled zero and span cycles in the system. See Section 2.3 Calibration Menu for details.
- If CAL (CALIBRATION) is programmed, system generates the zero and span adjust figures which are applied to the reaction results. If CHECK is programmed, system does not generate any zero or span adjust figures.
- The meaning of the abbreviations used in this menu are as follows:

--	No function is programmed.
S	Span reactions only.
Z	Zero reactions only.
ZS	Zero reactions followed by Span reactions.
CAL	Calibration reactions
CHECK	Check reactions.

8.2.8 4-20mA Program

OUTPUT MODE	DIRECT

- OUTPUT MODE specifies the 4-20mA outputs operation. This parameter is programmed as: DIRECT (direct mode by default), BASIC (basic mode), STREAM MUX (stream multiplex mode) or FULL MUX (full multiplex mode).
- In DIRECT mode, each 4-20mA output channel is dedicated to a specific stream and result type.
- In BASIC mode, 4-20mA signals of zero and span calibration/check reactions are also sent to the 4-20mA channels programmed as STREAM 1.
- In STREAM MUX and FULL MUX modes, specific channels are dedicated to periodically change their value in steps to indicate the stream number and result type. This periodic operation reduces the number of required 4-20mA channels significantly. If STREAM MUX and FULL MUX modes are required, please contact manufacturer or distributor for the complete protocols and the details of required system configuration modifications.

CHANNEL 1 CHANNEL 1 CHANNEL 2 CHANNEL 2 …… CHANNEL 7 CHANNEL 7	STREAM 1 500mgC/l STREAM 1 100mgC/l …… --- 100mgC/l	TOC INST TIC INST …… TIC AVRG	▪ In CHANNEL 1 STREAM 1 TOC setting, the first parameter defines the type of 4-20mA output which can be programmed as: STREAM and MANUAL reaction results, CAL (zero & span calibration results), CAL Z (zero results) and CAL S (span results). The second parameter is the data type which can be programmed as TOC, TIC, TC, VOC, BOD, COD, LPI, LP or TOCkg (TOC in kg/h). See Section 8.2.4 COD/BOD/LPI/FLOW Program for details. In TIC & TOC analysis mode, TC is the sum of TIC and TOC. ▪ In CHANNEL 1 500mgC/l INST setting, the first parameter (e.g. 500mgC/l) is the full scale of the channel. The second parameter could be programmed as INST (Instantaneous) or AVRG (Average). ▪ If INST is selected, the result for the selected stream is updated at the end of each reaction. If AVRG is selected, the average result of the 24 hour reactions is updated for the specific stream at the AVERAGE UPDATE time programmed in Sequence Program, Average Program menu. ▪ When ANALYSIS TYPE is changed in Analysis Mode menu, modifications on the 4-20mA result type and the channel full scale may be required.
SIGNAL FAULT	YES		▪ When SIGNAL FAULT is activated (YES) by default, if a fault occurs, system sends the FAULT LEVEL signal below for all 4-20mA channels. When it is set to (NO), 4-20mA outputs do not signal FAULT LEVEL if a fault occurs and system keeps sending live data on the outputs.
FAULT LEVEL	1.0mA		▪ FAULT (1.0mA by default) specifies the fault output level for all system 4-20mA channels.
OUTPUT < 4mA	0%		▪ OUTPUT < 4mA function defines the factor (0% by default) to be applied on the stream value if the output value becomes smaller than 4mA (negative result). This function allows the user to clamp or reduce the effect of negative result on the 4-20mA output value. ▪ For instance, if the OUTPUT value is set as 100%, 100% of the negative result is sent as 4-20mA signal. If the setting is 50%, 50% of the negative results is sent as 4-20mA signal. When the setting is 0%, no negative result is send and any negative result is clamped to 4mA (0mgC/l) level.
EXCLUDE RESULTS	3		▪ When OUTPUT MODE is programmed as BASIC above, EXCLUDE RESULTS defines the number of stream analysis reactions (3 by default) to be omitted after the zero and/or span calibration/check reactions. This is achieved by keeping the calibration output relay activated until the programmed number of stream analysis is completed. In other words, the calibration contact remains active for a programmable number of online reactions after the completion of the calibration cycle. This function helps to ignore any possible calibration impact on the system response.

8.2.9 Alarm Program

ALARM 1 TOC STREAM 1 20.0mgC/l ALARM 2 TIC STREAM 2 10.0mgC/l ALARM 3 COD STREAM 1 70.0mgO/l …… … …… ALARM 6 BOD STREAM 2 35.0mgO/l		▪ If ALARM 1-6 is not programmed in Output Devices menu, this option will not be available in this menu. See section 8.3.5 Output Devices for details. ▪ ALARM 1-6 operates on a specific stream and reaction result type. In "ALARM 1 TOC STREAM 1" setting, TOC is the desired reaction result, which can also be programmed as TIC, TC, VOC, COD, BOD, LPI, LP or TOCk (TOC in kg/h). STREAM 1 is the selected stream. See Section 8.2.4 COD/BOD/LPI/FLOW Program for details. ▪ In ALARM 1 20.0mgC/l setting, 20mgC/l defines the desired alarm activation level. The concentration level determines the alarm condition, where the Alarm Relay is set or reset at the end of each reaction once the calibrated result is known. In this example, ALARM 1 relay is activated when the TOC result of STREAM 1 exceeds 20mgC/l concentration level.
CO2 ALARM 1 50.0ppm CO2 ALARM 2 100.0ppm CO2 ALARM 3 150.0ppm …… …… CO2 ALARM 6 250.0ppm		▪ If CO2 ALARM 1-6 is not programmed in Output Devices menu, this option will not be available in this menu. See section 8.3.5 Output Devices for details. ▪ CO2 ALARM 1-6 is a predictor function of a possible high TOC/TC (COD or BOD if programmed) level for a specific stream. By default, this function is disabled by 0.0ppm setting. If programmed, it provides an earlier warning of an unusually high TOC result from the rising slope of the CO_2 peak generated during the reaction. ▪ If programmed, the alarm level (ppm CO_2 peak) need to be selected carefully considering the temperature effect, which could be significant on the CO_2 peaks. In other words, enough margins needs to be given for the settings which will create an actual early warning for an unusually high reading. At the end of the reaction, the CO2 Alarm Relay status is maintained or reset depending on the reading. In addition, this function is only suitable for multi-stream systems operating on fixed ranges, or systems operating on a single range. The use of this function is not recommended for systems which uses automatic range change. ▪ Note that in TIC & TOC and VOC analysis types, the CO_2 peak used for the CO2 ALARM 1-6 is the TOC CO_2 peak. In TC and TC – TIC analysis type, the CO_2 peak used is the TC CO_2 peak.
--> OUTPUT DEVICES		▪ Output Devices is a link to System Configuration, Output Devices menu.

8.2.10 Data Program

PRINTER, PC, MMC/SD CARD		▪ These menus allow the user to program three separate output device communication port configuration profiles, which are PRINTER, PC and MMC/SD flash card. ▪ The functions described below covers all programming options for each device. Some devices (e.g. MMC/SD Card) may have less programming functions.
PRINT MODE	ENGINEERING	▪ PRINT MODE specifies the format in which the data will be sent over the communication port to all output devices. The available modes are STANDARD (includes time, date and calibrated analysis data etc.), and ENGINEERING (includes un-calibrated data, temperature and atmospheric pressure, pump diagnostic information, liquid phase measurement information etc. in addition to the STANDARD data).
REACTION ON-LINE	NO	▪ REACTION ON-LINE enables (YES) or disables (NO) the automatic printout of the reaction result at the end of each reaction.
FAULT ON-LINE	NO	▪ FAULT ON-LINE enables (YES) or disables (NO) the automatic printout of a fault or warning log as soon as it occurs.
CONTROL CHARS	NO	▪ CONTROL CHARS enables (YES) or disables (NO) the control characters sent with the RS232 data for the output device operation.
BAUDRATE	9600	▪ BAUDRATE (9600bps by default) specifies the data communication baudrate for Printer and PC output devices. The baudrate range is between 2400 and 115200bps.
FLOW CONTROL	NONE	▪ FLOW CONTROL defines the data flow control mechanism used between BioTector and the connected Printer or PC output devices. The available options are NONE (no flow control), XON/XOFF (inbound XON/XOFF flow control) and LPS1/10 (1 to 10 lines of data sent per second).
DECIMAL	POINT	▪ DECIMAL specifies whether a POINT (.) by default or a COMMA (,) character represents the decimal point in the downloaded analysis data files for all output devices.

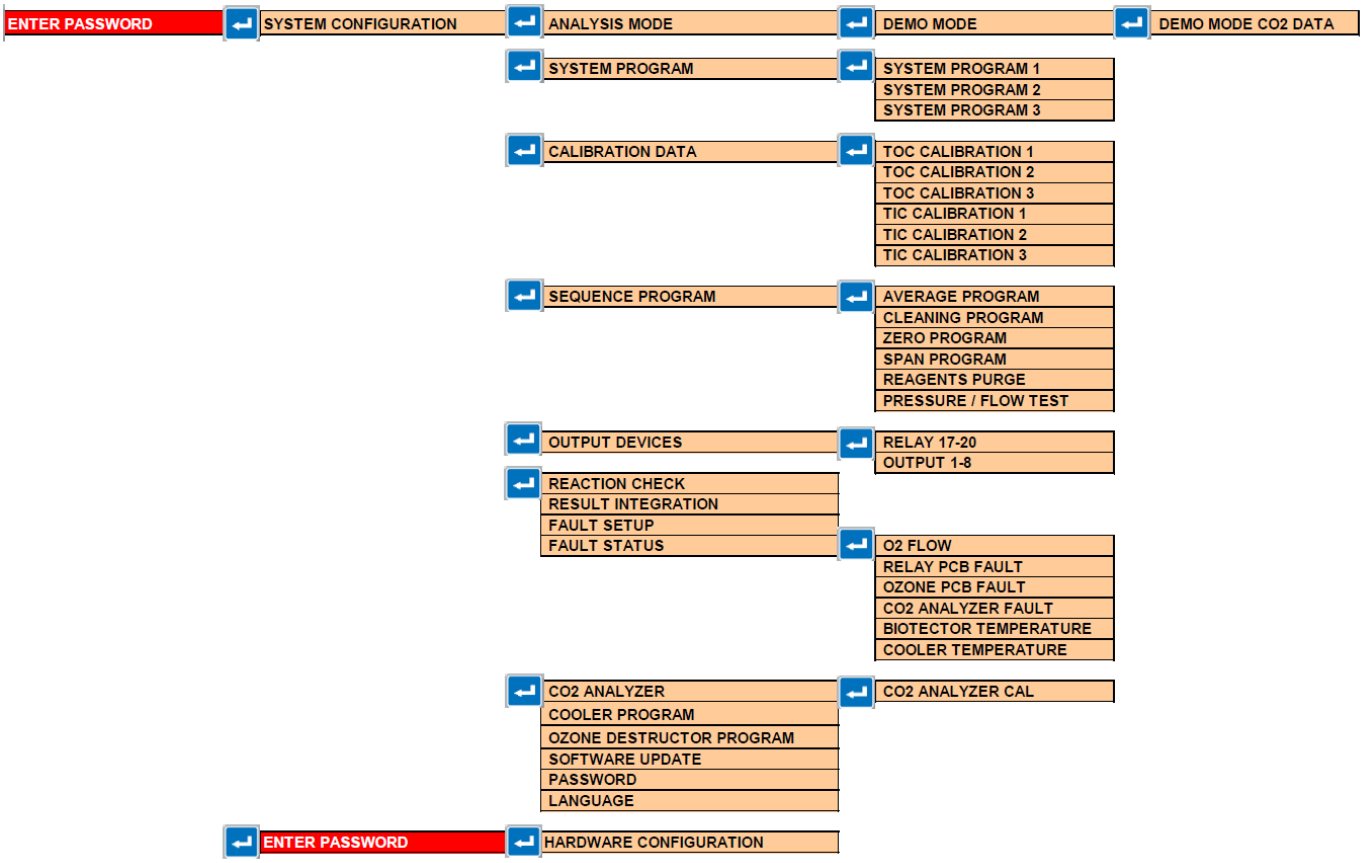
8.2.11 Information

CONTACT INFORMATION		▪ Contact menu displays the contact details of the manufacturer and if programmed the distributor.
SOFTWARE		
VERSION	04.01.00	▪ VERSION displays the system firmware (software) revision number.
DATE	July 27 2012	▪ DATE displays the firmware (software) revision date.
IDENTIFICATION		
	BAC 4.01 947	▪ IDENTICIFATION displays the specific identification number (system serial number) for the BioTector.

8.3 SYSTEM CONFIGURATION MENU

System Configuration menus are used to configure the system in the factory. The user should avoid any modifications in these menu settings unless it is absolutely necessary.

System Configuration Menu Diagram



8.3.1 Analysis Mode

ANALYSIS TYPE	TIC+TOC_D	▪ ANALYSIS TYPE defines BioTector's analysis modes, which are TIC+TOC, TC, VOC, TIC+TOC_D, TC_D and VOC_D. TIC+TOC (TIC&TOC) and VOC systems can be programmed to run in TIC+TOC, TC and VOC analysis types, including the "_D" analysis types. If it is necessary to run a TIC&TOC system in any other analysis modes, please contact the distributor or the manufacturer. ▪ When the analysis type is changed, the system automatically modifies several system configuration parameters and resets them to their default values. Therefore, when this function is entered, before the analysis type is changed, system automatically displays a "CAUTION! CHANGING ANALYSIS TYPE ALTERS SYSTEM PARAMETERS AND REQUIRES USER TO CHANGE SYSTEM CONFIGURATION SETTINGS. PLEASE PRESS ESCAPE OR RIGHT ARROW TO PROCEED." warning to the user to inform the user about the changes required in the system configuration settings. ▪ Systems, which are built with two or more analysis type options, are shipped with the relevant system configurations, which are available in both electronic format and as printouts. When the user changes the analysis type of the system, the necessary system configuration modifications needs to be carried out following the procedures described in information sheet "*M067. BioTector Arm Configuration Upgrade Procedure*", which is available in the MMC/SD card shipped with the BioTector. When the procedures are followed, the system configuration settings will be updated automatically. Alternatively, all system configuration modifications can be carried out manually by looking at the corresponding configuration printout.
DEMO MODE		
DEMO MODE	OFF	▪ When DEMO MODE (OFF by default) is activated (ON), system can be started to operate in demonstration mode. In this mode, BioTector does not require any reagents or carrier gas to operate. When BioTector is started using the Operation menus, the relevant CO_2 peaks are generated artificially to demonstrate the operation of the system. Because the system normal operation is inhibited, system automatically displays a warning to the user before the DEMO MODE is activated.
DEMO MODE CO2 DATA		
TIC CURVE PEAK TIC CURVE WIDTH TIC CURVE DELAY TOC CURVE WIDTH TOC CURVE PEAK TOC CURVE DELAY TC CURVE WIDTH TC CURVE PEAK TC CURVE DELAY	1000ppm 25s 2s 3000ppm 55s 5s 4000ppm 65s 5s	▪ The TIC/TOC/TC CURVE PEAK/WIDTH/DELAY functions in Demo Mode CO2 Data menu allows the user to program the size of the relevant CO_2 peaks, the duration of the CO_2 peaks and the time delays artificially generated during the DEMO MODE operation. ▪ In TC and VOC systems, the relevant TIC/TOC/TC CURVE PEAK/WIDTH/DELAY parameters are displayed.

8.3.2 System Program

SYSTEM PROGRAM 1		
SYSTEM PROGRAM 1 TIC + TOC_D		▪ SYSTEM PROGRAM 1 TIC + TOC_D defines the system parameters for Oxidation Phase operation in TIC & TOC_D analysis mode. In TIC & TOC_D analysis mode, the TIC and TOC contents of a sample are measured consecutively by means of a single sample injection into a single reactor. In this analysis mode, the reactor and sample lines are washed using base reagent depending on a pre-programmed cycle and depending on specific site conditions and TOC levels.
→ Sample Pump		▪ SAMPLE PUMP is a shortcut to Commissioning, Sample Pump menu. See Section 8.2.2 Sample Pump for details.
ANALYZER ZERO	15s 20l/h	▪ CO_2 analyzer establishes a zero offset level for the ANALYZER ZERO time (15s by default) with the oxygen flow (20 l/h) settings. ▪ A "12_HIGH CO2 IN O2" fault is generated during this phase and BioTector stops if the CO_2 analyzer's reading is higher than CO2 ZERO LINE plus the CO2 ZERO ALARM value (250ppm by default) for three consecutive reactions. See Section 8.3.8 Fault Setup for details.
SAMPLE IN	7p M-V	▪ SAMPLE IN defines the amount of sample (in pulses) to be injected into the reactor at range 1. M-V stands for "Motorized Variable" sample volume where sample is injected with the Sample Pump operation. ▪ A single pulse pump operation corresponds to ½ revolution of the pump roller. ▪ BioTector also utilizes M-F180 sample injection type which stand for "Motorized Fixed" volume sample injection by the 180° rotation of the Sample (ARS) Valve. ▪ Note that any change carried out on the factory SAMPLE IN setting requires recalibration of the system.
BASE INJECTION	1p	▪ BASE INJECTION defines the amount of base reagent (in pulses) used to inject the liquid sample into the reactor for the reaction at range 1.
TIC ACID	2p	▪ TIC ACID specifies the amount of acid reagent (in pulses) to be injected into the reactor at range 1.
TIC SPARGE TIME	25s 20l/h	▪ BioTector sparges and measures the TIC content of the sample for the TIC SPARGE TIME (25s by default) with the oxygen flow (20 l/h) settings. ▪ If the TIC level does not drop below the TIC CHECK level (100ppm CO2 by default in Reaction Check menu) by the end of TIC SPARGE TIME, BioTector automatically extends this time (extension time) until the TIC level drops below 100ppm level. ▪ A "50_TIC OVERFLOW" warning is generated and BioTector keeps running if the TIC level does not drop below 100ppm by the end of the maximum extension time, which is 300 seconds. The maximum extension time is not a programmable function. It is a fixed figure within the system software.
BASE	8p	▪ BASE defines the amount of base (in pulses) to be injected into the reactor for the reaction at range 1.
BASE OXIDATION	135s 10l/h	▪ BioTector oxidizes the sample for the BASE OXIDATION time (135s by default) with the oxygen flow (10 l/h) settings. If any CO_2 is released during this phase, it is measured and added to the TOC result because the default setting of PEAK INTEGRATION is TOC+BASE OXID in Result Integration menu.

