Process Gas Chromatograph

RGC 2000 SOFTWARE

Operation Manual
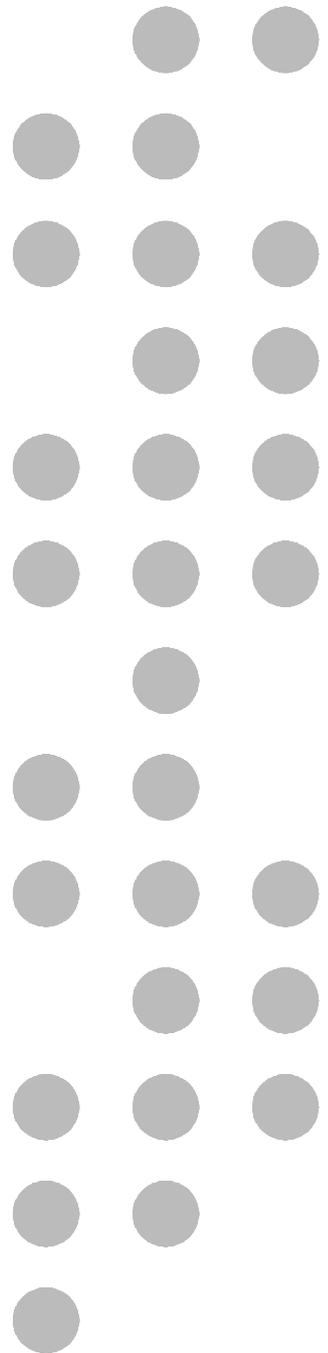
Instromet ®

1 Introduction

The RGC 2000 software (Remote Gas Chromatograph) is an application program that runs under the Microsoft Windows Operating Environment. RGC 2000 is the primary means of creating energy reports and performing routine maintenance and operational integrity checks. This manual discusses the software features in detail and gives information about the data storage files. For more information about the ENCAL 2000 PGC and the Control Unit, refer to the following manuals:

- ENCAL 2000 CONTROL UNIT – Instrument Instruction Manual
  Version 3.0 issue 1

- ENCAL 2000 PGC Installation Manual
  Version 3.0 issue 1

2 Table of Contents

3   Software Installation

3.1   System requirements

The following are required to run the RGC 2000 program:

- Windows 95, 98, 2000 or NT
- Hard disk (3 GB) file storage device
- Pentium II or higher
- Serial communication port (minimal 1)
- Parallel Printer port (or USB) for chromatogram printer
- Optional Modem port (9600 baud)

3.2   Installation procedure

The RGC 2000 software program is delivered on 2 floppy discs 3.5"or on a CD-ROM. Before starting the installation make sure all other applications are closed. The program should be installed using Windows explorer. The following steps must be performed to install the RGC 2000 software.

- Insert the CD-ROM in the CD-ROM drive or the disk labelled "Disk 1" into drive A.

- Open the windows explorer and select the appropriate disk drive.

- Activate the Set-up file by double clicking on the Icon; the following dialog window will appear:
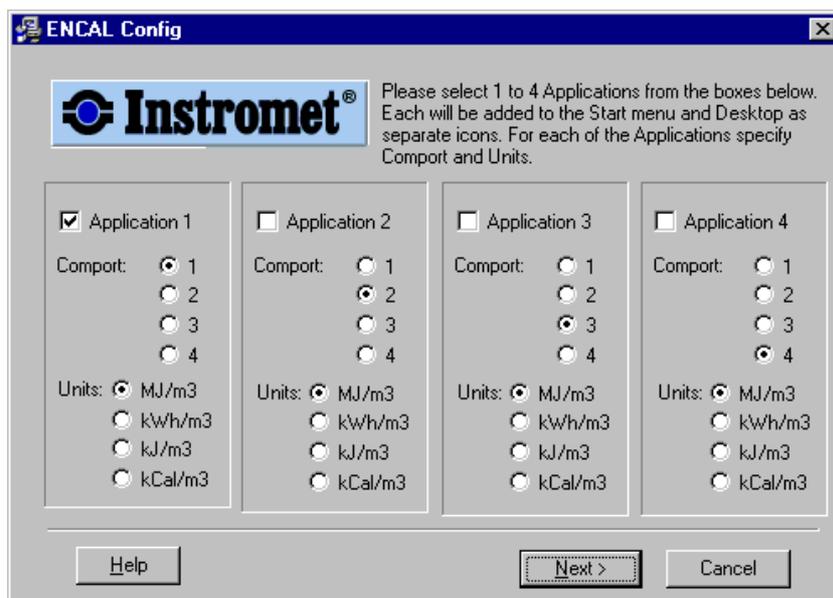
Figure 3-1 Install window

- Select how many applications you would like to install. Selecting more than one application enables you to communicate with up to four analysers at a time if the required hardware is available (com ports).

- Select for each application the communication port that will be used and the units type used for the heating value.

- Confirm by clicking "Next" Button. The following dialogs will take you through the rest of the installation.

3.3 File location

During installation the installer will suggest the default installing directory, C:\Program Files\Instromet. All Initiation, application and library files will be located in this directory. The initiation files RGCx.ini (x = 1 to 4) and RGCconfigx.ini (x = 1 to 4) are also numbered according to the RGC application they belong to.

In the INSTROMET directory a subdirectory REPORTS will be created for each application installed. The REPORTS directories are numbered, REPORTS1 to REPORTS4 indicating the application they belong to. In these directories the RGC data storage will locate its files. This means that if RGC application 1 is running and Online Monitor is active, RGC will store its data in the REPORTS1 directory.

The RGC2000.exe is only installed once. This means that if more applications are installed they all use the same executable. For each application a shortcut will be made referring to this executable. The shortcut also sets a ´Target' in which it refers to the RGCconfigx.ini which must be used for the application. For example if the shortcut RGC2000-2 is started the application will use RGCconfig2.ini. In this ini file a reference is made to the RGC2.ini which must be used.

3.4 Initialisation files

The RGC2000 program uses two Initialisation files that are named RGCx and RGCconfigx. The RGCx.ini contains several program variables. In this file the units, which are used for the Heating value, are defined.

The RGCconfigx.ini contains several parameters that can only be changed by the user directly in the file (manually by using a text editor) and not from the RGC2000 application program.

3.4.1 Chromatogram scaling

Two of these parameters contain the settings for the scales of the chromatogram printout. If for any reason these scales must be adjusted the following parameters must be changed

[CHROMATOGRAM]
X_AXIS_MAX=500   (= default setting)
Y_AXIS_MAX=10   (= default setting)

The X-axis is expressed in seconds and the Y-axis is expressed in mV.

3.4.2   Auto start Online Monitor setting

Another parameter is the *Autostart Online Monitor* parameter. By setting this parameter to "*Yes*" the RGC program will, at start-up, automatically connect to the analyser and start the online monitor. If the RGC 2000 program is in the "Autostart" directory of the Windows operating system RGC 2000 will automatically start up at a power-up of the PC (e.g. after a temporary power loss).

This option is used to make sure that in case of a power down of the RGC PC, the connection to the analyser is automatically restored at power up and data storage is continued. Since data storage is only active in the Online Monitor mode the Online Monitor is also automatically started.

To disable this option the *Autostart Online Monitor* parameter must be set to "No".

3.4.3   Automatic clock synchronisation

Another parameter in the Rgcconfigx.ini file is the *TG_Time_Update* parameter. If this is set to "Yes" the PC will synchronise the analyser clock with the PC clock each time an analysis has finished and is retrieved by the Online Monitor. This means that the time will only be updated if the analyser is running analysis and if the RGC 2000 software is running with the Online Monitor activated. If the *TG_Time_Update* is set to "No" the PC will not automatically synchronise the analyser clock.

To understand the clock synchronisation of an ENCAL system it is important to know that there are up to three clocks in an ENCAL system:

- Analyser clock
- Control unit clock
- PC clock

In paragraph 10.3 the clock synchromisation between Analyser and CU is described. Note that the Control Unit can update the Analyser clock, the Analyser clock can update the CU clock or both clocks can run independently from each other.

It is obvious that if the Analyser clock is updated from the Control Unit the TG_Time_Update must be set to "No".

It is possible to synchronise the PC time with the atomic clock by using an atomic clock signal receiver. If the TG_Time_Update is set to "Yes" and the control unit is being synchronised by the analyser, this receiver will then synchronise all clocks in the system.

3.5   Uninstall procedure

If the program is to be removed from your PC this is best done using the "software" application from the Windows configuration screen. The application is named here as ´Instromet RGC2000´ and by using the Remove command the program will be uninstalled. The Reports directories and data files in it will not be removed so stored data will still be available.

4 Analyser Basics

The ENCAL 2000 Energy Measurement System utilises a technique known as Gas Chromatography. In Gas Chromatography, a gas mixture whose energy value is to be calculated is physically separated into its individual components. The energy contribution of each component is calculated and summed to generate an energy number. This energy is expressed in terms of energy per unit volume, such as kWh/m^3 or MJ/m^3.

Separation of the individual components is accomplished with the use of a column. Physically a column is a long piece of tubing with a fine powder-like material that has been packed into it. Separation is achieved as each component of the gas mixture to be analysed travels through the column at different rates. A carrier gas, typically Helium, is used to transport the mixture through the column. The elution time, the time a component takes to traverse the column, serves to identify the component. A detector is used to sense components as they elude from the column.

A sample conditioning / selection system allows the user to select a stream for analysis from several available streams. The sample injection system flushes the sample loop with gas from the sample conditioning system. The sample loop allows for a uniform, repeatable quantity of gas to be analysed during each run.

A technique called "backflush to measure" is used to reduce the total analysis time by grouping the heavier components (hexanes and above) into one component. This mixture is referred to as C6+. This is achieved by allowing these components to traverse through a small portion of the columns. The technique is practicable as the component elution times are proportional to molecular weight.

The analyser is kept at a constant elevated temperature (approximately 135° C) by an oven in order to maintain a constant analysis temperature. Component elution times are affected by several factors, including temperature. The column, sample loop and switching valve are maintained in this oven.

4.1   Gas-Liquid Chromatography

Chromatography utilises a component's physical property to achieve the physical separation. When a component is exposed to several different media, it attempts to establish an equilibrium, with a certain percentage dissolved into each of the media. In Chromatography two media are present, a mobile phase media and a stationary phase media. In gas-liquid chromatography, the mobile phase media is the carrier gas and the stationary phase media is a liquid coated on solid support material packed in the column.

A component traverses the column only when it is in the mobile (gas) phase. As the gas traverses the column, it constantly establishes an equilibrium with the stationary (liquid) phase media in the column. Thus the effective rate at which a component traverses the column is dependent upon this equilibrium that is established between the stationary and mobile phases, which is different for each component.

There are several factors that affect the equilibrium that is established between the mobile and stationary phases. Two major factors will be discussed:

1.   **Temperature** - As temperature increases, the amount of gas that can be dissolved into a liquid is decreased. If one observes a slowly heated pot of water, one will notice tiny stream bubbles begin to form. This is excess oxygen that can no longer be dissolved into the water as its temperature increases. To minimise the effects of this phenomena, the analyser components are kept at a constant temperature by placing these components in an oven.

2.   **Pressure** - As pressure decreases, the amount of gas that can be dissolved into a liquid is decreased. If one opens a bottle filled with a carbonated beverage, one notices a sudden foaming of the liquid and streams of bubbles in the beverage. By opening the bottle, the pressure the liquid was experiencing is reduced to atmospheric pressure, reducing the amount of Carbon Dioxide that is dissolved in it. To minimise the effects of this phenomenon, the carrier gas head pressure is regulated accurately.

The Stationary Phase media is first kept in the column by coating a packing material with the media. This is analogous to cookie crumbs. Though the cookie crumbs appear to be dry, they are covered by a fine film of oil that is readily apparent when it is touched or wrapped in a napkin. This coated packing material is placed into a piece of tubing to form the column. The packed column derives its name from this construction technique.

4.2   Backflush to Measure

Backflush to Measure is a technique that treats the Hexanes and above as a single component, which is collectively known as C6+.

The technique relies on the component's property where its elution time is proportional to molecular weight. The column that performs the physical separation of components is split into two sections, a backflush and main column. The backflush column is much shorter than the main column.