TOC ACID	7p	▪ TOC ACID states the amount of acid (in pulses) to be injected into the reactor for the TOC SPARGE phase at range 1.
TOC SPARGE TIME	135s 20l/h	▪ BioTector sparges and measures the TOC content of the sample for the TOC SPARGE TIME (135s by default) with the oxygen flow (20 l/h) settings. ▪ If the TOC level does not drop below the TOC CHECK level (350ppm CO2 by default in Reaction Check menu) at the end of TOC OXIDATION TIME, BioTector automatically extends this time (extension time) until the TOC level drops below 350ppm level. ▪ A "51_TOC OVERFLOW" warning is generated if the TOC level does not drop below 350ppm at the end of the maximum extension time, which is 300 seconds. The maximum extension time is not a programmable function. It is a fixed figure within the system software.
TOC OXIDATION	60s	▪ TOC OXIDATION determines the time (60s by default), the ozone generator will be running at the start of the TOC Sparge phase. Note that TOC OXIDATION time is part of the TOC Sparge phase and does not increase the TOC SPARGE TIME.
REACTOR PURGE	47s	▪ REACTOR PURGE displays the overall time, which is 47s by default, the BioTector purges the Mixer Reactor. ▪ During the REACTOR PURGE phase, system continuously monitors the oxygen gas flow using the mass flow controller (MFC). If any gas leak or any flow problem is detected during this phase, BioTector generates a "06_PRESSURE CHCK FAIL" or a "02_LOW O2 FLOW - SO" fault and stops. These faults are logged into the fault archive.
PRESSURE CHECK	20s, 40 l/h	▪ PRESSURE CHECK defines the time and oxygen gas flow (20 second at 40 l/h by default) the Mixer Reactor is pressurized for the REACTOR PURGE phase above.
PRESSURE RELEASE	12s, 45 l/h	▪ When the gas flow is equal to or less than the PRESSURE CHECK FAULT level, which is 6.0 l/h defined in Sequence Program, Pressure/Flow Test Program menu, for longer than 1 second during the PRESSURE CHECK phase above, BioTector opens the Sample Out Valve (MV5) and releases the pressure of the reactor for 12 seconds at 45 l/h oxygen flow by default using the PRESSURE RELEASE function. With this process, the majority of the liquid present in the Mixer Reactor is discharged into drain through the Sample Out port.
PRESSURE PURGE	7s, 60 l/h	▪ When PRESSURE RELEASE phase above is completed, using the PRESSURE PURGE function, the Mixer Reactor is pressurized once again for 7 seconds at an oxygen flow of 60 l/h by default.
PRESSURE RELEASE	8s, 20 l/h	▪ When the PRESSURE PURGE phase above is completed, BioTector opens the Sample Out Valve (MV5) and releases the pressure of the reactor for 8 seconds at 20 l/h oxygen flow by default using the PRESSURE RELEASE function. ▪ Unlike the first PRESSURE RELEASE phase described above, the motor of the Mixer Reactor is activated during this phase. With this process, any remaining liquid present in the Mixer Reactor is discharged into drain through the Sample Out port.
CYCLES	1	▪ CYCLES (1 by default) defines the number of times the PRESSURE PURGE and the PRESSURE RELEASE phases take place during the REACTOR PURGE phase.
ANALYZER PURGE	15s 40l/h	▪ BioTector purges the CO_2 analyzer for the ANALYZER PURGE time (15s by default) with the default 40 l/h oxygen flow. System fan is always kept activated during this phase.
REACTION TIME	6m52s	▪ REACTION TIME displays the total reaction time (in minutes and seconds) for range 1, based on all programmed settings above.

SYSTEM PROGRAM 1 TC_D		▪ SYSTEM PROGRAM 1 TC_D defines the system parameters for Oxidation Phase operation in TC_D analysis mode. In TC_D analysis mode, the TC_D content of a sample is measured by means of a single sample injection into the reactor. ▪ When the Analysis Type is changed to TC_D, the System Program 1 menu is automatically updated with the corresponding TC_D system parameters. The TC_D system parameters, which are not covered in SYSTEM PROGRAM 1 TIC + TOC_D above are as follows:
PRE OXIDATION	10s , 10	▪ PRE OXIDATION defines the time (10s by default) and oxygen flow (10 l/h) settings for the initial oxidation stage, where hydroxyl radicals are generated for the VOC Oxidation phase.
VOC OXIDATION	45s , 3	▪ VOC OXIDATION states the time (45s) and oxygen flow (3 l/h flow by default) settings for the VOC Oxidation stage, where the volatile organic carbon element of the sample is oxidized. ▪ The objective of no oxygen flow at this reaction phase is to prevent the loss of any volatiles before they are oxidized.
ACID IN	1p	▪ ACID IN specifies the quantity of acid reagent (in pulses) to be injected into the reactor for the VOC Oxidation phase above.
TC SPARGE TIME	135s 20l/h	▪ BioTector sparges and measures the TC content of the sample for the TC SPARGE TIME (135s by default) with the oxygen flow (20 l/h) settings. ▪ If the TC level does not drop below the TC CHECK level (350ppm CO2 by default in Reaction Check menu) at the end of TC OXIDATION time, BioTector automatically extends this time (extension time) until the TC level drops below 350ppm level. ▪ A “91_TC OVERFLOW” warning is generated if the TC level does not drop below 350ppm at the end of the maximum extension time, which is 300 seconds. The maximum extension time is not a programmable function. It is a fixed figure within the system software.
TC ACID	7p	▪ TC ACID states the amount of acid (in pulses) to be injected into the reactor for the TC SPARGE phase in TC mode at range 1.
TC OXIDATION	60s	▪ TC OXIDATION determines the time (60s by default), the ozone generator will be running at the start of the TC Sparge phase. Note that TC OXIDATION time is part of the TC Sparge phase and does not increase the TC SPARGE TIME.

SYSTEM PROGRAM 1 VOC_D		▪ SYSTEM PROGRAM 1 VOC_D defines the system parameters for Oxidation Phase operation in VOC_D analysis mode. In VOC_D analysis mode, two reactions (first one in TC_D mode and the second one in TIC & TOC_D mode) are run consecutively by means of two sample injections into the reactor. ▪ When the Analysis Type is changed to VOC_D, the System Program 1 menu is automatically updated with the corresponding VOC_D system parameters. The VOC_D system parameters, which are not covered in SYSTEM PROGRAM 1 TIC + TOC_D and TC_D analysis modes above is as follows:
SAMPLE PUMP FORWARD 2	3s	▪ SAMPLE PUMP FORWARD 2 specifies the Sample Pump’s forward operation time (3s by default), where the Sample Pump runs forward to fill the Sample (ARS) Valve line with sample liquid, prior to the second sample injection into the reactor for the second TIC & TOC analysis reaction in VOC systems.

SYSTEM PROGRAM 2		
SYSTEM PROGRAM 2 TIC + TOC_D		
RANGE CHANGE 1-2	50.0mgC/l	▪ RANGE CHANGE 1-2 defines the concentration levels for the BioTector to change its range automatically from range 1 to range 2. ▪ The RANGE CHANGE 1-2 is typically the top concentration point of TOC RANGE 1 in System Range Data menu by default.
RANGE CHANGE 1-3	150.0mgC/l	▪ RANGE CHANGE 1-3 specifies the concentration level for the BioTector to change its range automatically from range 1 to range 3. ▪ The RANGE CHANGE 1-3 is typically 50-75% of the top concentration point of TOC RANGE 2 in System Range Data menu by default.
RANGE CHANGE 2-1	40.0mgC/l	▪ RANGE CHANGE 2-1 states the concentration level for the BioTector to change its range automatically from range 2 to range 1. ▪ The RANGE CHANGE 2-1 is typically 20% less of the top concentration point of TOC RANGE 1 in System Range Data menu by default.
SAMPLE IN	6p M-V	▪ SAMPLE IN identifies the amount of sample (in pulses) to be injected into the reactor at range 2. M-V stands for Motorized Variable sample injection by the Sample Pump.
BASE INJECTION	2p	▪ BASE INJECTION defines the amount of base reagent (in pulses) used to inject the liquid sample into the reactor for the reaction at range 2.
TIC ACID	2p	▪ TIC ACID defines the amount of acid reagent (in pulses) to be injected into the reactor at range 2.
BASE OXIDATION	135s	▪ BASE OXIDATION defines the oxidation time (150s by default), which can be programmed independently for range 2. ▪ If the Base Oxidation time is different than the one programmed in System Program 1 menu, depending on the difference between the two settings, the reaction time at range 2 will be either longer or shorter than the reaction time displayed in System Program 1 menu.
BASE	8p	▪ BASE specifies the amount of base (in pulses) to be injected into the reactor for the BASE OXIDATION phase at range 2.
TOC ACID	8p	▪ TOC ACID states the amount of acid (in pulses) to be injected into the reactor for the TOC SPARGE phase at range 2.

SYSTEM PROGRAM 2 TC_D		
SAMPLE IN	4p , M-V	▪ SAMPLE IN defines the amount of sample (in pulses) to be injected into the reactor in TC mode at range 2.
ACID IN	2p	▪ ACID IN identifies the quantity of acid reagent (in pulses) to be injected into the reactor for the VOC Oxidation phase in TC mode at range 2.
TC ACID	9p	▪ TC ACID states the amount of acid (in pulses) to be injected into the reactor for the TC SPARGE phase in TC mode at range 2.

SYSTEM PROGRAM 2 VOC_D	▪ All system parameters for SYSTEM PROGRAM 2 VOC_D analysis mode are covered in System Program 2 TC_D and System Program 2 TIC + TOC_D above.

SYSTEM PROGRAM 3		
SYSTEM PROGRAM 3 TIC + TOC_D		
RANGE CHANGE 2-3	150.0 mgC/l	▪ RANGE CHANGE 2-3 defines the concentration level for the BioTector to change its range automatically from range 2 to range 3. ▪ The RANGE CHANGE 2-3 is typically the top concentration point of TOC RANGE 2 in System Range Data menu by default.
RANGE CHANGE 3-2	120.0mgC/l	▪ RANGE CHANGE 3-2 specifies the concentration level for the BioTector to change its range automatically from range 3 to range 2. ▪ The RANGE CHANGE 3-2 is typically 20% less of the top concentration point of TOC RANGE 2 in System Range Data menu by default.
RANGE CHANGE 3-1	40.0mgC/l	▪ RANGE CHANGE 3-1 defines the concentration level for the BioTector to change its range automatically from range 3 to range 1. ▪ The RANGE CHANGE 3-1 is typically 20% less of the top concentration point of TOC RANGE 1 in System Range Data menu by default.
SAMPLE IN	0p MF-180	▪ SAMPLE IN states the amount of sample (in pulses) to be injected into the reactor at range 3. If the setting is 0p MF-180, it means that the sample injection at this range will be carried out by means of the Motorized Fixed 180° rotation of the Sample (ARS) Valve. ▪ When SAMPLE IN setting is MF-180, the Sample Pump does not inject the sample into reactor. Instead acid reagent (or base reagent depending on the analysis type of the system) and the carrier gas flow is used to inject the fixed volume of the sample sitting inside the Sample (ARS) Valve.
BASE INJECTION	2p	▪ BASE INJECTION defines the amount of base reagent (in pulses) used to inject the liquid sample into the reactor for the reaction at range 3.
TIC ACID	3p	▪ TIC ACID defines the amount of acid reagent (in pulses) to be injected into the reactor at range 3.
BASE	15p	▪ BASE specifies the amount of base (in pulses) to be injected into the reactor for the BASE OXIDATION phase at range 3.
BASE OXIDATION	135s	▪ BASE OXIDATION defines the oxidation time (150s by default), which can be programmed independently for range 3. ▪ If the Base Oxidation time is different than the one programmed in System Program 1 menu, depending on the difference between the two settings, the reaction time at range 3 will be either longer or shorter than the reaction time displayed in System Program 1 menu.
TOC ACID	12p	▪ TOC ACID states the amount of acid (in pulses) to be injected into the reactor for the TOC SPARGE phase at range 3.

SYSTEM PROGRAM 3 TC_D		
SAMPLE IN	1p , M-V	▪ SAMPLE IN defines the amount of sample (in pulses) to be injected into the reactor in TC mode at range 3.
ACID IN	2p	▪ ACID IN identifies the quantity of acid reagent (in pulses) to be injected into the reactor for the VOC Oxidation phase in TC mode at range 3.
TC ACID	12p	▪ TC ACID states the amount of acid (in pulses) to be injected into the reactor for the TC SPARGE phase in TC mode at range 3.

SYSTEM PROGRAM 3 VOC_D	▪ All system parameters for SYSTEM PROGRAM 3 VOC_D analysis mode are covered in System Program 3 TC_D and System Program 3 TIC + TOC_D above.

8.3.3 Calibration Data

DECIMAL PLACES	2	▪ DECIMAL PLACES setting defines the number of decimal places (0, 1, 2 or 3) system displays in the reaction results and in the relevant system menus.
TOC/TC CALIBRATION 1 **TOC/TC CALIBRATION 2** **TOC/TC CALIBRATION 3** **TIC CALIBRATION 1** **TIC CALIBRATION 2** **TIC CALIBRATION 3**		▪ Calibration menus are used to install the calibration data and thus to calibrate the BioTector in factory. TOC CALIBRATION 1, 2 and 3 shows the calibration curves for range 1, 2 and 3 respectively. In TC and VOC systems, the TOC CALIBRATION 1/2/3 menus are named as TC CALIBRATION 1/2/3. ▪ The first column shows the number of calibration points, the second point [%] shows the calibration factors automatically calculated from the calibration data, the third column STANDARD shows the standard solution concentrations and the fourth column shows the un-calibrated result (mgC/l) measured and calculated from the CO_2 analyzer readings. ▪ System calibration curves should not be modified by the user on site unless a recalibration of the system is required at a different analysis range.

8.3.4 Sequence Program

8.3.4.1 Average Program

LOG AVERAGE	NO	▪ LOG AVERAGE function enables (YES) or disables (NO by default) the 24-hour averaging of the reaction results in the reaction archive. ▪ The reaction results obtained from manual samples are not included in the averaging calculations.
AVERAGE UPDATE	00:00	▪ If the LOG AVERAGE above is enabled (YES), the system calculates a 24 hours average of the reaction results and displays it in the reaction archive for each stream at the time programmed for AVERAGE UPDATE (00:00, HR:MIN, by default).

8.3.4.2 Cleaning Program

The parameters in Cleaning Program menu identifies the operation of the specific cleaning cycle built and programmed for each specific analyzer.

CLEANING TYPE	BASE WASH	▪ Systems, programmed to operate with the BASE WASH cleaning type, carries out sample tubing wash cycle at a programmable frequency, and if necessary a reactor wash cycle using the base reagent. ▪ When CLEANING TYPE is programmed as REVERSE WASH, and if a STREAM REVERSE time is set in Sample Pump menu (see Section 8.2.2 Sample Pump for details), the Sample Pump runs reverse with the Cleaning Valve activated to wash the sample lines automatically using the BioTector oxidized sample liquid. ▪ During the Span Calibration and Span Check reactions, the REVERSE WASH cleaning cycle operation is automatically blocked by the software. ▪ During Manual sample analysis, the REVERSE WASH cleaning cycle is deactivated by default with the MANUAL REVERSE time set to 0 seconds. In order to utilize the reverse wash cleaning cycle during manual sample analysis, system requires a Manual Bypass Valve, which redirects the oxidized liquid back into drain. ▪ When the CLEANING TYPE is programmed as FULL REACTION, an external cleaning liquid is injected into the reactor and oxidized with a complete reaction cycle. ▪ If the CLEANING TYPE is programmed as REACTOR WASH, an external cleaning liquid is injected into the reactor and mixed for the REACTOR WASH TIME programmed below. ▪ Systems built and programmed with the BASE WASH and/or REVERSE WASH cleaning cycles cannot run FULL REACTION or REACTOR WASH cycles. In order to change the cleaning type in a BioTector, several mechanical and system configuration changes are required.
CLEANING START	FIRST	▪ CLEANING START determines whether BioTector to start the cleaning cycle before (FIRST by default) or after (LAST) the number of reactions programmed in CLEANING PERIOD below.
CLEANING PERIOD STREAM 1 STREAM 2 STREAM 3 …… STREAM 6	1 , 1 100 100 100 … 100	▪ In CLEANING PERIOD 1 , 1 setting, the first point “1 by default” defines the number of analysis cycles between each cleaning cycle, and the second point “1 by default” defines the number of the cleaning cycles to be performed. The default settings of “1 , 1” is the recommended setting for REVERSE WASH cleaning cycle. ▪ For instance, if the CLEANING PERIOD setting is “10 , 1”, one REVERSE WASH cleaning cycle (or one FULL REACTION or one REACTOR WASH cycle) is carried out every tenth analysis cycle. ▪ A setting of “0 , 1” inhibits the cleaning cycles. ▪ In BioTectors operating with BASE WASH cleaning cycle, the system carries out the base wash cleaning at the programmed analysis cycle (every 100 reactions by default) for each stream (STREAM 1-6).

CLEANING VALVE	SPF	▪ When the CLEANING VALVE is programmed with the SPF "Sample Pump Forward" setting or SPF/SAMPLER setting in systems operating with BioTector sampler, cleaning valve is powered just before and while the sample pump is running in forward direction. ▪ If CLEANING VALVE is set as ON, cleaning valve is powered just after the sample pump completes its operation in reverse direction. ▪ Cleaning valve is switched off when the injection into the reactor is complete. ▪ CLEANING VALVE setting is N/A (Not Applicable) for REVERSE WASH cleaning type by default.
VALVE DELAY	0s	▪ VALVE DELAY (0 seconds by default) defines the delay time which can be introduced before the activation of the Cleaning Valve. If programmed, the Cleaning Valve activates as soon as the VALVE DELAY time elapses. This operation allows the system to empty the liquid sample located between the Sample Bypass port and the Cleaning Valve during the Reverse Wash cleaning cycle. ▪ VALVE DELAY setting is not applicable for FULL REACTION and BASE WASH cleaning types.
CLEANING HIGH	0	▪ CLEANING HIGH (0 by default) defines the frequency of the Cleaning Cycle if the TOC/TC result exceeds the value set in CLEANING HIGH AL below. If the TOC/TC result is greater than the concentration level set in CLEANING HIGH AL, the cleaning cycle frequency defined in CLEANING HIGH is used. ▪ For instance, when the CLEANING HIGH setting is "5", and if the TOC/TC result exceeds the value set in CLEANING HIGH AL, in the example described for CLEANING PERIOD above, one REVERSE WASH cleaning cycle (or one FULL REACTION or one REACTOR WASH cycle) will be carried out every fifth analysis cycle. In other words, with the use of CLEANING HIGH and CLEANING HIGH AL functions, the cleaning cycle can be programmed to take place more frequently when necessary. ▪ CLEANING HIGH setting is not applicable for BASE WASH cleaning type by default.
CLEANING HIGH AL	1000.0mgC/l	▪ CLEANING HIGH ACTIVATION LEVEL defines the concentration level (1000mgC/l by default), over which the Cleaning Cycle switches to the frequency setting defined in CLEANING HIGH above. ▪ CLEANING HIGH AL setting is not applicable for BASE WASH cleaning type by default.
RANGE	1	▪ RANGE defines the operation range to be used for the FULL REACTION or REACTOR WASH cleaning cycles. It is used to determine the amount of cleaning liquid injected into the reactor. ▪ RANGE is N/A by default for REVERSE WASH cleaning cycle as REVERSE WASH cycle is independent of operation range.

TUBING WASH BASE 1 3p TUBING WASH ACID 5p TUBING WASH BASE 2 25p	▪ In systems programmed with BASE WASH cleaning cycle, TUBING WASH BASE 1, ACID and BASE 2 settings define the quantity of acid and base reagents (in pulses) used to wash the sample lines which include tubing located between the Sample (ARS) Valve and the Bypass port, and each stream specific tubing.
REACTOR WASH TIME 100s CLEANING ACID 3p CLEANING BASE 30p CLEANING OXID. 30s, 10l/h NEUTRALIZATION ACID 20p NEUTRALIZATION BASE 18p NEUTRALIZATION 30s, 10l/h	▪ REACTOR WASH TIME determines the length of time (100 seconds by default) the cleaning liquid is mixed during the REACTOR WASH cleaning cycle. ▪ REACTOR WASH TIME setting is not applicable for REVERSE WASH, FULL REACTION and BASE WASH cleaning cycles. ▪ In systems programmed with BASE WASH cycle, when the TOC results are above 15000 mgC/l for CLEANING ALARM described above, BioTector injects the programmed CLEANING ACID and CLEANING BASE reagents (in pulses) into the reactor and oxidizes these reagents with the CLEANING OXIDATION time and flow setting (30s at 10l/h by default). When the reactor wash cycle is complete, the reactor pH is neutralized with the NEUTRALIZATION ACID and NEUTRALIZATION BASE injections (in pulses). The neutralization reagents are mixed with the NEUTRALIZATION time and flow setting (30s at 10l/h by default).

8.3.4.3 Zero Program

ZERO PROGRAM	5 , 3 , 3	▪ In ZERO PROGRAM 5, 3, 3 setting, the first, second and third inputs define the minimum number of reactions to be carried out at Range 1, Range 2 and Range 3 respectively during the Zero Calibration and Zero Check cycles. Zero cycles are activated by RUN ZERO CALIBRATION/CHECK functions in Zero Calibration menu or by START NEW REAGENT CYCLE function in Install New Reagents menu. ▪ If two or any of the three ZERO PROGRAM settings is set to zero, system runs the zero calibration/check reactions only at the programmed range(s) and calculates the TOC Zero Adjust values for the corresponding range(s) using the measured zero adjust figure.
ZERO PROGRAM MAX	10	▪ ZERO PROGRAM MAX defines the maximum number of zero reactions system will operate at a specific range if the corresponding AVERAGE ZERO reading is not within the programmed ZERO BAND below. The corresponding AVERAGE ZERO result is calculated from the programmed number of readings defined in ZERO AVERAGE below. This parameter is common to all ranges.
ZERO AVERAGE	3 , 2 , 2	▪ In ZERO AVERAGE 3, 2, 2 setting, the first, second and third inputs define the number of zero reactions to be averaged to get a representative Zero Adjust value for Range 1, Range 2 and Range 3 respectively.
ZERO BAND	1.0mgC/l	▪ ZERO BAND is the ±mgC/l concentration band for the TOC/TC readings obtained during the Zero Calibration or Zero Check reactions. System initially runs the minimum number of reactions and calculates the average value at a specific programmed range. If the variation between the average result and each of the reaction results used in the averaging is not higher than the programmed ZERO BAND, the system completes its zero cycle and generates the necessary Zero Adjust figures. However, if any of the reaction results used in averaging is outside the band, then the system runs an additional Zero Reaction, and evaluates the readings again using the new average value. This cycle is repeated until the system obtains stable zero readings, which must be within the ZERO BAND. If stable zero readings are obtained within a certain number of reactions, which is less than or equal to the maximum number of reactions defined in ZERO PROGRAM MAX above, the Zero Adjust values are generated without any system warning. ▪ If zero stability is obtained on the executed range, system does not seek for further stability on the subsequent ranges. ▪ If the system cannot reach stable zero readings, in other words, if one or more of the TOC/TC readings are outside the programmed ZERO BAND at the end of the maximum number of reactions, depending on the type of zero cycle, system creates a “42_ZERO CAL FAIL” or a “43_ZERO CHCK FAIL” warning and logs it into the fault archive. When a “42_ZERO CAL FAIL warning occurs, system does not generate any Zero Adjust figures and continues operation using the previous Zero Adjust values.

SERVICE ZERO	20 , 5	▪ SERVICE ZERO specifies the number of zero calibration cycles to be repeated after a defined number of reactions between each zero calibration cycle. The first setting “20” is the number of reactions between each zero calibration cycle, and the second setting “5” is the total number of zero calibration cycles which will be carried out. ▪ SERVICE ZERO cycle is activated by the SET SERVICE ZERO function in Service menu.
ZERO ADJUST HISTORY		▪ Anytime the Zero Adjust value is changed, either manually by the user or automatically by the system, the new Zero Adjust value is stored in the Zero Adjust History archive with the time, date, zero range and the zero type (calibration, check or manual) information. ▪ The meaning of the codes used in the system for zero adjust are as follows: TOC/TC-ZC: Zero calibration result for TOC/TC. TOC/TC-ZK: Zero check result for TOC/TC. TOC/TC-ZM: Manually input Zero Adjust for TOC/TC.

8.3.4.4 Span Program

SPAN PROGRAM	5	▪ SPAN PROGRAM defines the number of reactions to be carried out for Span Calibration and Span Check cycles, which are activated by RUN SPAN CALIBRATION/CHECK functions in Span Calibration menu. If the Span Calibration or Span Check is programmed as YES in New Regents Program menu, START NEW REAGENT CYCLE function in Install New Reagents menu will also run the relevant span cycle. ▪ The span calibration/check reactions are run at a single range programmed by the RANGE below. System calculates and uses the same Span Adjust values for other ranges as well.
SPAN AVERAGE	3	▪ SPAN AVERAGE is the number of span reactions the system averages to calculate the Span Adjust factor.
RANGE	1	▪ RANGE (1 by default) determines the range at which all Span Calibration and Span Check reactions are carried out.
TOC CAL STD	200.0mgC/l	▪ TOC CALIBRATION STANDARD defines the TOC standard solution concentration level (mgC/l) to be used in Span Calibration reactions. ▪ If TOC CALIBRATION STANDARD is programmed as 0.0mgC/l, system ignores the Span Calibration results and omits any related warnings defined in TOC BAND below.
TOC CHECK STD	100.0mgC/l	▪ TOC CHECK STANDARD defines the TOC standard solution concentration level (mgC/l) to be used in Span Check reactions. ▪ If TOC CHECK STANDARD is programmed as 0.0mgC/l, system ignores the Span Check results and omits any related warnings defined in TOC BAND below.
TIC CAL STD	50.0mgC/l	▪ TIC CALIBRATION STANDARD defines the TIC standard solution concentration level (mgC/l) to be used in Span Calibration reactions. ▪ If TIC CALIBRATION STANDARD is programmed as 0.0mgC/l, system ignores the Span Calibration results and omits any related warnings defined in TIC BAND below. ▪ In TC systems, TIC CALIBRATION STANDARD is not displayed.
TIC CHECK STD	25.0mgC/l	▪ TIC CHECK STANDARD defines the TIC standard solution concentration level (mgC/l) to be used in Span Check reactions. ▪ If TIC CHECK STANDARD is programmed as 0.0mgC/l, system ignores the Span Check results and omits any related warnings defined in TIC BAND below. ▪ In TC systems, TIC CHECK STANDARD is not displayed.

TC CAL STD	250.0mgC/l	▪ In VOC systems, the sum of the TIC and TOC Calibration Standard solution is displayed as TC Calibration Standard. When TOC Calibration Standard is programmed as 0.0mgC/l above, and when a concentration of TIC Calibration Standard is programmed above, BioTector displays the TC Calibration Standard as 0.0mgC/l on purpose. This allows the calibration of TIC without any effect on the TC calibration. In other words, as programmed, system ignores the TC span calibration results and omits any TC related warnings.
TC CHECK STD	125.0mgC/l	▪ In VOC systems, the sum of the TIC and TOC Check Standard solution is displayed as TC Check Standard. When TOC Check Standard is programmed as 0.0mgC/l above, and when a concentration of TIC Check Standard is programmed above, BioTector displays the TC Check Standard as 0.0mgC/l on purpose. This allows the check of TIC without any effect on the TC check. In other words, as programmed, system ignores the TC span check results and omits any TC related warnings.
TOC BAND	25%	▪ TOC BAND determines the tolerance limits (±25% by default) for the Span Calibration or Span Check reaction results for TOC. ▪ In TC and VOC systems, this function is named as TC BAND. ▪ If the average span result is outside the tolerance limits, a "30_TOC/TC SPAN CAL FAIL" or "33_TOC/TC SPAN CHCK FAIL" warning is logged depending on system analysis mode.
TIC BAND	25%	▪ TIC BAND determines the tolerance limits (±25% by default) for the Span Calibration or Span Check reaction results for TIC. ▪ If the average span result is outside the tolerance limits, a "31_TIC SPAN CAL FAIL" or "34_TIC SPAN CHCK FAIL" warning is logged.
TIC FACTOR = TOC	YES	▪ If the TIC FACTOR = TOC is selected as "YES" (by default), the TOC span factor is used for TIC. ▪ If the TIC FACTOR = TOC setting is "YES", when the TOC Span Adjust value is changed, the TIC Span Adjust value will also change automatically. ▪ In VOC systems, this function is named as TIC FACTOR = TC.
SPAN ADJUST HISTORY		▪ Anytime the Span Adjust value is changed, either manually by the user or automatically by the system, the new Span Adjust factor is stored in the Span Adjust History archive with the time, date, span RANGE, span type (calibration or check) and the standard solution used. ▪ The meaning of the codes used in the system for span adjust are as follows: TOC/TC/TIC-SC: Span calibration result for TOC/TC/TIC. TOC/TC/TIC-SK: Span check result for TOC/TC/TIC. TOC/TC/TIC-SM: Manually input span adjust for TOC/TC/TIC.

8.3.4.5 Reagents Purge

ACID PURGE BASE PURGE	23s , 4 23s , 4	▪ ACID/BASE PURGE defines the operation time (23 seconds by default) of the acid and base pumps to prime the reagents during the Install New Reagent cycle. The reagent priming and the subsequent reactor purge operation is repeated 4 times by default. ▪ The reagent purge is activated by START NEW REAGENT CYCLE function in Install New Reagents menu or alternatively by RUN REAGENTS PURGE function in Zero Calibration menu.
TIC ACID FILL	30p	▪ TIC ACID FILL defines the quantity of acid reagent injected to prime the acid lines between the TOC Acid Valve (MV6) and Sample Valve (MV4).
REACTOR ACID FILL REACTOR BASE FILL REACTOR WASH TIME	12p 18p 100s	▪ The REACTOR ACID/BASE FILL time defines the quantity of acid and base reagents injected into the reactor at the end of the ACID&BASE PURGE and TIC ACID FILL phases described above. ▪ When the acid and base reagents are injected into the reactor, the reagents are mixed in the reactor for the duration of REACTOR WASH time (100 seconds by default) to balance and neutralize the reactor pH.

8.3.4.6 Pressure/Flow Test Program

TIME	08:15	▪ BioTector performs an automatic pressure and flow test every day at the TIME programmed (at 08:15 hours by default).
PRESSURE TEST FAULT	6.0l/h	▪ Each time BioTector is started up and every day during online operation at the programmed TIME above, BioTector pressurizes the system with oxygen gas and uses its mass flow controller to detect any gas leak in the system. If the measured flow is less than or equal to the programmed PRESSURE TEST FAULT flow level (6.0 l/h by default), the pressure test passes. ▪ If the flow is greater than programmed PRESSURE TEST FAULT setting, the pressure test fails, and BioTector generates a “05_PRESSURE TEST FAIL” fault and stops. This fault is logged in the fault archive. ▪ The pressure test cycle can be disabled by setting PRESSURE TEST FAULT setting to 0.0 l/h. When disabled, BioTector automatically displays an “OFF” message on the screen and logs a “29_PRESSURE TEST OFF” warning in the fault archive. ▪ If the pressure test is skipped during the startup sequence with the “Quick Startup” function (see Section 2.2.1 Start Stop for details) a “28_NO PRESSURE TEST” warning is logged in the fault archive. This warning cannot be acknowledged by the user, it can only be acknowledged automatically by the system the next time the pressure test is passed.
PRESSURE TEST WARN	4.0l/h	▪ PRESSURE TEST WARNING, which is typically 30% less than the PRESSURE TEST FAULT setting (4.0 l/h by default), gives an advanced warning of a possible gas leak in BioTector. ▪ The pressure warning can be disabled by setting PRESSURE TEST WARNING to 0.0 l/h. When disabled, BioTector automatically displays an “OFF” message on the screen. ▪ If the flow measured during Pressure Test is less than or equal to 6.0 l/h but greater than 4.0 l/h, BioTector generates a “26_PRESSURE TEST WARN” and continues to run. The warning is logged in the fault archive.

PRESSURE CHCK FAULT	6.0l/h	▪ At the end of each reaction during operation, BioTector automatically pressurizes the system with oxygen gas and uses its mass flow controller to detect any gas leak in the system. If the measured flow is less than or equal to the programmed PRESSURE CHECK FAULT flow level (6.0 l/h by default) during the test, the pressure check passes. The PRESSURE CHECK FAULT acts a safety function, to ensure that there is no gas leak in the system and it is safe to start the next analysis reaction. ▪ The pressure check cycle cannot be disabled. ▪ If the flow measured during the pressure check is greater than the programmed PRESSURE CHECK FAULT level (greater than 6.0 l/h), the pressure check fails, and BioTector generates a "06_PRESSURE CHCK FAIL" fault and stops. This fault is logged in the fault archive.
FLOW WARNING	72.0l/h	▪ Each time BioTector is started up and everyday during online operation at the programmed TIME above, oxygen gas flows through the system and mass flow controller is used to detect any blockage in the system. If the measured flow is greater than or equal to the programmed FLOW WARNING level (72.0 l/h by default), the flow test passes. ▪ If the measured flow is less than the programmed FLOW WARNING setting, the flow test fails, and BioTector generates a "22_FLOW WARNING - EX" or "23_FLOW WARNING - SO" in the fault archive and continues to run. This warning is logged in the fault archive.
REACTOR PURGE CHECK	4s	▪ During the two Pressure Release phases of the Reactor Purge carried out at the end of each analysis cycle described in section 8.3.2 System Program, BioTector monitors the oxygen gas flow for 4 seconds (by default) with the REACTOR PURGE CHECK function. This is carried out to detect any irregularities in the gas flow, which may indicate a possible blockage or restriction in the reactor and/or in the sample out lines, including Sample Out Valve (MV5).
REACTOR PURGE BAND	3.0l/h	▪ If the monitored oxygen gas flow readings during the REACTOR PURGE CHECK are not stable and move outside the REACTOR PURGE BAND, which is programmed as ±3 l/h by default, during the first Pressure Release phase for three consecutive times, a "128_REACTOR PURGE WARN" warning is logged in the fault archive and BioTector keeps running. ▪ If the monitored oxygen gas flow readings are not stable and move outside the REACTOR PURGE BAND during the second Pressure Release phase and if a flow problem has already been detected during the first Pressure Release phase of the same Reactor Purge cycle, a "129_REACTOR PURGE FAIL" fault is logged in the fault archive and BioTector stops.