Prior to sample injection, the columns are configured such that the components first elude through the backflush column and then through the main column, i.e. the backflush column is upstream of the main column. The sample is injected into the backflush column. The lighter components quickly elude from the backflush column and enter the main column. At a point in time where only C6+ remain in the backflush column, the columns are re-configured. Flow through the backflush column is reversed and is placed downstream of the main column. Both columns configurations are demonstrated in Figure 4-1.
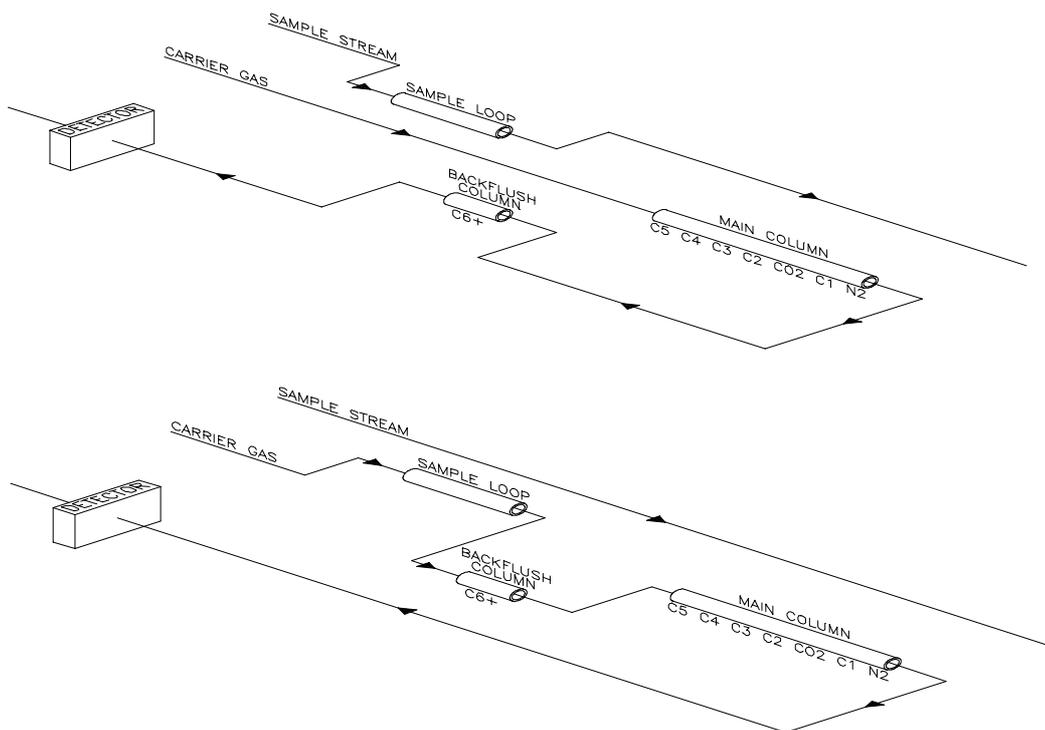
Figure 4-1 Backflush and sampling configuration

The C6+ components that have begun to separate recombine in the backflush column due to reversal of flow direction. Due to this reconfiguration, the C6+ component is the first to encounter the detectors and elude from the columns. The other components that have passed on to the main column now re-enter the backflush column and then flow past the detectors. The column reconfiguration is achieved via valve switching. The backflush valve time is the time in seconds after sample injection that this column reconfiguration occurs. Setting this time is crucial to repeatable energy measurement results.

4.3   Detector Operations

The ENCAL 2000 PGC utilises detectors known as thermal conductivity detectors. The detectors are two tiny thermistors placed in the gas stream. One thermistor, the reference, is placed in the gas stream where only carrier gas is present. The second thermistor, the measurement detector, is placed at the end of the columns where the separated components elude.

Thermistors are electronic components whose electrical resistance is proportional to temperature. A constant current is flowing through each thermistor, inducing a constant rate of heat dissipation and hence temperature experienced by the thermistor. As different components pass over the measurement thermistor, the heat dissipation rate and hence the temperature experienced by the thermistor changes. This is analogous to the wind chill factor that we experience during the winter. As the intensity of prevailing winds increase, it feels colder than the ambient temperature suggests as our bodies are losing heat at a faster rate when subjected to these winds.

The reference detector signal is subtracted from the measurement signal to account for the cooling effects of the carrier gas.

Thus we see that the detectors sense thermal conductivity and not component energy content. These conductivity readings must be correlated with energy content. This is performed by the energy calculation process.

4.4 Energy Calculation

4.4.1 Base conditions

For the calculations of heating value, density and compressibility the RGC 2000 uses the individual component heating values, the ideal relative densities and the summation factors. These are fixed values but are dependent on the base conditions (pressure and temperature). The base conditions used are different from country to country. In this manual we use 273.15 °C and 1 atmosphere and 298.15 °C for the superior heating value. Furthermore the units mentioned in this manual for heating value are kWh/m^3.

4.4.2 Calculation basics

The energy calculation is basically performed using the following three parameters:

- **Component Peak Areas** - need to be precisely and repeatably determined for each analysis. These peaks must then be identified to apply the appropriate response factors to derive component concentrations

- **Response Factors** - are required to convert the raw areas derived from the detectors into component percent concentration, which is the desired quantity

- **Component Contribution** - the total energy and normal density are derived by multiplying the fractional contribution of each component with the heating value of one standard cubic meter of this component respectively with its normal density. The heating values of one standard cubic meter pure gas and its normal density are given values for each of the components to be measured.

Response factors are calculated by analysing a gas mixture whose composition is known. This gas is known as the calibration gas. The area's of the gas components are measured and normalised to generate a table that represents the component's raw percent areas. The response factor is calculated by dividing the components' known percent composition by the measured raw percent area. The response factors are then saved for subsequent use in energy calculations. Thus to calculate the response factors, a table containing the calibration gas composition must be available to calculate it. This table is referred to as the METHOD TABLE.

Component Peak Areas are calculated by carefully monitoring the stream of detector data and deciding where the peaks begin and end. Once the peak areas are found, they must be identified. To identify the components, two tables are required:

- **Elution Time** - table that identifies the elution time of each component. This uniquely identifies the component. The elution time must be entered in the 2nd column of the Method Table.

- **Elution Band** - table that specifies a tolerance band to apply to the component Elution time to accommodate slight variation in elution times between analysis runs. Elution band must be entered in the third column of the Method table.

With the normalised peak areas calculated and the peaks being identified, the response factors are applied to derive the percent concentration of each component. To calculate the heating value and normal density of the mixture two tables are required:

- **Energy** - table that specifies the energy content of a standard volume of each component. For example, if the energy units were kWh/m3 at standard temperature and pressure, each table entry reflects the energy value of a cubic meter of gas composed of just one component at standard temperature and pressure.

- **Density** - table that specifies the normal density of each component.

To be able to calculate the **Compressibility factor Z** of the gas the contribution of each component to this Z factor is calculated using the information in the far right column of the method table labelled ZFR

5   Basic description of RGC 2000 Features

From the user's perspective, RGC 2000 provides the primary means of interacting with the ENCAL 2000 system. RGC 2000 allows the user to maintain the analyser and to generate reports based on analysis runs performed by the analyser.

RGC provides the means to access an ENCAL 2000 analysers in the field, either using the modem connection or the direct connection. Remote analysers may be connected to via regular telephone connections. The local connection is either to the SKT 9 port of the CU or one of the RS-232 serial ports on the fibre optic converter module. Menu *items Open Phone List*, *Port Select*, *Phone Settings* and *Connect* are used to establish communications with the desired Analyser.

Maintenance of the Method tables must be performed in order to tune the unit. *Edit Method*, *Edit TSC*, *Edit SST* and *Configure Analyser* provide the means of performing all the table maintenance functions. Note that you may manually balance the bridge via the *Balance Bridge* function. In the event of loss of data, the *Load Method Table from File* allows the user to download previously stored method data into the Analyser. *The Save Method Table to File* menu item should be performed to have this file available for downloading. All the tables may be printed using the *Print Method Table* menu item.

In the menu item *Reports* the *Online Monitor* can be activated. As long as the On-line Monitor is active data will be written to the PC's hard disk.

To set the Analyser time and date, the *Set Time* menu item is provided. It reads the PC's time, allows the user to review it and send it to the analyser.

Additional maintenance aids include the *Status menu* item, which provides a real-time view of current Analyser operations, and *Get Last Chromatogram* which retrieves the last analysis run chromatogram and report data, and displays it in the main Window. The user may then print the chromatogram using the *Print Chromatogram* menu item.

The method of generating reports is to use the *Online Monitor* menu item. This menu item presents a Dialog Box displaying the report for the previous analysis run. When a new analysis run is available from the Analyser, it is retrieved, a new report is generated and the Dialog Box is updated.

As long as RGC 2000 operates in the Online Monitor mode it will store data files with all analysis and calibration results. The data files are described in Section 8.

6 Menus Reference

This chapter sums up the menu items of the RGC 2000 software. Several menu items that are greyed out are not active in this software version these menu items can be ignored. Other menu items may be only active depending on the mode of operation (secure or insecure mode). Where applicable this will be indicated.

The secure mode is selected by dip-switch setting in the CU (see paragraph 10.2) and is used for those applications where government regulations require a secure system to which the customer has only limited access.

Several menu items are standard "windows" menu's and will not be discussed in this manual. In chapter 7 Operation the use of the menu items is described in detail.

RGC is composed of six major menu headings:

rgc - 60100003 Direct Connection

File Communications Analyzer Reports Advanced Utilities View Window Help

Figure 6-1 Menu bar

1. **File** - contains six selections that allow the user to select a phone list used to connect with a remote PGC via a modem, and to manage printing of several items.

2. **Communications** - contains three selections that allow the user to set several communications settings and to establish a connection with an analyser.

3. **Analyser** - contains eight selections that allow the user to maintain the tables required for proper analyser operations. It also contains two selections to display the current or last chromatogram in the main window.

4. **Reports** - contains two selections that allow the user to activate data storage and select average intervals for the average file

5. **Advanced** - contains set-up password settings, system behaviour after power down, and several special analyser features discussed later

6. **Utilities** – contains test tool for valve control, and resetting of analyses data storage

6.1   File Menu

The File menu contains the following selections:
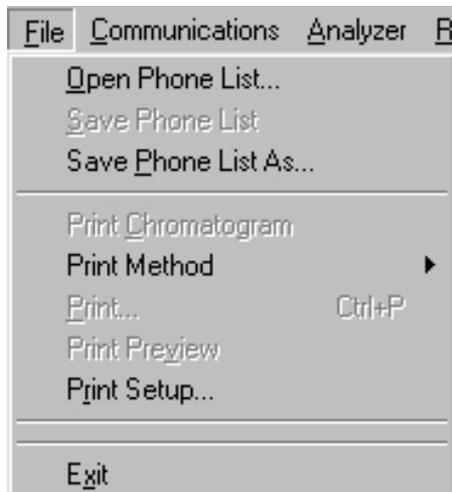
Figure 6-2 'File' Pull down Menu

1.   **Open Phone List** - Allows the user to open a file containing information required to connect to a remote Analyser. The opened phone list is then displayed by the Phone Settings menu selections under the Communication menu.

2.   **Save Phone List** - Allows the user to save a modified phone list.

3.   **Save Phone List As** - Allows the user to save the current phone list in a new file.

4.   **Print Chromatogram** - prints the chromatogram previously retrieved from the Analyser using the *Get Last Chromatogram* selections found in the Analyser menu. Please refer to paragraph 7.5.6 for a sample report.

5.   **Print Method Table** - A separate Method Table exists for each calibration gas connected to the System. This selection prints the Method Table, TSC Table, SST Table, Alarm Table and the Analyser Configuration Table. These tables are retrieved from the Analyser currently connected to RGC.

6.   **Printer Setup** - displays the set-up dialog box for the selected printer. This is the same dialog box displayed by printer set-up found in the Control Panel.

7.   **Exit** – closes the RGC program

6.2   Communications

The Communications menu contains the following selections:
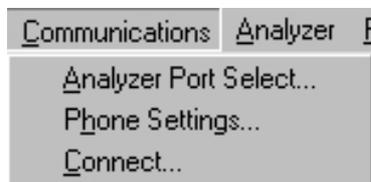
Figure 6-3 'Communications' Pull down Menu

1.   **Analyser Port Select** - allows the user to select which Com port is used and if the analyser is remote or locally connected.

2.   **Phone Settings** – allows the user to select a remote analyser and to enter telephone numbers of remote analysers.

3.   **Connect** - allows the user to connect/disconnect with the selected analyser. When this item is activated, RGC is connected to the analyser. This item is selected a second time to disconnect.

6.3   Analyser

The Analyser menu contains the following selections:
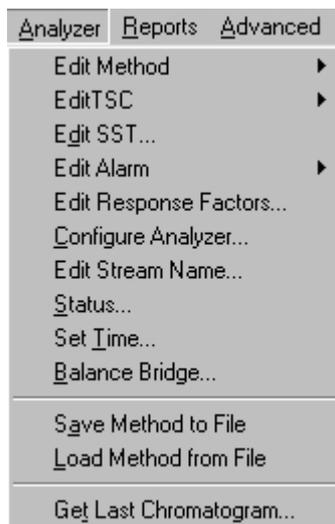
Figure 6-4 'Analyser' Pull down Menu

1.   **Edit Method** - allows user to edit the Method Table.
        There are three Method Tables - one for each calibration gas.

2.   **Edit TSC** - allows the user to edit the Time Sequence Table.
        There are three TSC Tables - one for each calibration gas.

3.   **Edit SST** - allows the user to edit the Stream Select Table.

4.   **Edit Alarms** - allows the user to edit the Alarm Table.
        There are three Alarm Tables - one for each calibration gas.

5.   **Edit Response Factors** - allows the user to edit the response factors for each
        calibration gas. The three sets of response factors are available in one table.

6.   **Configure Analyser** - allows the user to edit the Configuration Table.

7.   **Status** - displays the current status of the connected analyser. This screen is updated
        approximately two times per second.

8.   **Set Time** - allows the user to change the analyser's time and date

9.   **Balance Bridge** - allows the user to manually balance the detector bridge.

10.   **Save Method to File** - allows the user to save the current tables in the connected
        analyser to a file on the PC.

11.   **Load Method from File** - allows the user to download the analyser tables from a file
        on the PC to the connected analyser.

12.   **Get Last Chromatogram** - retrieves the last chromatogram and feature data and
        displays the chromatogram in the main window.

6.4 Reports

The Reports menu contains seven selections:

Figure 6-5 'Reports' Pull down Menu

1. **Online Monitor** – Displays the Online Monitor screen. In this operating mode the RGC software stores analysis data on the PC's hard disk.