8.3.5 Output Devices

POWERED ALL TIME	NO	▪ POWERED ALL TIME parameter specifies if the relays are powered all the time even if the system is stopped or paused with the YES setting, or if the relay is powered only when required with the default NO setting.
VALVE ACTIVATION	SPF/SAMPLER	▪ VALVE ACTIVATION determines the two possible times for the multi-stream valve to change over for the next stream. If the default SPF (SAMPLE PUMP FORWARD) option is selected, the valve for the next stream is selected as the Sample Pump starts to run forward to bring the sample from the next stream. If SPR (SAMPLE PUMP REVERSE) option is selected, the valve for the next stream is selected when the Sample Pump reverse operation is completed for the current stream, or when the BioTector powers up. ▪ If SAMPLER is activated in Stream Program menu, SPF option is displayed as SPF/SAMPLER.
RELAY 17-20		▪ OUTPUT 17-20 menus contain system standard and optional output relay settings. Relay terminals 17-20 are located on the Relay PCB. ▪ RELAY 17 is a programmable system relay (24V DC OUTPUT with a maximum output current of 750mA). The default setting of Relay 17 is MANUAL 1 if this option is installed into the BioTector. ▪ RELAY 18 and 19 are freely programmable system relays (VOLT FREE CHANGEOVER CONTACT with a current rating of 1Amp at 30V DC), which are supplied with every BioTector as standard. These relays are typically not programmed to any output function by default. See below example for the output settings of RELAY 18. ▪ RELAY 20 is a programmable system relay (volt free changeover contact with a current rating of 1Amp at 30V DC), which is supplied with every BioTector as standard. The default setting of Relay 20 is STOP and FAULT. See also below example for the output settings of RELAY 20. ▪ RELAY 17-20 can be programmed to a single output function or to multiple output functions if the relevant output option has been installed in the BioTector. The programmed output function or functions are marked with an asterisk "*" sign in these menus as in the example for RELAY 18, which is programmed for MAINTANENCE SIGNAL and CALIBRATION SIGNAL below. ▪ When multiple functions are programmed for an output relay, the relay output is activated when one or multiple conditions are initiated. In the example below, RELAY 18 is activated when MAINTANENCE SIGNAL or CALIBRATION SIGNAL is triggered. RELAY 20 is activated when BioTector is stopped or when there is a fault in the BioTector. ▪ In BioTector configuration data download (or in All Data download), the programmed output functions for each output is tabulated and marked with asterisk "*" signs for clarity.

RELAY 18		
DEFAULT STATE	N/D	DEFAULT STATE defines the idle state of the relay. N/D stands for “Normally De-energized” relay by default and N/E stands for “Normally Energized” relay.
STOP		Output set to operate when the BioTector is stopped condition. Note that remote stand-by is not considered as a stop condition.
FAULT		Output set to operate on fault condition.
WARNING		Output set to operate on warning condition.
NOTE		Output activated when a notification is logged in the fault archive.
SAMPLER FILL		Fill signal, sent to the sampler, which remains on from start of sampler fill time to the completion of the sample injection.
SAMPLER EMPTY		Empty signal, sent to the sampler, which is a pulse of 5 seconds duration and is triggered after the Sample Pump reverse operation is complete.
SAMPLER ERROR		Output when SAMPLER ERROR input signal is activated due to a sample error in the BioTector Sampler.
SYNC		Synchronization relay, use to synchronize the system with external control units.
REMOTE STANDBY		Output when Remote Standby input is activated.
MAN MODE TRIG		Indicates that manual reactions are activated and going to be executed regardless of the activation is carried out manually on the keyboard or remotely from a system input.
MAINT SIGNAL	*	Output when MAINTENANCE SWITCH input is activated.
TEMP. SWITCH		Temperature Switch output activated when the temperature of the system increases above the predefined system temperature control level (System Fan Control), which is programmed as 20°C by default.
CAL		Calibration Valve used during calibration reactions.
CAL SIGNAL	*	Output set to operate on Zero/Span Check and Zero/Span Calibration reactions.
STREAM 1-6		Output set for Stream Valves 1-6.
MANUAL 1-6		Output set for Manual Valves 1-6.
SAMPLE STATUS 1-6		Digital output activated (energized) when BioTector Sample Sensor detects no sample or when the sample quality is less than the default 75% threshold value for a specific stream (i.e. when there is significant quantity of air bubbles in the stream/manual grab sample lines).
ALARM 1-6		Alarm relay, activated upon programmed alarm conditions for a specific stream.
CO2 ALARM 1-6		CO2 Alarm relay, activated upon programmed CO2 alarm conditions for a specific stream.
4-20mA CHNG		4-20mA output change flag relay, which is always activated for a period of 10s, when a new result causes update of any of the 4-20mA output channels.
4-20mA CHNG 1-6		4-20mA output change flag relay, which is always activated for a period of 10s, when a new result causes update of a given 4-20mA output channel for a specific stream.
4-20mA READ		This signal is used to indicate valid/stable values on 4-20mA output channels in 4-20mA Stream & Full Multiplex operation modes.
SAMPLE FAULT 1-6		Output when the external stream specific SAMPLE FAULT 1-6 input signal is activated.

RELAY 20	
DEFAULT STATE	N/E
STOP	*
FAULT	*
WARNING	
NOTE	
SAMPLER FILL	
……	..
……	..
……..	..

OUTPUT 1-8

- OUTPUT1-8 menus contain system optional output relay settings. Relay terminals 1-8 are located on the stream expansion board (auxiliary board), which is an optional feature of the system.
- OUTPUT1-8 relays can be programmed to a single output function or to multiple output functions as described for RELAY 17-20 above. STREAM 1 is always functional as default within the system software.
- The programmed output function or functions are marked with an asterisk "*" sign in these menus as in the example for OUTPUT 2, which is programmed for STREAM 2 below if this option is installed into the BioTector.
- When multiple functions are programmed for an output relay, the relay output is activated when one or multiple conditions are initiated.
- Stream and manual grab sample selection outputs are assigned to one output function only. In the example below, OUTPUT 2 is activated to select stream channel 2 function only. Any output menu, assigned for a specific stream or for a grab sample channel output function, should not be programmed for multiple output functions.
- In BioTector configuration data download (or in All Data download), the programmed output functions for each output is tabulated and marked with asterisk "*" signs for clarity as illustrated below.

OUTPUT 2

DEFAULT STATE	N/E
.....	..
CAL SIGNAL	
STREAM 1	
STREAM 2	*
STREAM 3	
.....	..

SYSTEM OUTPUTS

	RELAY			SYSTEM OUTPUTS							
OUTPUT	17	18	19	20	1	2	3	4	5	6	7	8
DEFAULT STATE	N/D	N/D	N/D	N/E	N/D	N/D	N/D	N/D	N/D	N/D	N/D	N/D
STOP	-	-	-	*	-	-	-	-	-	-	-	-
FAULT	-	-	-	*	-	-	-	-	-	-	-	-
WARNING	-	-	-	*	-	-	-	-	-	-	-	-
NOTE	-	-	-	-	-	-	-	-	-	-	-	-
SAMPLER FILL	-	-	-	-	-	-	-	*	-	-	-	-
SAMPLER EMPTY	-	-	-	-	-	-	-	-	-	-	-	-
SAMPLER ERROR	-	-	-	-	-	-	-	-	-	-	-	-
SYNC	-	-	-	-	-	-	-	-	-	-	-	-
REMOTE STANDBY	-	-	-	-	-	-	-	-	-	-	-	-
MAN MODE TRIG	-	-	-	-	-	-	-	-	-	-	-	-
MAINT SIGNAL	-	-	-	-	-	-	-	-	-	-	-	-
TEMP. SWITCH	-	-	-	-	-	-	-	-	-	-	-	-
CAL	*	-	-	-	-	-	-	-	-	-	-	-
CAL SIGNAL	-	-	-	-	-	-	-	-	-	-	-	-
STREAM 1	-	-	-	-	-	-	-	-	-	-	-	-
STREAM 2	-	-	-	-	-	-	-	-	-	-	-	-
STREAM 3	-	-	-	-	-	-	-	-	-	-	-	-
STREAM 4	-	-	-	-	-	-	-	-	-	-	-	-
STREAM 5	-	-	-	-	-	-	-	-	-	-	-	-
STREAM 6	-	-	-	-	-	-	-	-	-	-	-	-

8.3.6 Reaction Check

CO2 LEVEL	100ppm, AUTO	▪ Due to the organic and inorganic contamination in the BioTector reagents, every TOC/TC reaction will generate a small level of CO_2 from the reagents alone even if there is no sample present. The first setting (100ppm by default) of CO2 LEVEL specifies the reaction check CO_2 level, which is the minimum expected CO_2 reading in ppm measured by the CO_2 Analyzer in a reaction. ▪ The second setting (AUTO by default) of CO2 LEVEL defines the reaction check CO_2 level mode. When programmed as AUTO, BioTector automatically sets the CO2 LEVEL to 60% of the average CO_2 peak reading recorded during the Zero Calibration or Zero Check reactions. If it is set as MAN (Manual), system uses the fixed programmed CO2 LEVEL value. ▪ BioTector looks for first an increase and then a decrease in the CO_2 peak data during the TOC phase (or TC phase depending on ANALYSIS TYPE). If the CO_2 peak occur at the wrong phase of the reaction and/or if the CO_2 peak is smaller than the expected CO2 LEVEL (100ppm by default) for the number of consecutive reactions defined by REACTION COUNT below (3 reactions by default), system generates a "04_NO REACTION" warning or a "04_NO REACTION" fault (depending on the FAULT TYPE setting below) and logs into the fault archive. ▪ When CO2 LEVEL is programmed as 0ppm, the reaction check function will be disabled. Reaction check function is omitted during the zero calibration or zero check reactions.
FAULT TYPE	WARNING	▪ FAULT TYPE determines the type (WARNING or FAULT) of the "04_NO REACTION" fault. ▪ When "04_NO REACTION" fault occurs, if FAULT TYPE is programmed as WARNING (by default), BioTector keeps running. If it is programmed as FAULT, BioTector stops.
REACTION COUNT	3	▪ REACTION COUNT defines the number of consecutive reactions (3 by default) before a "04_NO REACTION" fault is triggered.
TIC CHECK	25ppmCO2	▪ TIC CHECK (25ppm CO_2 by default) represents the CO_2 check point in the TIC phase. If the CO_2 level is above the programmed check point at the end of the TIC phase, then the system automatically extends the TIC SPARGE TIME by 1 second and checks the CO_2 level again. If the TIC level does not drop below the check point at the end of the maximum 300 seconds, a "50_TIC OVERFLOW" warning is generated.
TOC CHECK	100ppmCO2	▪ TOC CHECK (100ppm CO_2 by default) represents the CO_2 check point in the TOC phase. If the CO_2 level is above the programmed check point at the end of the TOC Oxidation section of the TOC phase, then the system automatically extends the TOC SPARGE TIME and TOC OXIDATION time by 1 second and checks the CO_2 level again. If the TOC level does not drop below the check point at the end of the maximum 300 seconds, a "51_TOC OVERFLOW" warning is generated.
TC CHECK	100ppmCO2	▪ In TC and VOC systems, TC CHECK (100ppm CO_2 by default) represents the CO_2 check point in the TC phase. If the CO_2 level is above the programmed check point at the end of the TC Oxidation section of the TC phase, then the system automatically extends the TC SPARGE TIME and TC OXIDATION time by 1 second and checks the CO_2 level again. If the TC level does not drop below the check point at the end of the maximum 300 seconds, a "91_TC OVERFLOW" warning is generated.

8.3.7 Result Integration

RESULT INTEGRATION	3	▪ RESULT INTEGRATION (3 by default) defines the number of reaction results to be averaged to get the actual TOC result.
INTEGRATION LIMITS	10% , 5.00	▪ INTEGRATION LIMITS controls the averaging function defined in RESULT INTEGRATION above. The first parameter "10%" defines the % band variation and the second parameter "5.00" defines the absolute variation in mgC/l. If the reaction result is outside the specified bands (INTEGRATION LIMITS), then the reaction result averaging is omitted. In other words, the result which is outside the INTEGRATION LIMITS is displayed at the end of the reaction without averaging. If the result is within the INTEGRATION LIMITS, the averaging function is continued and the programmed number of reaction results (defined in RESULT INTEGRATION above) is averaged.

8.3.8 Fault Setup

LOW O2 FLOW TIME	12s	▪ If the O_2 flow drops more than 50% of the MFC set value for longer than the LOW O2 FLOW TIME (12s by default), a "01_LOW O2 FLOW - EX" or "02_LOW O2 FLOW - SO" fault is logged.
HIGH O2 FLOW TIME	20s	▪ If the O_2 flow increases more than 50% of the MFC set value during any reaction phase for longer than the HIGH O2 FLOW TIME (20s by default), a "03_HIGH O2 FLOW" fault is logged.
BASE CO2 ALARM	1000ppm	▪ During the zero calibration & zero check reactions, system monitors the CO_2 peak level with the CO_2 Analyzer. If the monitored value is higher than the programmed BASE CO2 ALARM level (1000ppm by default), a "52_HIGH CO2 IN BASE" warning is logged into the fault archive.
CO2 ZERO LINE	0ppm , AUTO	▪ When it is set as AUTO (Automatic by default), the CO2 ZERO LINE value is updated automatically by the system during Analyzer Zero phase. If it is set as M (Manual), the set value (ppm) is used as the fixed CO_2 zero line. ▪ For instance, if there is a CO_2 leak into the CO_2 analyzer's source or detector sections, a typical of 400ppm CO_2 level in the environment will increase the CO2 ZERO LINE level to ≈250ppm within 24 days of online operation or approximately after 5000 reactions.
CO2 ZERO ALARM	250ppm	▪ If the concentration of CO_2 measured during the Analyzer Zero phase for the oxygen gas input is higher than CO2 ZERO LINE plus CO2 ZERO ALARM (250ppm by default) value for 3 consecutive reactions, a "12_HIGH CO2 IN O2" fault is logged in the fault archive and the system stops. ▪ The purpose of this function is to monitor the operation of the oxygen concentrator. If the oxygen concentrator fails, then the oxygen purity will be reduced and CO_2 at atmospheric levels (≈400ppm) will enter the BioTector, and will be detected by the CO_2 analyzer. It is important not to run the BioTector with a faulty oxygen concentrator as eventually water could enter the BioTector with the contaminated oxygen gas which may cause damage on the Mass Flow Controller.

SERVICE COUNTER	180 DAYS	▪ SERVICE COUNTER (180 days by default) specifies the number of days the system operates before triggering an "83_SERVICE TIME" warning. ▪ Note that the service counter keeps operating and decreases the count by a day if system is powered up during the same day even though system was not running. Because the default factory setting is a typical value for normal site conditions, the service interval may need to be adjusted according to specific site conditions.
OZONE TEST TIME	18s	▪ OZONE TEST TIME defines the programmed time which passes the Ozone Test in Process Test, Ozone Test menu. The maximum time the ozone generator remains on during the Ozone Test is 60 seconds.
SAMPLE STATUS	5s , 75%	▪ The first parameter in SAMPLE STATUS setting is the sample detection time (5 seconds by default) BioTector processes the output of the Sample Sensor. When the parameter is set to 0s (zero seconds), the sample detection is switched off. The second parameter (75% by default) is the % sample quality threshold, which is used to activate SAMPLE STATUS output. ▪ Sample Status output is activated (energized) when BioTector Sample Sensor detects no sample or when the sample quality is less than the default 75% threshold value (i.e. when there is significant quantity of air bubbles in the stream/manual grab sample lines). ▪ Sample Status output is set/reset as soon as the Sample Sensor signal is processed. Sample Status holds its state between reactions and when system is stopped or put into standby mode.
ARCHIVE	NO	▪ In systems built with Sample Sensor, if SAMPLE STATUS ARCHIVE function is programmed as "YES", the "116/117/118/119/120/121 LOW/NO SAMPLE 1/2/3/4/5/6" notification events are generated and logged into the Fault Archive when there is no or low sample liquid in the corresponding streams from stream 1 to stream 6.
AUTO RESET	NO	▪ If SAMPLE STATUS AUTO RESET function is programmed as "YES", the corresponding "116/117/118/119/120/121 LOW/NO SAMPLE 1/2/3/4/5/6" notification events are automatically acknowledged in the Fault Archive depending on the sample status of the relevant streams from stream 1 to stream 6. ▪ In multi-stream systems, the Sample Status relay output signal is a common signal, which is activated/deactivated when the sample quality is determined by the BioTector Sample Sensor for any of the streams during analysis.
SAMPLE FAULT 1 SAMPLE FAULT 2 SAMPLE FAULT 3 …… SAMPLE FAULT 6	1000s 1000s 1000s … 1000s	▪ SAMPLE FAULT 1-6 defines the stream specific programmable output time delay (1000 seconds by default), which delays the activation of the SAMPLE FAULT 1-6 output signals and logging of the "122/123/124/125/126/127 SAMPLE FAULT 1/2/3/4/5/6" notification events into the fault archive. The purpose of the time delay is to prevent unnecessary generation of the sample fault signals if the sample fault only occurs for a very short time.
AUTO RESET	NO	▪ SAMPLE FAULT AUTORESET determines whether the "122/123/124/125/126/127 SAMPLE FAULT 1/2/3/4/5/6" notification events are automatically acknowledged by the system (with the "YES" setting) or to be acknowledged manually from the BioTector keyboard (with the "NO" setting by default).
TEMPERATURE ALARM	45.0C	▪ TEMPERATURE ALARM represents the BioTector ambient temperature alarm level (45°C by default). ▪ If BioTector temperature is higher that the set level for more than 120 seconds, a "53_TEMPERATURE ALARM" warning is logged into the fault archive.

BACKUP BATTERY LOW	WARNING	▪ BACKUP BATTERY LOW function allows the programming of the event type for the 133_BACKUP BAT. LOW note/warning/fault. The default event type setting is warning. ▪ When the system detects that the voltage of the cell/coin backup battery, located on the mainboard, is low, a 133_BACKUP BAT. LOW warning is generated and logged into the fault archive.