2. **Preferences** - Allows the user to enable or disable the processing of average files and allows to enter the time intervals of the average files. In a submenu *File Access Options* settings are done related to the "CUSTOMER files" data storage.

6.5 Advanced

The Reports menu contains seven selections:
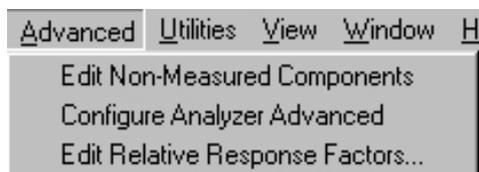
Figure 6-6 'Advanced' Pull down Menu

1. **Edit non-measured components** – Allows the user to enter fixed concentration values of components that are present in the sample gas but are not measured by the chromatograph.

2. **Configure analyser advanced** – Allows the user to enable or disable the use of passwords., sets the analyser' behaviour at power-up after power loss. Allows the user to set a number of consecutive analyses of a selected stream. Setting of a possible time delay between two consecutive analyses.

3. **Edit relative responsfactors** – Allows the user to enable the use of relative responsfactors.

6.6 Utilities
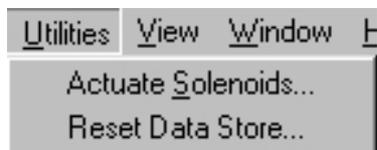
Figure 6-7 'Utilities' Pull down Menu

1. **Actuate Solenoids** – Test facility to check the control of the five available (maximum) stream selection valves and the 10 ports sample valve.

2. **Reset Data Store** – Analyses are stored with and labelled with an analysis number. This number is reset to zero when this menu item is activated.

Note: If the "reset data store" action is performed the unit should first be calibrated to get valid results.

7 Operation

This chapter describes the software functions in detail. The software must be installed according to chapter 3. The hardware connection to the analyser is described in the ENCAL 2000 PGC installation manual.

7.1 Establish connection to local analyser

The first step is to select the communication port that is used. This is done through the menu item *Analyser port select* in the *Communications* menu.

7.1.1 Analyser Port Select

If the *Analyser port select* menu item is selected a dialog box will appear in which the user can select the communication port to be used and the communication baud rate. The standard baud rate setting of the analyser is 9600.

The user must also select the connection mode by selecting one of the radio buttons. In order to connect to a locally connected ENCAL 2000 PGC analyser, *´Direct´* should be selected. After the selections are made confirm by pressing the OK button.
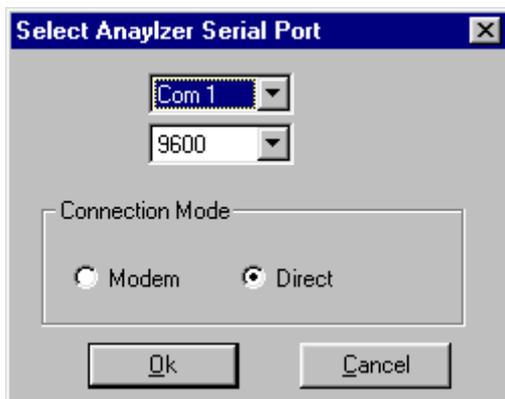
Figure 7-1 'Analyser Port Select' Menu

7.1.2 Connect

To establish the connection between the analyser and the personal computer the *Communications* menu item *Connect* must be activated. As soon as this is done the connection will be established. This takes approximately two seconds in which the software downloads the analyser configuration and its security state. For detailed information on the security state please refer to paragraph 10.2. A window will appear for confirming the connection. After selecting the OK button in this window the communication is established.

As soon as the communication is established the serial number of the analyser of issue is displayed on the title bar.

7.2 Establish connection to remote analyser

To connect to a remote ENCAL 2000 PGC unit the following hardware connections must be established:

- The RS-232 fibre optic converter unit as described in the ENCAL 2000 PGC installation manual must be connected to the ENCAL using the 4 wire fibre optic cable. One RS-232 port must be connected to the control unit. The second RS-232 port must be connected to a modem.

- The local modem must be connected to one of the communication ports of the PC system running the RGC 2000 application.

7.2.1 Analyser Port Select

Select the menu item *Communications* and the submenu *Analyser Port Select*.
The dialog box that appears is shown in Figure 7-1 'Analyser Port Select' Menu.

As described in paragraph 7.1.1 the communication port and baud rate setting which is used must be selected. The standard 9600 baud rate setting is also applicable here. Instead of the *Direct* connection mode the *Modem* radio button must be selected.
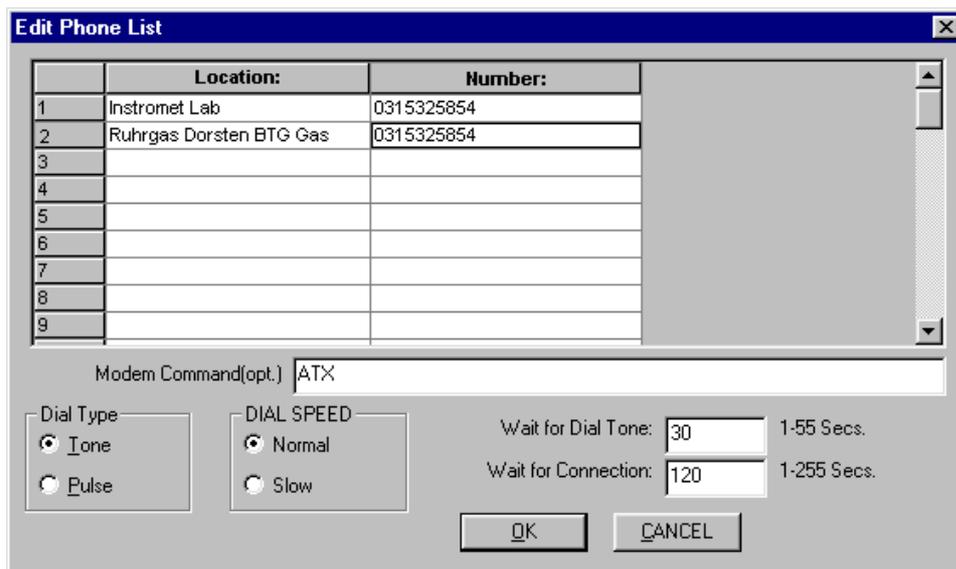
Figure 7-2 Edit Phone List Window

7.2.2 Phone settings

Select the menu item *Phone Settings* in the *Communications* menu. The following window will appear:

- **Locations** – The name of the remote location or analyser identification

- **Number** – The telephone number of the remote modem unit.

  Remark: Comma's can be used in the telephone number to delay dial out to wait for a dial tone if required.

- **Modem Command (optional)** - this is provided to allow the user to enter a command string to his modem, if necessary, to assure Hayes compatibility. This field will normally be empty.

- **Dial type** – allows the user to select pulse or tone dialling. Most users will use tone dialling.

- **Dial speed** – allows the user to select Normal or Slow dialling. Most users will use Normal dialling speed.

- **Wait for Dial Tone** – This allows the user to specify how long RGC is to wait for a dial tone. The default of 35 seconds will be adequate for most users.

- **Wait for Connection** - This allows the user to specify how long RGC is to wait for connection. The default of 60 seconds will be adequate for most users.

7.2.3 Connect

When the phone settings are correctly entered and confirmed using the OK button the connection can be established by selecting *Connect* in the *Communications* menu.

7.2.4 Save Phone List as / Open phone List

The phone settings can be entered and can be stored using the *File* Menu selection *Save Phone List as*. In a next session this file can be loaded using the *Open Phone List* selection.

7.3 Secure Initial/Factory Settings

Each ENCAL 2000 PGC is delivered with factory setting which are applicable for the customer's application. The analyser is also tuned to perform correct integration of the analysis. The settings are stored in the analyser. After the connection between customer's RGC 2000 computer and the ENCAL is established for the first time we recommend saving the configuration to the PC's hard disk. If for any reason the settings are lost the original setting can be restored.

7.3.1 Save Method To File

To store the analyser setting on the PC's Hard disk select *Save Method To File* in the *Analyser* menu. It is not possible to assign a name and storing location. RGC automatically assigns the *CUSTOMER ID* which can be found and edited in the Submenu *Configure Analyser* in the *Analyser* Menu. The file Extension is *BIN*

The file will be located in a subdirectory of the REPORTS directory. The name of this subdirectory is identical to the *Customer ID*. If the default installation location is used this means that the following would be applicable for an analyser with a Customer ID '1234567890'.

C:\Programm files\Instromet\Reports\1234567890\1234567890.BIN

The *CUSTOMER ID* must be an integer with a maximum of 10 digits. In the factory standard setting the Customer ID is identical to the analyser serial number.

7.3.2 Load Method From File

If a method is saved it can be loaded into the analyser's memory by selecting *Load Method From File* in the *Analyser* menu.

The *Customer ID* in the *Configure analyser* window is decisive for the file that will be downloaded. This means that if the Customer ID is 1234567890 the software will automatically search in the Reports subdirectory 1234567890 for the file named 1234567890.BIN.

If a method is saved under another name, the Customer ID should be changed accordingly before giving the *Load Method From File* command.

7.3.3 Print Method Table

As soon as a connection is established to an ENCAL 2000 PGC analyser it is possible to make a printout of the main settings of the analyser. By selecting *Print Method Table* in the *File* menu the user can select any of the three method tables available.

A printout of Method Table 1 consists of three pages containing the following information:

- Complete Method Table
- TSC table
- Other analyser parameters (like Customer ID, Station name, Calibration time, bridge balance settings and others)
- SST table (stream sequence table)
- Alarm settings
- Non-measured components
- Response factors
- Stream names

A Print out of Method table 2 or 3 exists of 2 pages containing only the information that is different from the information in Method table 1:

- *Elution time* and *Cal Weight* column from the Method table
- TSC table
- Alarm settings
- Response factors

7.4 Edit Initial/Factory Settings

The following paragraphs describe the functionality of the analyser settings and how they can be changed. The following (incomplete) list contains some reasons for changing the settings.

- Change of calibration gas
- Optimise integration settings (to compensate for change in Helium pressure, oven temperature or drift)
- Change Auto Calibration time and numbers of calibration runs to be averaged
- Change alarm settings
- Adjust Bridge Balance
- Change heating value units / norm conditions
- Change concentrations of unmeasured components or enable/disable the use of them.
- Change/enable/disable relative response factors

7.4.1 Edit Method Table

Select *Edit Method Table* from the *Analyser* menu. Select method table 1,2 or 3.
The following window will appear when a method table 1 is selected.

Metric Method Table 1
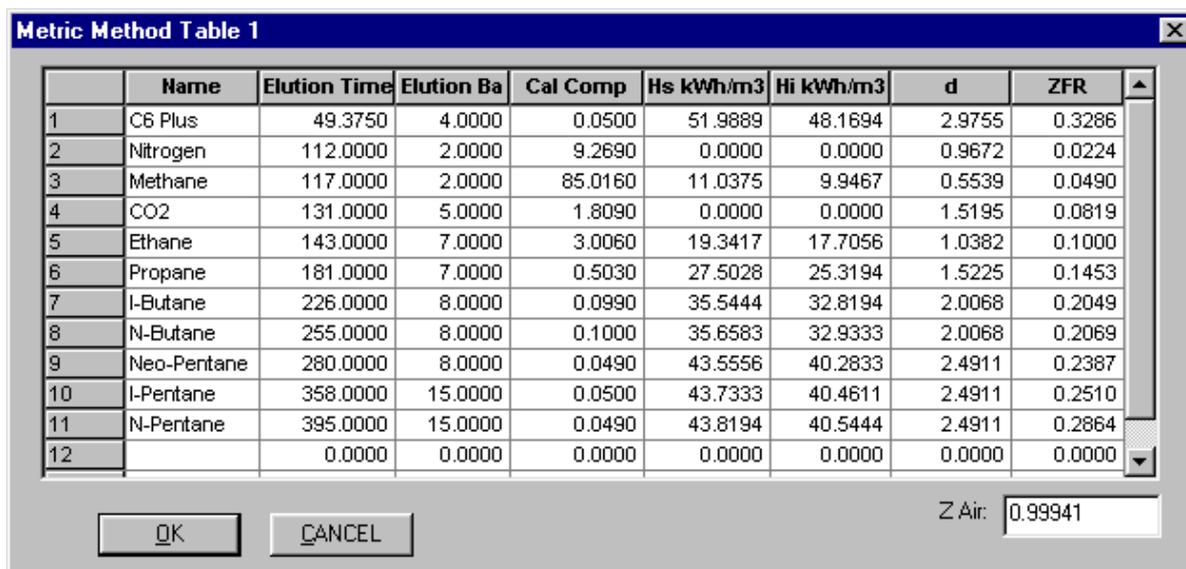
	Name	Elution Time	Elution Ba	Cal Comp	Hs kWh/m3	Hi kWh/m3	d	ZFR
1	C6 Plus	49.3750	4.0000	0.0500	51.9889	48.1694	2.9755	0.3286
2	Nitrogen	112.0000	2.0000	9.2690	0.0000	0.0000	0.9672	0.0224
3	Methane	117.0000	2.0000	85.0160	11.0375	9.9467	0.5539	0.0490
4	CO2	131.0000	5.0000	1.8090	0.0000	0.0000	1.5195	0.0819
5	Ethane	143.0000	7.0000	3.0060	19.3417	17.7056	1.0382	0.1000
6	Propane	181.0000	7.0000	0.5030	27.5028	25.3194	1.5225	0.1453
7	I-Butane	226.0000	8.0000	0.0990	35.5444	32.8194	2.0068	0.2049
8	N-Butane	255.0000	8.0000	0.1000	35.6583	32.9333	2.0068	0.2069
9	Neo-Pentane	280.0000	8.0000	0.0490	43.5556	40.2833	2.4911	0.2387
10	I-Pentane	358.0000	15.0000	0.0500	43.7333	40.4611	2.4911	0.2510
11	N-Pentane	395.0000	15.0000	0.0490	43.8194	40.5444	2.4911	0.2864
12		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Z Air: 0.99941

OK   CANCEL

Figure 7-3 Method Table 1

The table contains eight columns with the following information.