8.3.9 Fault Status

This menu gives a short status history of several system devices before a fault is registered. The default 0.0 values indicate that there are no faults detected for the specific device.

O2 FLOW	▪ The O2 FLOW menu consists of 120 entries for the MFC setpoint value (first column) and MFC flow value (second column). The entries are sampled at every 1 second intervals. If a fault is detected, the events are stored in the O2 FLOW fault archive and are retained even if the fault is acknowledged in Fault Archive menu. The archive is only over-written if a new fault is detected.
RELAY PCB FAULT	▪ The RELAY PCB FAULT menu consists of 120 readings of the input to terminal S41 FLT on the Signal PCB. If a fault is detected, the number logged is "1". The events stored in the RELAY PCB FAULT archive and are retained even if the fault is accepted in Fault Archive menu. The archive is only over-written if a new fault is detected. By careful analysis of the fault data, it is possible to determine between an abrupt fault, and an intermittent fault.
OZONE PCB FAULT	▪ The OZONE PCB FAULT menu consists of 120 readings of the input to terminal S42 FLT O3 on the Signal PCB. If a fault is detected, the number logged is "1". The events are stored in the Ozone PCB FAULT archive and are retained even if the fault is accepted in Fault Archive menu. The archive is only over-written if a new fault is detected. By careful analysis of the fault data, it is possible to determine between an abrupt fault, and an intermittent fault.
CO2 ANALYZER FAULT	▪ The CO2 ANALYZER FAULT menu consists of 120 readings of the input to terminal S11, which is the 4-20mA signal from the CO_2 Analyzer on the Signal PCB. The entries are sampled at every 2 second intervals, covering 240 seconds. If a fault is detected, the events are stored in the CO2 ANALYZER FAULT archive and are retained even if the fault is accepted in Fault Archive menu. The archive is only over-written if a new fault is detected.
BIOTECTOR TEMPERATURE	▪ The BIOTECTOR TEMPERATURE menu consists of 120 readings of the BioTector temperature. The entries are sampled at every 2 seconds intervals, covering 240 seconds. If a fault is detected, the events are stored in the BIOTECTOR TEMPERATURE fault archive and are retained even if the fault is accepted in Fault Archive menu. The archive is only over-written if a new fault is detected.
COOLER TEMPERATURE	▪ The COOLER TEMPERATURE menu consists of 120 readings of the cooler temperature. The entries are sampled at every 10 seconds intervals, covering 20 minutes. If a fault is detected, the events are stored in the COOLER TEMPERATURE fault archive and are retained even if the fault is accepted in the Fault Archive menu. The archive is only over-written if a new fault is detected.

8.3.10 CO2 Analyzer

ANALYSIS GRAPH SCALE	10000ppm	▪ ANALYSIS GRAPH SCALE determines the scale of the y-axis "CO_2 analyzer's ppm-CO_2 readings" on the Analysis Graph Screen (see Section 2.1.4 Analysis Graph Screen for details). This function allows the system to display CO_2 data peaks in optimal resolution on the LCD screen. ▪ The ANALYSIS GRAPH SCALE is independent of the CO2 ANALYZER RANGE described below. Note that, in certain circumstances, when the displayed CO_2 peaks on screen exceeds the scale of the graph, the CO_2 analyzer keeps measuring and integrating the CO_2 readings to obtain the TOC result, without losing any CO_2 data.
INTERFACE	RS232	▪ INTERFACE (RS232 by default) defines whether the communication between the CO_2 Analyzer and the BioTector is by analog (4-20mA) or digital (RS232) signals.
BAUDRATE	9600	▪ BAUDRATE (9600bps by default) specifies the data communication signaling speed of CO_2 Analyzer when the INTERFACE is programmed as RS232 above.
CO2 ANALYZER RANGE	15000ppm	▪ CO2 ANALYZER RANGE (15000ppm by default) defines the full scale range of the CO_2 analyzer installed inside the BioTector. ▪ When RS232 INTERFACE is used, CO2 ANALYZER RANGE only displays the range of the specific CO_2 analyzer installed into the BioTector. ▪ When 4-20mA INTERFACE is used, CO2 ANALYZER RANGE defines the full scale of the 4-20mA analog input signal coming from the CO_2 analyzer.
CO2 ANALYZER CAL		▪ The CO2 ANALYZER CALIBRATION menu allows the user to change the CO_2 analyzer range and the CO_2 analyzer zero and span parameters when necessary. ▪ If the INTERFACE is RS232, the calibration range of the CO_2 analyzer can be changed using the CO2 ANALYZER CALIBRATION menu directly. ▪ If the INTERFACE is 4-20mA, and if it is absolutely necessary to change the CO_2 analyzer range, please contact manufacturer or distributor for details of the CO_2 analyzer calibration procedures.

8.3.11 Cooler Program

COOLER 16.0C DIFF		▪ COOLER 16.0C DIFF, defines the programmed cooler temperature setpoint (16°C by default) and the operation mode DIFF (DIFFERENTIAL temperature mode by default). Other available operation modes are F (FIXED temperature mode) and B (BACKUP mode). ▪ In DIFFERENTIAL temperature mode, the cooler's setpoint is the ambient temperature, which is BioTector temperature, minus the programmed setpoint. For instance, if BioTector temperature is 20°C, the cooler setpoint temperature with above default settings would be 4°C. ▪ In FIXED temperature mode, the cooler's setpoint can be programmed at a fixed temperature, e.g. 5°C. ▪ The BACKUP mode, which can also be programmed manually, is automatically activated by the BioTector when a cooler fault occurs. A "54_COOLER LOW TEMP" warning is logged in the Fault Archive if the cooler temperature has been below 2°C for more than 600 seconds. If the cooler temperature has been 5°C greater than the cooler setpoint temperature and <8°C below the ambient temperature for more than 600 seconds a "55_COOLER HIGH TEMP" warning is logged. ▪ Note that the BACKUP mode is automatically cancelled when the fault is acknowledged in Fault Archive menu.
BACKUP PWM	30%	▪ BACKUP PULSE WIDTH MODULATION (30% by default) specifies the cooler control routine, which uses a PWM period of 800 milliseconds to achieve the programmed cooler temperature for all cooler operation modes. For instance, with the default 30% setting, the cooler is switched on for 240 milliseconds, and switched off for 560 milliseconds. ▪ When a cooler fault occurs, the cooler operates in BACKUP mode, where the cooler is controlled by the fixed PWM operation. In the BACKUP mode operation, the COOLER settings above and the temperature sensor information is ignored.

8.3.12 Ozone Destructor Program

PURGE CYCLE MODE	AUTO	▪ PURGE CYCLE MODE, which is automatically controlled (AUTO by default), specifies how the purging of the Ozone Destructor is carried out. In AUTO (Automatic) mode, the Ozone Destructor heater and the BioTector Cooler are controlled by the PURGE CYCLE FLOW and AUTO PURGE CYCLE parameters defined below. ▪ When PURGE CYCLE MODE is OFF, the Ozone Destructor heater and the BioTector Cooler operate normally. ▪ When PURGE CYCLE MODE is programmed as MAN (Manual), the Ozone Destructor heater and the Cooler operates as described in MAN PURGE CYCLE below.
PURGE CYCLE FLOW	77 l/h	▪ When the PURGE CYCLE MODE above is programmed as AUTO, and if the flow measured during the Flow Test (see Section 8.3.4.6 Pressure/Flow Test Program for details) is below the default PURGE CYCLE FLOW setting of 77 l/h, the Ozone Destructor heater and the BioTector Cooler operates as described in AUTO PURGE CYCLE below. ▪ This menu item is only displayed, when the PURGE CYCLE MODE operation mode is selected as AUTO above.
AUTO PURGE CYCLE	15 , 15	▪ When the PURGE CYCLE MODE above is programmed as AUTO above, in AUTOMATIC PURGE CYCLE setting, the first parameter (15 by default) defines the number of analysis cycles the Ozone Destructor heater is switched off. The second parameter (15 by default) defines the number of analysis cycles both the Ozone Destructor heater and the BioTector Cooler are switched off. ▪ The AUTO PURGE CYCLE operation routine is carried out only once after the Flow Test routine. ▪ This menu item is only displayed, when the PURGE CYCLE MODE operation mode is selected as AUTO above.
MAN PURGE CYCLE	2000, 15, 15	▪ When the PURGE CYCLE MODE above is programmed as MAN above, in MANUAL PURGE CYCLE setting, the first parameter (2000 by default) defines the number of analysis cycles the Ozone Destructor and the BioTector Cooler operates as normal. The second parameter (15 by default) defines the number of analysis cycles the Ozone Destructor heater is switched off. The third parameter (15 by default) defines the number of analysis cycles both the Ozone Destructor heater and the Cooler are switched off. ▪ When MANUAL PURGE CYCLE is selected, above operation routine is repeated with the relevant number of programmed analysis cycles. ▪ This menu item is only displayed, when the PURGE CYCLE MODE operation mode is selected as MAN above.

8.3.13 Software Update

LOAD FACTORY CONFIG.	▪ Each BioTector system contains a configuration which is installed and protected by system flash memory. When any modification is carried out in system configuration, LOAD FACTORY CONFIGURATION function allows the user to revert back to the original system settings programmed in the factory. ▪ Before any change is carried out in the system configuration, it is recommended to use the SAVE FACTORY CONFIGURATION function below.
SAVE FACTORY CONFIG.	▪ When SAVE FACTORY CONFIGURATION function is activated, the system saves the most up to date configuration into system flash memory. When this function is used successfully, it allows the user to make necessary modifications in system configuration and then revert back to the original settings with the use of LOAD FACTORY CONFIGURATION function above.
LOAD CONFIG. FROM MMC/SD CARD	▪ Each system contains an external flash memory card (MMC/SD card), which contains the factory configuration, with the name “syscnfg.bin” in binary format. When any modification is carried out in system configuration, LOAD CONFIG. FROM MMC/SD CARD function can be used and the user can revert back to the original system settings programmed in factory or on site. ▪ This function is very useful during system software update (see UPDATE SYSTEM FIRMWARE below), as the new system configuration can be installed automatically with this function once the new configuration is available inside the MMC/SD card (in binary format and with the correct name).
SAVE CONFIG. TO MMC/SD CARD	▪ When SAVE CONFIG. TO MMC/SD CARD function is activated, the system saves the most up to date configuration into the MMC/SD card. When this function is used successfully, it allows the user to make necessary modifications in system configuration and then revert back to the original settings with the use of LOAD CONFIG. FROM MMC/SD CARD function above.
UPDATE SYSTEM SOFTWARE	▪ UPDATE SYSTEM SOFTWARE function can be used to update system software on site. If a software update is required, please contact manufacturer or distributor for details of the system software update procedures.

8.3.14 Password

OPERATION	0000
CALIBRATION	0000
DIAGNOSTICS	0000
COMMISSIONING	0000
SYSTEM CONFIGURATION	0000

- Password menu allows any number from 1 to 9999 to be set as passwords for the Operation, Calibration, Diagnostics, Commissioning and System Configuration menus (levels). When the setting is 0000 (by default), the password is disabled.
- The higher level passwords can be used to access password protected lower levels. For instance the DIAGNOSTICS password can be used for access the OPERATION level. The SYSTEM CONFIGURATION password can be used to access the password protected OPERATION, CALIBRATION, DIAGNOSTICS and COMMISSIONING levels.

8.3.15 Language

ENGLISH
DEUTSCH
FRANCAIS

- LANGUAGE menu allows the user to change the language of the system if it is available in the software.

8.3.16 Hardware Configuration

- Hardware Configuration menus are for factory use only.

Section 9 Troubleshooting of System Fault, Warning and Notification Events

9.1 BioTector Fault Event Explanation and Remedial Action

The following fault conditions activate the BioTector stop sequence, set all 4-20mA signals to the FAULT LEVEL (1mA by default) programmed in the 4-20mA Program menu, and activate the FAULT relay. When the system fault is rectified, acknowledge the fault by pressing the ENTER key in the Fault Archive menu. Faults must be acknowledged in the Fault Archive menu to be able to restart the BioTector. If there are multiple faults in the system, check the fuses on the Relay PCB and the Signal PCB.

Detailed information on system operation, commissioning & startup, service and Process Tests are available in the MMC/SD card shipped with the BioTector. It is recommended to review these documents for troubleshooting purposes.

FAULT	CONDITION	CAUSE/REMEDY
01_LOW O2 FLOW - EX	MFC oxygen flow through the Exhaust "EX" Valve (MV1) has been below 50% of its setpoint for the time longer than the "LOW O2 FLOW TIME" defined in Fault Setup menu.	Various, for example, oxygen supply problem, oxygen pressure should be ~400mbar. See Section 8.1.6 Oxygen Controller Status for details. Blocked ozone destructor. Blocked tube after MFC. Faulty/blocked Exhaust Valve. Faulty MFC. Run Flow Test (see Section 8.1.1.2 Flow Test for details).
02_LOW O2 FLOW - SO	MFC oxygen flow through the Sample Out "SO" Valve (MV5) has been below 50% of its setpoint for the time longer than the "LOW O2 FLOW TIME" defined in Fault Setup menu.	Various, for example, oxygen supply problem, oxygen pressure should be ~400mbar. See Section 8.1.6 Oxygen Controller Status for details. Faulty/blocked Sample Out Valve. Blocked tube after MFC. Faulty MFC. Run Flow Test (see Section 8.1.1.2 Flow Test for details).
03_HIGH O2 FLOW	MFC oxygen flow through the Exhaust Valve (MV5) has been above 50% of its setpoint for the time longer than the "HIGH O2 FLOW TIME" defined in the Fault Setup menu.	Faulty MFC. Check oxygen pressure, it should be ~400mbar. See Section 8.1.6 Oxygen Controller Status for details.
04_NO REACTION *(can also be programmed as a warning condition)*	No TOC (or TC) CO_2 peak detected or the CO_2 peak is below the "CO2 LEVEL" for 3 consecutive reactions. See Section 8.3.6 Reaction Check for details.	Acid/Base containers are empty. Acid/Base tube rail installed incorrectly. Acid/Base Pumps are faulty. Delivery problem or air bubbles in Acid/Base lines. Mixer Reactor is not mixing. Acid/Base reagents are at incorrect strength. Run pH Test (see Section 8.1.1.5 pH Test for details).

05_PRESSURE TEST FAIL	MFC flow did not drop below the “PRESSURE TEST FAULT” level during the pressure test cycle. See Section 8.3.4.6 Pressure/Flow Test Program for details.	Gas/liquid leak in the BioTector. Valve leaking or not sealing. Open Sample Out Valve, inspect for dirt/damage. Check Sample ARS Valve and system fittings. Check Mixer Reactor. Run Pressure Test (see Section 8.1.1.1 Pressure Test for details).
06_PRESSURE CHCK FAIL	MFC flow did not drop below the “PRESSURE CHCK FAULT” level during the pressure check cycle for 3 consecutive reactions. See Section 8.3.4.6 Pressure/Flow Test Program for details.	Gas/liquid leak in the BioTector. Valve leaking or not sealing. Open Sample Out Valve, inspect for dirt/damage. Check Sample ARS Valve and system fittings. Check Mixer Reactor. Run Pressure Test (see Section 8.1.1.1 Pressure Test for details).
08_RELAY PCB FAULT	Fuse blown in the 81204001 Relay PCB. Fuse F3 blown in the 81204010 Signal PCB. 24V PSU faulty.	Check the incoming 24V DC power. Check the fuses on the Relay PCB. Check the fuse F3 on the Signal PCB. LED 6 on the Signal PCB should be off when the fault has been corrected.
09_OZONE PCB FAULT	Faulty Ozone PCB.	Inform the distributor or the manufacturer. Replace the Ozone PCB.

11_CO2 ANALYZER FAULT	Fault in CO_2 Analyzer. Very dirty optics in CO_2 Analyzer.	Check CO_2 analyzer's ppm CO_2 response in Simulate menu. Open CO_2 analyzer and clean the optics. Power down and power up the BioTector. If problem persists, check outgoing 24V DC power to CO_2 analyzer on Motherboard at wires 101 and 102. *For further tests, see information sheet "T019. BioTector CO_2 Analyzer Troubleshooting" supplied in the MMC/SD card, shipped with the BioTector.*
12_HIGH CO2 IN O2	High level of CO_2 has been detected in the input oxygen gas. Go to Simulate menu and read the CO_2 analyzer's CO_2 ppm value. If this value is greater than 250-300ppm, check the oxygen purity.	Check the quality of oxygen following the Oxygen Purity Test procedures in Section 7 Analyzer Commissioning and Startup. If the oxygen purity test is satisfactory, open CO_2 analyzer and clean the optics. If problem persists, replace the CO_2 Analyzer filters. If the oxygen purity test is unsatisfactory, replace the oxygen concentrator/bottle.
13_SMPL VALVE SEN SEQ	Sample Valve sensors have been registered in a wrong sequence other than the Sensor 1, 2, 3 and 4 sequence. Check if faults 14/15/16/130_Sample Valve Sen1/2/3/4 below are also registered.	Confirm that the switches "1" and "2" are both at the "ON" (4 Sensors) position on the Sample Valve Sensor PCB. Check fuse F6 on the Relay PCB. Check that the SAMPLE VALVE is rotating using the Simulate menu. Check Sample Valve sensor wiring.
14_SAMPLE VALVE SEN1 15_SAMPLE VALVE SEN2 16_SAMPLE VALVE SEN3 130_SAMPLE VALVE SEN4	Sample Valve Sensor 1, 2, 3 or 4 did not register the position of the valve.	Check fuse F6 on the Relay PCB. Faulty Sample Valve sensors or orientation problem. Check the wiring on the valve PCB and on the Signal PCB. Check sensor signals looking at LEDs 12, 13 & 14 on Signal PCB and DI01, DI02 & DI03 in Digital Input menu for sensors 1 , 2 and 3 respectively. Check sensor signals looking at LEDs 12 and 13 on Signal PCB, and DI01 and DI02 in Digital Input menu, both of which are activated for sensor 4. Replace the valve assembly.

17_SMPL VALVE NOT SYNC	Correct sensor position for Sensor 1 (SEN1) has not been detected in Sample Valve when Sample Pump is running.	Change Relay 4 on the Relay PCB. Check sensor signal looking at LED 12 on Signal PCB and DI01 in Digital Input menu. Check Sample Valve SEN1 position and SEN1 signal using the Simulate menu. *For further tests, see information sheets "T018. BioTector Sample Valve Not Synchronized Fault Troubleshooting" and "TT002. BioTector Sample Valve Not Sync Fault_Quick Troubleshooting" supplied in the MMC/SD card, shipped with the BioTector.* Replace the valve assembly.
18_LIQUID LEAK DET	BioTector's liquid leak detector is activated by the two liquid leak detector points fitted in the BioTector, one of which is in the analysis enclosure and the other is in the Mixer Reactor. See figure 1 in Section 4.1.1 Analysis Enclosure for details.	Check for a liquid leak in the BioTector analysis enclosure. Check for a liquid leak in the Mixer Reactor by unplugging the leak detector connector on the bottom of the reactor. Rectify the leak.
20_NO REAGENTS *(can also be programmed as a warning or notification condition)*	BioTector has calculated that the reagent containers should be empty.	Change reagents, and reset reagent monitor in Install New Reagents menu. Confirm that the reagent volume/container size input values are correct in the Reagents Monitor menu. If necessary, to readjust the number of days reagents last, see Section 8.2.6 Reagents Monitor for details.
129_REACTOR PURGE FAIL	System has detected a possible blockage or restriction in the reactor, Sample Out Valve (MV5) or associated tubing and fittings. See Reactor Purge Check and Reactor Purge Band defined in Pressure/Flow Test Program menu 8.3.4.6 Pressure/Flow Test Program.	Various, for example, air and oxygen supply problem. Check oxygen pressure looking at the Oxygen Controller Status (O2-CTRL STATUS) menu. See Section 8.1.6 Oxygen Controller Status for details. The pressure is typically 400mbar (±10mbar) at 20 l/h MFC flow. Blocked reactor. Faulty/blocked Sample Out Valve. Blocked tube after MFC. Faulty MFC. Run Flow Test (see Section 8.1.1.2 Flow Test for details).

9.2 BioTector Warning Event Explanation and Remedial Action

The following warning conditions do not activate the BioTector stop sequence and leave the 4-20mA signals un-changed and do not activate the fault relay. If there are multiple warnings in the system, check the fuses on the Relay PCB and Signal PCB. When the warning is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu.

WARNING	CONDITION	CAUSE/REMEDY
21_CO2 ANL LENS DIRTY	CO_2 Analyzer has detected dirt on its optical system.	Clean the CO_2 Analyzer. Clean the lenses on the CO_2 Analyzer.
22_FLOW WARNING – EX	MFC oxygen flow through the Exhaust "EX" Valve (MV1) has dropped below the "FLOW WARNING" level defined in Pressure/Flow Test Program menu 8.3.4.6 Pressure/Flow Test Program during the Pressure/Flow Test cycle.	Various, for example, oxygen supply problem. Oxygen pressure should be ~400mbar. See Section 8.1.6 Oxygen Controller Status for details. Partially blocked ozone destructor. Partially blocked tube after MFC. Faulty/blocked Exhaust Valve. Faulty MFC. Run Flow Test (see Section 8.1.1.2 Flow Test for details).
23_FLOW WARNING – SO	MFC oxygen flow through the Sample Out "SO" Valve (MV5) has dropped below the "FLOW WARNING" level defined in Pressure/Flow Test Program menu 8.3.4.6 Pressure/Flow Test Program during the Pressure/Flow Test cycle.	Various, for example, oxygen supply problem. Oxygen pressure should be ~400mbar. See Section 8.1.6 Oxygen Controller Status for details. Faulty/blocked Sample Out Valve. Partially blocked tube after MFC. Faulty MFC. Run Flow Test (see Section 8.1.1.2 Flow Test for details).
26_PRESSURE TEST WARN	MFC flow did not drop below the "PRESSURE TEST WARNING" level defined in Pressure/Flow Test Program menu 8.3.4.6 Pressure/Flow Test Program during the Pressure/Flow Test cycle.	Small gas/liquid leak in the BioTector. Valve leaking or not sealing. Open Sample Out Valve, inspect for dirt/damage. Check ARS Valve and system fittings. Check Mixer Reactor. Run Pressure Test (see Section 8.1.1.1 Pressure Test for details).
28_NO PRESSURE TEST	This warning is logged when the pressure test procedure is skipped during the system startup sequence. This warning cannot be acknowledged by the user. It can only be acknowledged automatically by the system next time the pressure test is passed.	This warning occurs when the Pressure/Flow Test is deactivated, and when the "QUICK STARTUP" function is used. See Section 2.2.1 Start Stop for details.

29_PRESSURE TEST OFF	There are two pressure tests carried out in BioTector. One is a daily pressure test and the other, called pressure check, is carried out every analysis cycle. This function relates to the daily pressure test. Pressure/Flow Test cycle has been switched off. See Section 8.3.4.6 Pressure/Flow Test Program for details.	Activate the Pressure/Flow Test cycle by programming the factory flow settings in Pressure/Flow Test Program menu. *System factory configuration settings are available in the MMC/SD card shipped with the BioTector.*
30_TOC/TC SPAN CAL FAIL 31_TIC SPAN CAL FAIL	TOC/TC/TIC Span Calibration result is outside the specified TOC/TC/TIC BAND defined in Span Program menu. See Section 8.3.4.4 Span Program for details.	Check the concentration of the standard solution used. Check the settings in Span Calibration menu. Check the operation of the BioTector.
33_TOC/TC SPAN CHCK FAIL 34_TIC SPAN CHCK FAIL	TOC/TC/TIC Span Check result is outside the specified TOC/TC/TIC BAND defined in Span Program menu. See Section 8.3.4.4 Span Program for details.	Check the concentration of the standard solution used. Check the settings in Span Calibration menu. Check the operation of the BioTector.
42_ZERO CAL FAIL	Zero Calibration result is outside the specified ZERO BAND defined in Zero Program menu. See Section 8.3.4.3 Zero Program for details.	Check the stability of the zero reactions and the quality of the reagents used. Check the settings in Zero Program menu. Repeat the zero calibration cycle.
43_ZERO CHCK FAIL	Zero Check result is outside the specified ZERO BAND defined in Zero Program menu. See Section 8.3.4.3 Zero Program for details.	Check the stability of the zero reactions and the quality of the reagents used. Check the settings in Zero Program menu. Repeat the zero calibration cycle.
50_TIC OVERFLOW	High TIC reading at the end of the TIC phase, even though the TIC sparge time has been automatically extended to its maximum time of 300s. See Section 8.3.6 Reaction Check for details.	Exceptionally high TIC. Check system operation ranges in System Range Data menu. Increase operation range to reduce injected sample volume. Increase the TIC SPARGE TIME in System Program, System Program 1 menu.
51_TOC OVERFLOW	High TOC readings at the end of TOC phase, even though the TOC time has been automatically extended to its maximum time of 300s. See Section 8.3.6 Reaction Check for details.	Exceptionally high TOC. Check system operation ranges in System Range Data menu. Increase operation range to reduce injected sample volume. Increase the TOC SPARGE TIME in System Program, System Program 1 menu.

52_HIGH CO2 IN BASE	CO_2 level in the base reagent, which is checked during the Zero Calibration or Zero Check cycles, is higher than the "BASE CO2 ALARM" level programmed in Fault Setup menu.	Confirm the base reagent CO_2 filter is serviced and in good condition, and the container is sealed. Check reagent quality. Replace the base reagent.
53_TEMPERATURE ALARM	Temperature of the BioTector is above the "TEMPERATURE ALARM" level programmed in Fault Setup menu. BioTector fan operates constantly in backup mode until the warning is acknowledged.	Check temperature of the BioTector. Check the filters in the fan and vent. Check the operation of the fan. *(Note that at temperatures below 25°C, BioTector automatically switches the fan off to stabilize system temperature using its own internal heat.)*
54_COOLER LOW TEMP	Cooler temperature has been below 2°C for longer than 600 seconds. See Section 8.3.11 Cooler Program for details.	Check the operation of the Cooler by observing flashing LED 3 on the Signal PCB. Faulty temperature sensor. Replace the Cooler.
55_COOLER HIGH TEMP	Cooler temperature has been 5°C above the setpoint (programmed by "COOLER" in Cooler Program menu) and 8°C below the ambient temperature for longer than 600 seconds. See Section 8.3.11 Cooler Program for details.	Check the operation of the Cooler by observing flashing LED 3 on the Signal PCB. Faulty temperature sensor or peltier element. Current taken by the Cooler peltier element should be ~1.4 Amp. *For further tests, see information sheet "T022. BioTector Cooler Troubleshooting" supplied in the MMC/SD card, shipped with the BioTector.* Replace the Cooler.
62_SMPL PUMP STOP ON	Sample Pump stopped with its rotation sensor ON or the sensor is faulty and it is always showing ON. ON state = LED 15 on (Signal PCB).	Run the Sample Pump and check the rotation. Change Relay 2 on Relay PCB. Check pump sensor signal looking at LED 15 on Signal PCB and DI04 in Digital Input menu. *For further tests, see information sheet "TT001. BioTector Sample Pump Stop On & Off Warning_Quick Troubleshooting" supplied in the MMC/SD card, shipped with the BioTector.* Replace the pump.

63_SMPL PUMP STOP OFF	Sample Pump stopped with its rotation sensor OFF or the sensor is faulty and it is not sensing the rotation of the pump. OFF state = LED 15 off (Signal PCB).	Run the Sample Pump and check the rotation. Change Relay 2 on Relay PCB. Check pump sensor signal looking at LED 15 on Signal PCB and DI04 in Digital Input menu. *For further tests, see information sheet "TT001. BioTector Sample Pump Stop On & Off Warning_Quick Troubleshooting" supplied in the MMC/SD card, shipped with the BioTector.* Replace the pump.
64_ACID PUMP STOP ON	Acid Pump stopped with its rotation sensor ON or the sensor is faulty and it is always showing ON. ON state = LED 16 on (Signal PCB).	Run the Acid Pump and check the rotation. Check pump sensor signal looking at LED 16 on Signal PCB and DI05 in Digital Input menu. Replace the pump.
65_ACID PUMP STOP OFF	Acid Pump stopped with its rotation sensor OFF or the sensor is faulty and it is not sensing the rotation of the pump. OFF state = LED 16 off (Signal PCB).	Run the Acid Pump and check the rotation. Check pump sensor signal looking at LED 16 on Signal PCB and DI05 in Digital Input menu. Replace the pump.
66_BASE PUMP STOP ON	Base Pump stopped with its rotation sensor ON or the sensor is faulty and it is always showing ON. ON state = LED 17 on (Signal PCB).	Run the Base Pump and check the rotation. Check pump sensor signal looking at LED 17 on Signal PCB and DI06 in Digital Input menu. Replace the pump.
67_BASE PUMP STOP OFF	Base Pump stopped with its rotation sensor OFF or the sensor is faulty and it is not sensing the rotation of the pump. OFF state = LED 17 off (Signal PCB).	Run the Base Pump and check the rotation. Check pump sensor signal looking at LED 17 on Signal PCB and DI06 in Digital Input menu. Replace the pump.
81_ATM PRESSURE HIGH	System atmospheric pressure sensor reading is above 115kPa. Therefore, the sensor reading is defaulted to 101.3kPa fault operation mode.	Check ADC[8] in Analog Input menu, which should be ~4 Volts. Faulty pressure sensor. Replace the motherboard.
82_ATM PRESSURE LOW	System atmospheric pressure sensor reading is below 75kPa. Therefore, the sensor reading is defaulted to 101.3kPa fault operation mode.	Check ADC[8] in Analog Input menu, which should be ~4 Volts. Faulty pressure sensor. Replace the motherboard.
83_SERVICE TIME	The service counter has counted down the days between service intervals and indicates that service is required.	Service the BioTector. After service, acknowledge the warning by resetting the counter using the "RESET SERVICE COUNTER" function in Diagnostics, Service menu.

84_SAMPLER ERROR	Warning generated on the BioTector venturi/vacuum sampler due to no/low sample or low air pressure/vacuum in the sampler.	Check the LCD screen of the venturi/vacuum sampler for details. See BioTector venturi/vacuum sampler user manual.
88_O2 CONTROLLER WARN	A problem has been found during communication with the O2-Controller Board. The communication between the O2-Controller Board and the Motherboard is lost.	Check LED 2 (L2) on the O2-Controller Board, it should be on. Check the 24V DC power on the O2-Controller Board at terminals J6. Check the data cable (ribbon cable) connections on the board. Power down and power up the BioTector to reset the system. Replace the board.
89_TC SPAN CAL FAIL 90_TC SPAN CHCK FAIL	TC Span Calibration/Check result is outside the specified TC BAND defined in Span Program menu. See Section 8.3.4.4 Span Program for details.	Check the concentration of the standard solution used. Check the settings in Span Calibration menu. Check the operation of the BioTector.
91_TC OVERFLOW	High TC readings at the end of TC phase, even though the TC time has been automatically extended to its maximum time of 300s. See Section 8.3.6 Reaction Check for details.	Exceptionally high TC. Check system operation ranges in System Range Data menu. Increase operation range to reduce injected sample volume. Increase the TC SPARGE TIME in System Program, System Program 1 menu.
92_HI AIR PRESSURE 2	Air pressure supply has been more than 2.0 bar for longer than 5 seconds. When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar. If system does not detect the air pressure drop to normal levels, the air supply is isolated from the system and oxygen is not generated.	Extreme fluctuations in air supply pressure or faulty external air regulator. Reduce the external air supply pressure to 1.5 bar when the oxygen concentrator is not running. When the problem is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu, to reset the O2-Controller Board.
93_HI AIR PRESSURE 1	Air pressure supply has been more than 1.8 bar for longer than 60 seconds. When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar.	Extreme fluctuations in air supply pressure or faulty external air regulator. Stop the BioTector and reduce the external air supply pressure to 1.5 bar when the oxygen concentrator is not running. When the problem is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu, to reset the O2-Controller Board.

94_LO AIR PRESSURE 2	Air pressure supply has been less than 0.6 bar for longer than 5 seconds. When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar. If system does not detect the air pressure increase to normal levels, the air supply is isolated from the system and oxygen is not generated.	Extreme fluctuations in air supply pressure or faulty external air regulator. Increase air supply pressure to 1.5 bar when the oxygen concentrator is not running. When the problem is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu, to reset the O2-Controller Board.
95_LO AIR PRESSURE 1	Air pressure supply has been less than 0.8 bar for longer than 60 seconds. When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar.	Extreme fluctuations in air supply pressure or faulty external air regulator. Increase air supply pressure to 1.5 bar when the oxygen concentrator is not running. When the problem is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu, to reset the O2-Controller Board.
96_HI O2 PRESSURE 2	Oxygen pressure supply has been more than 500 mbar for longer than 5 seconds. If system does not detect the oxygen pressure drop to normal levels, the air supply is isolated from the system and oxygen is not generated.	Reduce oxygen pressure to 400 mbar (±10mbar) at 20 l/h MFC flow, looking at the Oxygen Controller Status (O2-CTRL STATUS) menu and using the oxygen pressure regulator. When the problem is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu, to reset the O2-Controller Board.
97_HI O2 PRESSURE 1	Oxygen pressure supply has been more than 450 mbar for longer than 60 seconds.	Reduce oxygen pressure to 400 mbar (±10mbar) at 20 l/h MFC flow, looking at the Oxygen Controller Status (O2-CTRL STATUS) menu and using the oxygen pressure regulator.
98_LO O2 PRESSURE 2	Oxygen pressure supply has been less than 150 mbar for longer than 5 seconds. If system does not detect the oxygen pressure increase to normal levels, the air supply is isolated from the system and oxygen is not generated.	Increase oxygen pressure to 400 mbar (±10mbar) at 20 l/h MFC flow, looking at the Oxygen Controller Status (O2-CTRL STATUS) menu and using the oxygen pressure regulator. When the problem is rectified, acknowledge the warning by pressing the ENTER key in the Fault Archive menu, to reset the O2-Controller Board.
99_LO O2 PRESSURE 1	Oxygen pressure supply has been less than 200 mbar for longer than 60 seconds.	Increase oxygen pressure to 400 mbar (±10mbar) at 20 l/h MFC flow, looking at the Oxygen Controller Status (O2-CTRL STATUS) menu and using the oxygen pressure regulator.