- **Name** – this column contains the component names

- **Elution Time** – time when the component is expected to exit the columns and pass over the detector. Expressed in seconds.

- **Elution Time Band -** specifies an upper and lower bounds to place about the Elution Time to allow for some variation in retention time. Expressed in seconds.

- **Cal Comp** – concentrations of calibration gas components. Expressed as a percent. The values must be normalised so that the total of the components is always 100%.

- **Hs ……** - Superior heating value for 1 m3 of the gas component of issue at norm conditions

- **Hi ……** - Inferior heating value for 1 m3 of the gas component of issue at norm conditions

- **d** – Relative density of the component under ideal gas conditions

- **ZFR** – Summation factor of each component ($\sqrt{b}$ according to ISO 6976) at 237.15 K and 101.325 kPa

- **Z-air -** The compressibility (or compression factor) of air at 273.15 K and 101.325 kPa

The information in the method table is used to perform the heating value calculation. Since the calculation is done according to the ISO 6976 the information is also derived from this standard. This means that the following columns are filled with fixed (however editable) values. Hs, Hi, d, ZFR, Z_{air}

The units in which the heating value is expressed can be MJ/m3, kJ/m3, kCal or kWh/m3. This selection is done during installation of the RGC software. Refer to chapter 3.

7.4.2   Edit Time Sequence Table (TSC)

When the Edit TSC menu selection is made, RGC first retrieves the TSC tables from the currently connected Analyser. The TSC tables may be edited at any time. After the edited data is uploaded to the analyser it is held in a memory buffer until the current analysis is complete. At the end of the running analysis the modified TSC Table is moved from the buffer to the active location. The next analysis will start using the updated information. When the Edit TSC selection is made the user must select one of the three available TSC tables. If TSC table 1 is selected the following window will appear:
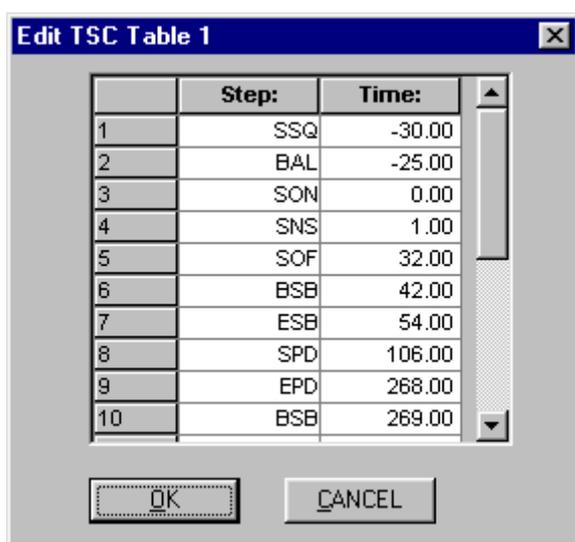
Figure 7-4 TSC Table 1 window

- **Step** - shows the consecutive entries in the TSC table. When a field is modified a list box will appear with all possible entries. The functionality of the three-letter Mnemonics is explained later in this paragraph.

- **Time** - allows the user to enter the time associated with the selected TSC List box step. Entry is in seconds.

When the operator presses the Ok Pushbutton, RGC sends the new data to the connected Analyser. The communications activity is indicated by the Dialog Box. At 9600 bps, this box is displayed on the screen for just an instant. When the Cancel button is pressed the TSC data in the analyser will remain unchanged.

The following table lists the TSC Table mnemonics and their associated function:

SSQ   Start Sequence - must be the first command in the TSC Table
ESQ   End Sequence - must be the last command in the TSC Table
SON   Sample On - turn the sample-inject valve on. Must be at 0.00 time.
SOF   Sample Off - time is adjusted to retain C6+ components in the backflush column.
BVN   Blocking Valve On - operates the sample-blocking valve if the analyser is fitted with this option.
BVF   Blocking Valve Off - turns the block valve off.
BFN   not used (Future option)
BFF   not used (Future option)
SNS   Select Next Stream - selects the next stream to be analysed and starts the sample flushing the sample loop.

SPD   Start Peak Detection - sets the initial baseline and activates the automatic peak detection.

EPD   End Peak Detection - sets the final baseline (if required) and stops the automatic peak detection.

BSB   Begin Simple Peak with Baseline - sets the opening baseline for a simple peak and starts integrating the peak area.

ESB   End Simple Peak with Baseline - sets the closing baseline for a simple peak and stops integrating the peak area.

NOP   No Operation - used in place of any TSC command to temporarily disable that function. (Normally used when checking for a malfunction.)

BAL   Balance - starts the automatic bridge balance function. The automatic balance stops when the SON command is executed. (This must be entered as a negative (-) value before the SON command.)

NUL   No operation – normally used to fill unused fields at the end of the TSC table

7.4.3   Edit Stream Selection Table (SST)

When the Edit SST menu selection is made, RGC first retrieves the SST Table from the currently connected Analyser. This communications activity is indicated by the display of a Dialog Box. When the data is retrieved, a Dialog Box with the following controls is displayed. There are three tabs available in this window; SST, Cal Select, Ports. Each of them is described in the following paragraphs.

7.4.3.1   SST (stream sequence table)

As default the SST tab is selected and the following window will appear.
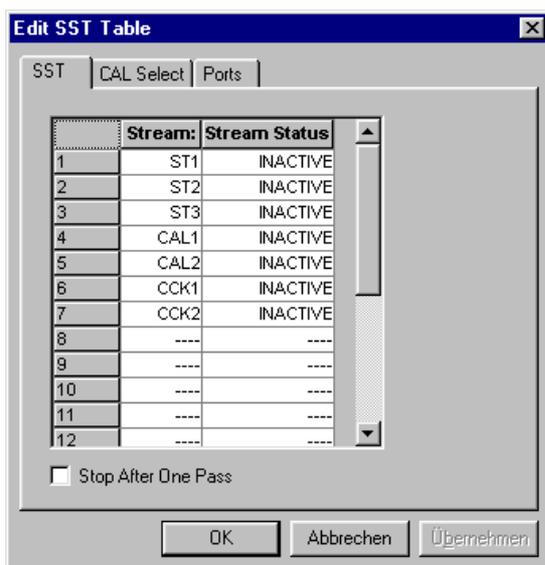
Figure 7-5 Stream Sequence Table

- **Stream –** This column shows all available streams.
  In practice the following stream types will be used.