100_ROTARY V STOP:ON	Rotary Valve stopped with its rotation sensor on (sensor signal 1). The sensor is faulty and it is always showing on (sensor signal 1). See Rotary Valve and Rotary Valve Sensor in Section 8.1.6 Oxygen Controller Status for details.	Go to Simulate menu, set MFC flow to 20 l/h and check the rotation of the Rotary Valve. Check ROTARY VALVE SENSOR signals (1 “on” and 0 “off”) in the Oxygen Controller Status menu as the valve rotates. Replace the valve. When the warning is cleared, the green LED, labeled as “Stepper” on the Oxygen Controller Board, should be on.
101_ROTARY V STOP:OFF	Rotary Valve stopped with its rotation sensor off (sensor signal 0). The sensor is faulty and it is not sensing the rotation of the pump. Sensor in Section 8.1.6 Oxygen Controller Status for details.	Go to Simulate menu, set MFC flow to 20 l/h and check the rotation of the Rotary Valve. Check ROTARY VALVE SENSOR signals (1 “on” and 0 “off”) in the Oxygen Controller Status menu as the valve rotates. Replace the valve. When the warning is cleared, the green LED, labeled as “Stepper” on the Oxygen Controller Board, should be on.
114_I/O WARNING	System has detected changes in the Input/Output bus extender MCP23S17 chips, which have read/write control registers, during the periodic checks carried out automatically.	When system detects a discrepancy between the requested and the read configuration registers values, then all devices on SPI “Serial Peripheral Interface” bus are reset and re-initialized automatically. Acknowledge the warning and inform the distributor or the manufacturer.
128_REACTOR PURGE WARN	System has detected irregularities in the gas flow, which indicates a possible blockage or restriction in the reactor, Sample Out Valve (MV5) or associated tubing and fittings. See Reactor Purge Check and Reactor Purge Band defined in Pressure/Flow Test Program menu 8.3.4.6 Pressure/Flow Test Program.	Various, for example, air/oxygen supply problem, partially blocked reactor. Faulty/blocked Sample Out Valve. Partially blocked tube after MFC. Faulty MFC. Check oxygen pressure looking at the Oxygen Controller Status (O2-CTRL STATUS) menu. See Section 8.1.6 Oxygen Controller Status for details. The pressure is typically 400mbar (±10mbar) at 20 l/h MFC flow. Run Flow Test (see Section 8.1.1.2 Flow Test for details).
133_BACKUP BAT. LOW	System has detected that the voltage of the cell/coin backup battery, located on the mainboard, is low (< 2.6 Volts).	Replace the cell/coin battery located on the mainboard.

9.3 BioTector Notification Event Explanation and Remedial Action

The following Notification conditions do not activate the BioTector stop sequence, leave the 4-20mA signal un-changed and do not activate the fault relay. Relevant notifications below can be acknowledged in the Fault Archive menu.

NOTIFICATION	CONDITION	CAUSE/REMEDY
85_REAGENTS LOW *(can also be programmed as a warning condition)*	BioTector has calculated that the reagent containers are running low.	Change reagents, and reset reagent monitor in Install New Reagents menu. Confirm that the reagent volume/container size input values are correct in the Reagents Monitor menu. If necessary, to readjust the number of days reagents last, see Section 8.2.6 Reagents Monitor for details.
86_POWER UP	Power applied to the BioTector or system reboot after the processor watchdog timeout.	Automatically acknowledged notification. No action is required.
87_SERVICE TIME RESET	This message is logged into the fault archives when “RESET SERVICE COUNTER” function is selected in Diagnostics, Service menu.	Automatically acknowledged notification. No action is required.
116/117/118/119/120/121 LOW/NO SAMPLE 1/2/3/4/5/6	This message is logged into the fault archives when BioTector Sample Sensor detects no sample liquid or when the sample quality is less than the default 75% threshold value for the corresponding streams from stream 1 to stream 6. See Section 8.3.8 Fault Setup for details.	Check sample liquid level and sampling system for each sample channel. Go to Sample Pump Test menu and run PUMP FORWARD TEST and check sample delivery and sample bypass. Confirm that no air bubbles are getting introduced into the sample lines.
122/123/124/125/126/127 SAMPLE FAULT 1/2/3/4/5/6	This message is logged into the fault archives when external device sends a stream specific sample fault input signal to the BioTector. See Section 8.3.8 Fault Setup for details.	Check the external sample liquid level and sampling system for each sample channel. Check the external sample monitoring device and the external input signal wiring.

Section 10 Service and Maintenance

10.1 Weekly Maintenance

- Check the air supply pressure:
  A) An existing instrument air supply line
  B) BioTector Compressor

- Check and confirm that the air pressure is 1.5 bar on the filter pack pressure regulator.
- Check the Sulfuric Acid level in the acid reagent container. Check the Acid Pump and confirm that there are no leaks. See figure 1 and table 2 in Section 4.1.1 Analysis Enclosure for the location of Acid Pump inside the BioTector.
- Check the Sodium Hydroxide (base) level in the base reagent container. Check the Base Pump and confirm that there are no leaks. See figure 1 and table 2 in Section 4.1.1 Analysis Enclosure for the location of Base Pump inside the BioTector.
- Check the Mixer Reactor and confirm that there are no leaks. See figure 1 and table 2 in Section 4.1.1 Analysis Enclosure for the location of the Mixer Reactor inside the BioTector.
- If installed check the sampling system:
  Option 1: Confirm that the BioTector Vacuum Sampler or BioTector Venturi Sampler is operating.
  Option 2: Confirm that the Sample Catch-Pot has sufficient sample flow, which guarantees a fresh sample for each analysis cycle.
  Option 3: Confirm that the Sample Pipe has sufficient sample flow, which guarantees a fresh sample for each analysis cycle.
- Check the Sample Pump and confirm that there are no leaks. See figure 1 and table 2 in Section 4.1.1 Analysis Enclosure for the location of Sample Pump inside the BioTector. Observe Sample Pump operation and sample delivery from the sample point and confirm that there are no blockages inside sample lines.
- Check all valves inside the BioTector and confirm that there are no leaks. See figure 1 and table 2 in Section 4.1.1 Analysis Enclosure for the location of the valves inside the BioTector.
- Check the filter mats in the Fan and Vent housings and confirm that they are not blocked.
- Check the Bypass, Sample Out and Exhaust lines outside the BioTector and confirm that there are no damages and blockages. See figure 17 in Section 5.4.2 Drain, Bypass and Exhaust Connections for details.

10.2 Six Month Service

Below procedure is a recommended check list for the 6th month service on the BioTector TOC analyzers, built with Mixer Reactor, using the 6 Month Service Kit. Please note that any special models and applications may require additional service items. Service procedures may be changed without notice due to the continuous research and development program. Therefore, please refer to the service check list supplied with the service kit for most up to date information.

Detailed service procedures are available in a presentation format in the MMC/SD card shipped with the BioTector. It is recommended to review this document before starting the service procedures.

Service should only be carried out when “SYSTEM STOPPED” message is displayed on the top left corner of the main Analysis Data screen or when the system is powered down. When “REMOTE STANDBY” or “SYSTEM RUNNING” message is displayed on the screen, stop the BioTector using the “Finish & Stop” or “Emergency Stop” function.

For system and personal safety, all reagent lines should be washed with water and then purged with air before the service procedures are carried out. In order to wash the reagent lines, connect all reagent tubes to a DIW (or tap water) container. Go to Zero Calibration menu and activate “RUN REAGENT PURGE” function to wash the reagent lines with water. When the reagent purge with water is completed, remove the tubes from the water container and place them open to air. Using the same menu, select the “RUN REAGENT PURGE” function one more time to purge the reagent lines with air. As the system may still contain small traces of reagents after the reagent purge cycles, it is strongly recommended to take the necessary safety precautions, such as wearing eye protection and gloves throughout the service. In systems built with Cleaning Valve (MV3) and Oxidized Sample Catch-pot/Cleaning Vessel, using the Simulate menu (see Section 8.1.2 Simulate for details), activate Cleaning Valve and run Sample Pump in reverse (REV) direction until all liquid inside the catch-pot is discharged.

Disconnect power to ozone destructor heater. The ozone destructor should never be opened when it is hot as the threads may seize.	_____
Replace the three 24V plug in relays on the Relay Driver PCB, 81404001. The relay type is OMRON G2R-2-SN *(see item R in service kit)*.	_____
Check and confirm that the Sample Valve (ARS-Automatic Range Selection Valve) is not leaking: Go to Sample Pump Test menu and run PUMP FORWARD TEST to fill the sample lines with sample (see Section 8.1.1.4 Sample Pump Test for details). Go to Pressure Test menu and run PRESSURE TEST (see Section 8.1.1.1 Pressure Test for details) and observe the elbow fitting on the top port of the Sample (ARS) Valve (see figure 1 and table 2 in Section 4.1.1Analysis Enclosure). If the valve is leaking, bubbles will be visible at this location and inside the sample bypass lines.	_____
Check the rollers on the rotor of all peristaltic pumps manually and confirm that they are rotating freely.	_____
Replace the 152mm long tubing (6.4mm OD, 3.2mm ID Norprene Chemical tube) of the WMM60 Sample Pump *(see item AH in service kit)*. If process conditions require this tube to be changed every 3 months, an additional tube is supplied in the service kit. *(When the pump tubing is removed from the fitting, it gets distorted. Therefore, it should not be reused.)*	_____
Replace the 120mm long, 5.6mm OD, 2.4mm ID EMPP 562 tube in the Acid and Base Pumps *(see item E in service kit)*. Replace the pump tube rail for the Acid and Base Pumps *(see item B in service kit)*.	_____
Replace the 6.4mm OD, 3.2mm ID EMPP 562 tubing used in the Pinch Valves *(see item C in the service kit)* and any PP (Poly-Propylene) Y fittings *(see item J in service kit)* in the analyzer. If additional Y fittings are required they should be ordered separately.	_____
Replace any other additional 6.4mm OD, 3.2mm ID EMPP 562 tubing if used inside the BioTector *(see item C in service kit)*.	_____

Using the Simulate menu (see Section 8.1.2 Simulate for details) and referring to figure 1 and table 2 in Section 4.1.1 Analysis Enclosure, check and confirm that the valves are operating and there are no leaks:

Check Sample (ARS) Valve, MV4 rotation from sensor 1 (SEN1) to sensor 2 (SEN2) to sensor 3 (SEN3) and to (SEN4) positions. _____

Check Sample Out Valve, MV5. When the valve is activated, the LED on the valve should be on. _____

Check Exhaust Valve, MV1. When the valve is activated, the LED on the valve should be on. _____

Inspect the TEE fitting connected to the TOC Acid Valve MV6. If any manganese build-up is present, clean the tubes and confirm that the acid reagent is correctly injected into the reactor. When the valve is activated, the LED on the valve should be on. _____

Check Base Valve, P2. When the valve is activated, the LED on the valve should be on. _____

Check Injection Valve, MV7. When the valve is activated, the LED on the valve should be on. _____

Check all the other valves (e.g. multi-stream valves) if installed in the BioTector. _____

Check and confirm that MANUAL/CALIBRATION ports are not blocked or isolated. _____

Check the oxygen/ozone inlet port at the bottom of the Mixer Reactor for build-up of salts. Clean the inlet tube if necessary. _____

Remove Ozone Line Filter and wash it with DIW (or tap water). Dry the filter well and reinstall in place. See figure 1 and 4 in Sections 4.1.1 Analysis Enclosure and 4.2.2 BioTector Sample Injection for details. _____

Using the Simulate menu (see Section 8.1.2 Simulate for details) and referring to figure 1 and table 2 in Section 4.1.1 Analysis Enclosure, check and confirm that the peristaltic pumps are pumping correctly. The pump rate measurements are used to confirm that the correct tubing has been installed in the appropriate pump.

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 liquid discharged. Place a 10ml graduated cylinder under the open end of the T fitting. Activate the Acid Valve and run the Acid Pump. 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 Simulate menu.)* _____

Activate the Base Valve and run the Base Pump rate for SR25 Pump at 20 pulses should be between 3.9ml and 4.9ml in ~13 seconds. Reconnect the tubing and fittings. _____

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.

Sample Pump rate for WMM60 Pump 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.*) _____

Replace the 149mm filter mats in fan and vent housing *(see item AI in service kit).* _____

Check the operation of the fan. *(Note that at temperatures below 25°C, BioTector automatically switches the fan off to stabilize system temperature using its own internal heat.)* _____

Check the operation of the Ozone Generator Fan, which is located inside the Ozone Generator.

Clean CO_2 analyzer optics by removing the 4x M4x60 Allen bolts on the detector section. If necessary, clean both lenses, which are located on the detector and the source section of the CO_2 Analyzer using the Lens Tissue *(see item T in the service kits)*. Replace o-ring with the 72-0325-30 o-ring provided *(see item P in the service kit)*.

Oxygen Purity Test: 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_2 analyzer for 5 minutes. At the end of this period, the CO_2 analyzer zero reading (ppm CO2) should be within ±0.5% of full scale of the CO_2 analyzer range. For instance, if the CO_2 analyzer range is 15000ppm, then the CO_2 analyzer zero reading should be typically within ±75ppm. Go to CO2 Analyzer menu (see section 8.3.10 CO2 Analyzer) to view the CO_2 Analyzer Range.
(If the CO_2 analyzer zero reading is outside the specifications, confirm that there is no CO_2 in the oxygen gas by connecting the CO_2 filter "used with the base container" between the Cooler and CO_2 analyzer inlet port and set the MFC to 10 l/h. As the size of the CO_2 filter is small, keep the 10 l/h gas flow running for at least for 5 minutes and record the CO_2 zero readings at the end of the 5 minute period. If the CO_2 zero readings do not drop significantly with the CO_2 filter in place, this will indicate that there is no CO_2 contamination in the oxygen supply.)

Warning! A Torque Screwdriver with 3mm Allen bit, calibrated to 1.5 Nm (150 Ncm), is required for the correct service of the Mixer Reactor. It is strongly recommended not to proceed with the Mixer Reactor service procedures without a torque screwdriver. An adjustable torque screwdriver can be obtained from a local supplier. Example specifications and suppliers of the torque screwdriver are as follows:

Lindstrom adjustable torque driver, 40-200Ncm
Stanley Supply & Services, Inc.
http://www.stanleysupplyservices.com/product-detail.aspx?pn=419-704
RS Components Ltd.
http://uk.rs-online.com/web/p/torque-drivers/3851794/

Loosen each bolt, located on the front of the Mixer Reactor, with small steps, moving from one bolt to another across. Remove the 4 bolts and remove the reactor motor, which contains the diaphragm, located at the back. Hold the reactor motor and turn the diaphragm anti-clockwise to unscrew. It is recommended to count the number of turns by putting a small mark on the diaphragm during this process. Place the M4 washer (spacer), which has a height of ~0.7mm, at the center on the diaphragm support. Screw in the new diaphragm (*see item M9 in the service kit*) and tighten it firmly. The typical minimum number of turns to tighten the diaphragm is from 7 to 8.5 turns. If a minimum number of 7 turns, or the number of turns counted above when the old diaphragm was removed, is not achieved, the diaphragm must be removed and reinstalled. Push the center and the edge of the diaphragm down firmly into place. When the installation of the diaphragm is complete, confirm that the diaphragm forms a "concave" shape at the center and the diaphragm is aligned with the diaphragm housing. In other words, when the diaphragm is installed correctly, the diaphragm should curve in forming a dent at the center. If such dent has not formed and if the diaphragm has not aligned with the housing, unscrew the diaphragm, confirm that the diaphragm is installed correctly and if necessary tighten the diaphragm more with additional turns.

Confirm that the sealing face at the back of the reactor, where the diaphragm sits, is clean. Install the reactor motor back onto the Mixer Reactor and tighten each bolt by engaging the threads and stopping as soon as the threads are just engaged. Tighten each bolt, with small steps, moving from one bolt to another across. There are two side plates positioned perpendicular to the reactor back plate at the back, which helps align the diaphragm with the reactor. Using these two side plates as a guide, hold the reactor motor in place, which will align the diaphragm with the reactor, and tighten the bolts using the 3mm washers under each bolt. The torque of the bolts should not exceed 1.5 Nm (150 Ncm). It is important that the diaphragm has not shifted and it has not lost its alignment with the diaphragm housing during the installation process.

Confirm that the temperature of the ozone destructor has dropped to ambient temperature level. Open the ozone destructor. The ozone destructor should never be opened when it is hot as the threads may seize. Confirm that the PTFE filters (discs) in the ozone destructor are clean. If there is any material build up (e.g. white powder), wash the filters using DIW (or tap water) and dry. Do not use compressed air or any gas to clean the filters. _____

Replace the catalyst and PTFE wool in the ozone destructor *(see item X in service kit)*. Note that in applications containing HCl or HF, the ozone destructor catalyst may require more frequent replacement. _____

Replace the o-ring in the Ozone Destructor *(see item P in service kit)*. _____

Reconnect power to ozone destructor heater. _____

Remove the tapes, which are used to seal the ends of the supplied CO_2 filter *(see item M11 in service kit)*. Replace the CO_2 filter on the Base reagent container. Seal the Base container tightly. _____

Isolate the air supply to the analyzer. Go to Simulate menu and set MFC to 60 l/h and run the oxygen supply until the flow drops to 0 l/h (until the oxygen tank is empty). Install the new Hepa Filter *(see item "10-KBS-003" in the service kit)* carefully without contaminating the open tubing. Turn the air supply on. _____

Check the air supply pressure. The set point pressure should be 1.5 bar (BioTector compressor 1.2 bar). When the oxygen concentrator is running, the pressure typically cycles from 1.5 bar to 0.9 bar. Check the O2 PRESSURE SENSOR reading looking at the O2-Controller Status menu. The pressure is typically 400 mbar (±10 mbar) at 20 l/h MFC flow. See Section 8.1.6 Oxygen Controller Status for details. _____

Using the Simulate menu (see Section 8.1.2 Simulate for details), check the operation of the Mass Flow Controller (MFC) and confirm that the MFC is working at various flow set points. _____

Check the BioTector for any gas/liquid leaks by running the PRESSURE TEST cycle using the Pressure Test menu (see Section 8.1.1.1 Pressure Test for details). Note that the BioTector should be pressure tested at 400 mbar pressure only. _____

Confirm all signals (4-20mA and volt free contacts) are signaling correctly to the external control device (see Section for 8.1.3 Signal Simulate details). _____

If necessary, go to Operation, Time & Date menu and adjust the time and the date. When the system service is completed, go to Diagnostics, Service menu and select RESET SERVICE COUNTER function (see Section 8.1.7 Service for details). _____

Carry out an "Install New Reagents" cycle using the Install New Reagents menu (see Section 2.2.2.1 Install New Reagents for details). Confirm that the zero readings obtained during the Zero Calibration cycle are stable. _____

When Mixer Reactor is serviced, there is a possibility of contamination, which may create an unacceptable TOC offset. If the TOC readings obtained during the zero calibration cycle are higher than expected, a service zero calibration cycle can be initiated using the SET SERVICE ZERO function in Service menu, while the BioTector is running. When initiated, BioTector automatically runs a total of 5 zero calibration cycles during the following 100 online measurements and automatically adjusts the zero offset values to compensate for the removal of the contamination. It will therefore not be necessary to revisit the BioTector after the service or to repeat the zero calibration cycle. See Section 8.1.7 Service for further details. _____

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.)*

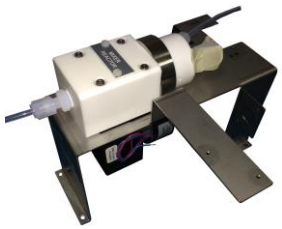
Connect the standard solution to the MANUAL/CALIBRATION port. If these ports are not available, use the SAMPLE 1 port. Avoid the manual purging of the calibration, manual grab sample and sample lines using the Simulate menu, because the system reactor may get contaminated during the automatic sample 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. Span Calibration cycle should be carried out only when stable zero readings are obtained after a Zero Calibration cycle completed without any warnings. (*In systems using multiple operation ranges, it is recommended to carry out a Span Check cycle at the other operation ranges used and if necessary to adjust the span factor manually using the Span Calibration menu.*)

Section 11 System Replacement and Spare Parts

Typical Consumable & Wear Parts for 3 Year Operation for 1 BioTector B7000i Dairy TOC Analyzer

Item No	Description	Typical Consumable & Wear Parts						Recommended / Essential Customer Stock Quantity for Spare Parts
		6 months	12 months	18 months	24 months	30 months	36 months	
		Typical Consumables						
19-KIT-132	B7000i Type D TOC Analyzer 6 Month Service Kit	1	1	1	1	1	1	1
-	Acid 25L, 1.8N H_2SO_4, with Mn catalyst	See section 6 in BioTector user manual.						
-	Base 25L, 1.2N NaOH, low in carbonate							
		Typical Wear Parts						
19-PCB-046	ARM Mainboard, Rev 4, Including Processor & LCD	-	-	-	-	-	-	0
10-EMT-090	Compact PEEK Sample ARS Valve. 2.5mm. With Integrated Fittings	-	-	-	1	-	-	1
19-MAX-010	WMM60 Peristaltic Pump with Norprene Chemical Tubing	-	-	-	1	-	-	1
19-ASF-004	SR25 Acid and Base Pump	-	-	-	-	-	-	0
10-KNF-038	NF300 PTFE Diaphragm	-	-	-	-	-	-	1
19-BAS-015	B4M Mixer Reactor Motor, 24V DC Complete with Leak Detection	-	-	-	-	-	-	1
19-BAS-016	B4M Mixer Reactor, PTFE, complete with 24V DC motor	-	-	-	-	-	-	0
19-BAS-017	B4M Mixer Reactor, PTFE	-	-	-	-	-	-	0
10-SMR-001	Non return valve (check valve), 1psi	-	-	-	-	-	-	1
19-EMC-001	Type 6606 Burkert N/C valve with plug	-	-	-	-	-	-	1
19-EMC-002	Type 6606 Burkert N/O valve with plug	-	-	-	-	-	-	1
19-EMC-003	Type 6606 Burkert C/O valve with plug	-	-	-	-	-	-	1
19-B5C-012	Air Isolation Valve, N/C	-	-	-	-	-	-	0
12-BIO-001	B4M C/O Pinch Valve, complete	-	-	-	-	-	-	0
19-PCB-003	Power PCB (Mains PCB)	-	-	-	-	-	-	0
10-KNK-001	Isolation Amplifier	-	-	-	-	-	-	1
20-CO2-011	B7000i CO_2 Analyzer, Hastelloy, including Cable, 0-15000ppm	-	-	-	-	-	-	0
19-BAS-018	B4M Cooler with Glass Bead Filter	-	-	-	-	-	-	0
20-PCB-136	B7000i Oxygen Controller Board, complete	-	-	-	-	-	-	0
10-HAW-001	Ozone Destructor Heater	-	-	-	-	-	-	0
10-DVB-012	Oxygen Concentrator Pressure Regulator	-	-	-	-	-	-	0
10-DVB-013	Oxygen Concentrator Sievebeds (set of 2)	-	-	-	-	-	-	1
20-B5C-011	Oxygen Concentrator Rotary Valve	-	-	-	-	-	1	1
10-DVB-024	Oxygen Concentrator Pressure Relief Valve	-	-	-	-	-	-	0
10-DVB-005	Exhaust Filter/Muffler	-	-	-	-	-	-	1
10-SMC-001	B5C Instrument Air Filter Pack	-	-	-	-	-	-	0
12-SMC-001	B5C Filter Pack Elements (for air supply)	-	-	-	1	-	-	1
10-SCA-002	PFA Tubing, 3/16" OD x 1/8" ID - 1 meter	-	-	-	-	-	-	5 meters
10-SCA-003	PFA Tubing, 1/4" OD x 5/32" ID - 1 meter	-	-	-	-	-	-	5 meters
10-SCA-006	PFA Tubing, 1/4" OD x 1/8" ID (6.35mm OD x 3.18mm ID) - 1 meter	-	-	-	-	-	-	5 meters
10-SCA-007	PFA Tubing, 3/16" OD x 1/16" ID - 1 meter	-	-	-	-	-	-	1 meter
10-REH-002	EMPP Tubing, 6.4mm OD x 3.2mm ID - 1 meter	-	-	-	-	-	-	2 meters
10-REH-003	EMPP Tubing, 5.6mm OD x 2.4mm ID - 1 meter	-	-	-	-	-	-	1 meter
10-EMT-114	Set of 1x1/4" PTFE Ferrule and PEEK locking ring	-	-	-	-	-	-	5
10-EMT-136	Set of 1x3/16" PTFE Ferrule and PEEK locking ring	-	-	-	-	-	-	5

BioTector Parts and Spare Parts

Part Number and Description		Part Number and Description	
19-KIT-132 B7000i Type D BioTector TOC Analyzer 6 Month Service Kit		19-PCB-046 ARM Mainboard, Rev 4, Including Processor and LCD Hazardous area analyzers may have a different motherboard with a special battery. Contact manufacturer for details.	
20-PCB-136 B7000i Oxygen Controller Board, complete		10-EMT-090 PEEK ARS Sample Valve (2.5mm)	
19-MAX-010 WMM60 Sample Pump with Norprene Chemical Tubing		19-ASF-004 SR25 Acid and Base Pump	
10-KNF-038 NF300 PTFE Diaphragm		19-BAS-015 B4M Mixer Reactor Motor, 24V DC, complete with leak detection.	
19-BAS-016 B4M Mixer Reactor, PTFE, complete with 24V DC motor		19-BAS-017 B4M Mixer Reactor, PTFE	

Part Number and Description		Part Number and Description	
10-SMR-001 Non return valve (check valve), 1psi		19-EMC-001 Type 6606 Burkert N/C valve with plug	
19-EMC-002 Type 6606 Burkert N/O valve with plug		19-EMC-003 Type 6606 Burkert C/O valve with plug	
12-BIO-001 B4M C/O Pinch Valve, complete.		19-PCB-003 Power PCB (Mains PCB)	
10-KNK-001 Isolation Amplifier		20-CO2-011 B7000i CO2 Analyzer, Hastelloy, 0-15000 ppm (default calibration)	
19-BAS-018 B4M Cooler with Glass Bead Filter		12-SMC-001 Filter Pack Elements	
12-PCS-021 B7000i Ozone Destructor including bracket		10-HAW-001 Ozone Destructor Heater	

Part Number and Description		Part Number and Description	
10-SCA-002 PFA Tubing, 3/16" OD x 1/8" ID - 1 meter		10-SCA-003 PFA Tubing, 1/4" OD x 5/32" ID - 1 meter	
10-SCA-006 PFA Tubing, 1/4" OD x 1/8” ID (6.35mm OD x 3.18mm ID) – 1 meter		10-SCA-007 PFA Tubing, 3/16" OD x 1/16” ID – 1 meter	
10-REH-002 EMPP Tubing, 6.4mm OD x 3.2mm ID – 1 meter		10-REH-003 EMPP Tubing, 5.6mm OD x 2.4mm ID – 1 meter	
10-EMT-114 Set of 1x1/4” PTFE Ferrule and PEEK locking ring		10-EMT-136 Set of 1x3/16” PTFE Ferrule and PEEK locking ring	
10-DVB-013 Oxygen Concentrator Sieve Beds (set of 2)		20-B5C-011 Oxygen Concentrator Rotary Valve	

Section 12 Warranty and Exclusions

Coverage of BioTector Warranty

The BioTector comes with a standard 1 year warranty for agreed applications. The BioTector warranty is against manufacturing defects only. The warranty does not cover service/consumable items and consequential damage.

Validity of Warranty

For the warranty to be valid, regular 6th Month servicing must be carried out using the Service Kit supplied by the manufacturer. The recommendations on Maintenance and Service given in the manual should, as a general rule, be followed. However, service needs will vary from site to site and difficult applications may require additional service checks and/or service items not normally supplied with the BioTector Service Kit.

Exclusions

The following standard service items are not covered under the BioTector warranty:

- EMPP tubing
- Peristaltic pumps if the lifetime of the DC motor has been exceeded.
- PP Y connectors
- Filter mats in fan and vent housing
- Viton tubing in ozone generator
- Catalyst in ozone destructor
- CO_2 filter
- 24V relay on the Ozone PCB
- 24V plug-able relays in the Relay PCB, 81204001
- Sample Out Valve
- Exhaust Valve
- Acid Valve
- Diaphragm in Mixer Reactor
- Wetted parts of Sample Valve (ARS Valve)

Limitations

The manufacturer liability with respect to certain moving parts (e.g. peristaltic pumps, control valve in mass flow controller, sample valve) will be limited to the manufacturer's specified lifetimes.

Agreed Applications

It is important that the Pre-Installation Questionnaire be filled in for each new application as the manufacturer cannot guarantee the BioTector without knowing what chemicals/substances it is being exposed to.

Procedure for Warranty Repair/Replacement

Prior to returning any item under warranty, a Returned Merchandise Authorization (R.M.A.) number must first be requested from the manufacturer. The R.M.A. number must be quoted on all correspondence.

Shipping Costs

The cost of transporting the parts to be repaired or replaced under warranty from the end-user to the manufacturer shall be borne by the end-user. The transport costs from the manufacturer back to the distributor shall be borne by the manufacturer.
Method of delivery shall be at the sender’s discretion. The manufacturer will use the lowest cost service (including regular post) available. If the distributor requires goods returned on an urgent basis, the distributor may nominate his preferred means of transport but shall then be liable for shipping costs.

BioTector Software

BioTector analyzers operate using BioTector proprietary software “BioTector OS3” (BioTector Operating System 3). This software and all associated copyright is the sole property of BioTector Analytical Systems Ltd. Purchase of the BioTector analyzer licenses the user to use the BioTector OS3 software as configured and for the purpose of operating the BioTector during the life of the analyzer.

Section 13 Appendices

Appendix 1 Instructions for Connecting Printer to BioTector

Protocol used by the BioTector

Baud rate	9600
Data bits	8
Stop bits	1
Parity	None
Flow control	None

Note that these instructions refer to the Epson LX300 printer with the optional serial port fitted.

If a printer cable provided by the BioTector manufacturer is used, the electrical connections are as follows:

- Terminal TX on the microcontroller is connected to pin 3 on the D25 plug.
- Terminal RX on the microcontroller is connected to pin 2 on the D25 plug.
- Terminal GND on the microcontroller is connected to pin 7 on the D25 plug.
- The cable should be screened and the screen earthed at the printer.

The BioTector uses the factory default settings on the Epson LX 300. Thus, when the printer is connected to the BioTector and the BioTector port is switched on, the printer should begin to operate immediately. For details on changing the settings on the Epson LX300, see the printer manual.

The procedure for connecting the printer to the BioTector is as follows:

1. Connect the printer RS232 cable.
2. Switch the printer on.
3. In BioTector's Data Program, Printer menu, set the PRINT MODE to STANDARD.

The BioTector will print the analysis data conforming to the headings of the selected mode at the end of each reaction.

Appendix 2 Setting up Windows to Receive Data from BioTector

To set up Windows for receiving data from the BioTector, open the Hypertrm file found within the HyperTerminal folder. This may be carried out by selecting Start, Programs, Accessories, Communications, HyperTerminal. If appears, cancel the Location Information pop up menu.

Modify the Hyper Terminal settings as follows:

1. From the File menu:
   - Choose New Connection.
   - In the Connection Description page, enter a name for the file (e.g., BioTector).
   - In the Connect To page, select the required Com Port in the Connect using box.
   - Set up the Com Port as required. The actual settings will depend on the settings in the BioTector, Below list is an example:

Bits per second	9600
Data bits	8
Parity	None
Stop bits	1
Flow control	None

2. From the File menu:
   - Choose Properties
   - Select the Settings page
   - From the Emulation box, select VT100
   - In the Terminal Settings box, if the PRINT MODE setting in BioTector's Data program, PC, Printer, MMC/SD menu is STANDARD, select 80 columns mode in the Terminal Setup menu. If the PRINT MODE setting in Data program, PC, Printer, MMC/SD menu is ENGINEERING, select 132 Columns mode.

3. From the Transfer menu:
   - Choose Capture Text.
   - Select or create a file to hold the data (e.g., data.txt)

Windows is now setup to receive data from the BioTector. To reactivate the link to the BioTector, click on the BioTector icon in the HyperTerminal folder and from the Transfer menu, click on Capture Text and select a file.

Appendix 3 Glossary of Terms and Abbreviations

- - -	No function is programmed
4-20mA CHNG	4-20mA Change signal
A	Amperes
A1 - A6	24 hours average for stream 1 – 6
ALLDAT	All Data
Amp	Amperes
ARS Valve	Automatic Range Selection Valve (Sample Valve)
ATM	Atmospheric pressure
BOD	Biochemical Oxygen Demand
C-276	Hastelloy
CAL MUX	Calibration multiplexer
CAL SIGNAL	Calibration signal
CAL	Calibration reactions
CE	European Conformity (Conformité Européene)
CF	Full cleaning reaction
CNFG	Configuration
CO_2	Carbon dioxide
CO2p	CO_2 peak
CO2z	CO_2 analyzer zero
COD	Chemical Oxygen Demand
CSA	Cross Sectional Area
DegC	Degrees Centigrade (°C)
DIAG	Diagnostics
DIN	German Institute for Standardization (Deutsches Institut für Normung e.V.)
DIW	Deionized Water
EMPP	Elastomer-modified-poly-propylene
EN	European Norm
ETL	Electrical Testing Laboratories
F	Fuse
FARCH	Fault Archive
FRP	Fiberglass Reinforced Polyester
H	High Interrupt
H_2SO_4	Sulphuric acid
HCl	Hydrochloric acid
HS	High Speed
Hz	Hertz
ID	Internal Diameter, Identification
kPa	Kilo Pascal
L	Low Interrupt
l/h	Liters per hour
LP	Lost Product (l/h)
LPI	Lost Product Index (%)
M	Molar
M1 - M6	Manual stream 1 - 6
mA	Milli-amperes
MAINT SIGNAL	Maintenance signal
MAN MODE TRIG	Manual Mode Trigger
mbar	Millibar
MCB	Miniature Circuit Breaker
MCR	Multi-Component Reactor
mg	milligram
ml	Milliliter
ml/min	Milliliters per minute
MMC/SD	Multi Media Card/Secure Digital Card
N	Normal

N/A	Not Applicable
N/D	Normally de-energized
N/E	Normally Energized
NaOH	Sodium Hydroxide
NDIR	Non-dispersive Infrared
NOTE	Notification
NPOC	Non-purgeable Organic Carbon
O_2	Oxygen
O_3	Ozone
OD	Outside Diameter
OS3	Operating System 3
PCB	Printed Circuit Board
PEEK	Poly-ether-ether-ketone
PFA	Per-fluoro-alkoxy
POC	Purgeable Organic Carbon
PP	Poly-propylene
ppb	Parts per billion (μg/l)
ppm	Parts per million (mg/l)
PTFE	Poly-tetra-fluoro-ethylene
PVDF	Poly-vinylidene-flouride
RARCH	Reaction Archive
RS	Remote standby reaction
RW	Reactor wash reaction
S	Span
S1 - S6	Stream 1 - 6
SC	Span calibration
SK	Span check
SM	Manually input span adjust
SMPL	Sample
sparge	Removal of a chemical by purging a gas through a liquid
SS-316	Stainless Steel 316
STD	Standard
STM ALARM	Stream alarm
SYNC	Synchronization
T	Time Lag (Time Delay)
TC	Total Carbon
TCmgC/l	Total Carbon value in mgC/l
TIC	Total Inorganic Carbon
TICmgc	Calibrated Total Inorganic Carbon value in mgC/l
TICmgC/l	Total Inorganic Carbon value in mgC/l
TICmgu	Un-calibrated Total Inorganic Carbon value in mgC/l
TOC	Total Organic Carbon
TOCk	Total Organic Carbon in kg/h
TOCmgc	Calibrated Total Organic Carbon value in mgC/l
TOCmgC/l	Total Organic Carbon value in mgC/l
TOCmgu	Un-calibrated, atmospheric pressure uncompensated TOC in mgC/l
V	Volts
VOC	Volatile Organic Carbon
VOCmgC/l	Volatile Organic Carbon value in mgC/l
W	Watts
Z	Zero
ZC	Zero calibration
ZK	Zero check
ZM	Manually input zero adjust
ZS	Zero and Span

Appendix 4 Contact Information

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