  STR 1   : This is process gas connected to "Stream 1" input of the analyser.

  STR 2   : This is process gas connected to "Stream 2" input of the analyser.

  STR 3   : This is a (cylinder) gas connected to the "Reference" input of the analyser.

  CCK 1   : Stands for Calibration Check and activating this stream will result in analysis of the calibration gas connected to "Cal. 1" input of the analyser without performing a real calibration.

  CCK 2   : Stands for Calibration Check and activating this stream will result in analysis of the calibration gas connected to "Cal. 2" input of the analyser without performing a real calibration.

  CAL 1   : This is the calibration gas connected to "Cal. 1" input of the analyser activating this will result in performing continuous calibrations using calibration gas 1

  CAL 2   : This is the calibration gas connected to "Cal. 2" input of the analyser activating this will result in performing continuous calibrations using calibration gas 2

NOTE: The software is capable of handling three calibration gasses. The analyser, however only provides two calibration gas connections. If required the "Reference" connection, which is normally configured as STR 3, can be configured as a calibration gas input. This is done in the *Ports Select* sub-menu of the *SST Table (see paragraph 7.4.3.3).*

- **Stream Status** – field in which the user can activate or deactivate the selected stream. If a stream is active, it is analysed in the order it appears in the SST table. If a stream is inactive, it is skipped and not analysed.

- **Stop after one pass** - If this check box is activated the sequence of streams will be analysed once and the analyser will go back to the idle state.

The original factory settings of the SST table will only show those streams for which hardware is available in the analyser. If for example the analyser of issue has 1 stream and 1 calibration gas connection available only STR1, CCK1, and CAL1 will be entered in the *stream* column.

Activation of streams

Activation of streams is normally not done directly in this table. There is a link between the Online Monitor and the SST table. In the Online Monitor streams that are entered in the SST table can be activated by clicking the checkbox of the stream of issue. This will automatically update the SST table information accordingly. Refer to paragraph 7.5.1

Automatic Calibration

The entries of CAL1 and CAL2 in the SST table are also linked to the automatic daily calibration. If CAL1 is removed out of the table no automatic calibration will be performed for CAL1. The same is applicable for CAL2. For more information refer to paragraph 7.5.3.

NOTE: It is important that the SST table has no empty lines between stream entries. Empty lines are seen as the end of the table and following entries will be discarded.

7.4.3.2   CAL Select

If the *CAL Select* tab is selected the following window will appear.
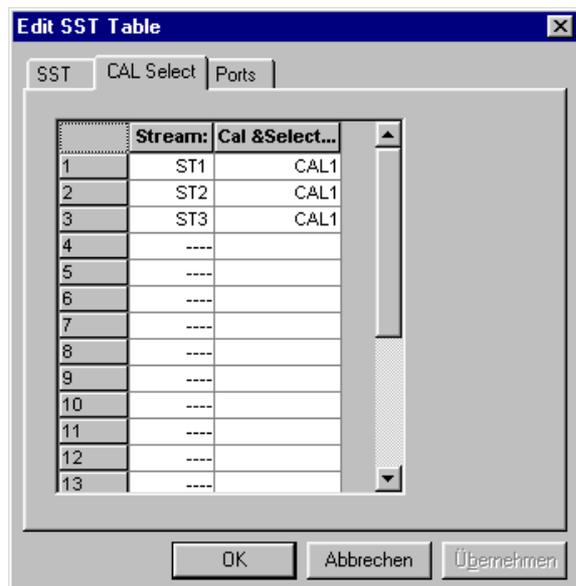
Figure 7-6 CAL Select Table

The analyser can be configured to use one of three different calibration gases. Each stream to be analysed must be assigned to one of the calibration gases available. The appropriate information should be entered into the Method Table (calibration gas composition), TSC Table and Alarm Table prior to assigning a sample stream to a calibration gas.

- **Stream** – In this column all available streams should be entered (maximum STR1, STR2 and STR3)

- **CAL & Select** – In this column the Calibration gas which is used for the stream in that row must be selected.

If a stream is assigned to CAL1 it will use the information from Method Table 1, TSC table 1, and Alarm table 1. This feature makes it possible to use different calibration gasses for different streams. This means that for different stream gas compositions the user can select the best fitting calibration gas composition. This will result in more accurate analysis results.

7.4.3.3 Ports Select

If the third and last tab *Ports* in the Edit SST Table window is selected the following window will appear:
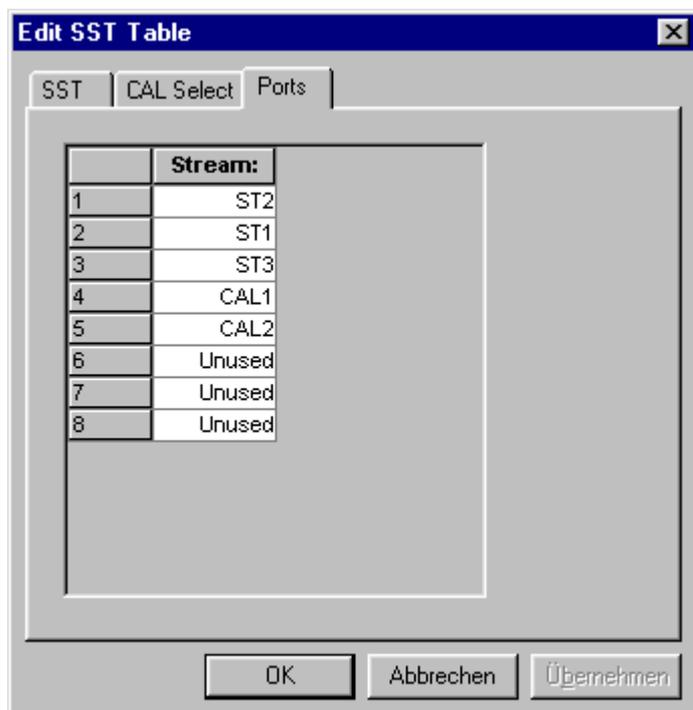
Figure 7-7 Ports Assigning window

This column allows the user to associate the location of each stream with a physical connection to the analyser hardware. The analyser has a maximum of 6 hardware outputs available. The first one is always used for the 10 port membrane valve in the analyser oven and is used for sampling and back-flushing. The other five ports are assigned in this table.

<div style="text-align:center">

WARNING !!

</div>

This table is established at the factory when the system is configured for your requirements. This table should not be changed unless you are installing a modification to your hardware.

7.4.4 Edit Alarm settings

When selecting *Edit Alarm* in the *Analyser* menu the user can choose between the three available alarm tables. If alarm table one is selected the following window will be displayed.

Edit Alarm Table One
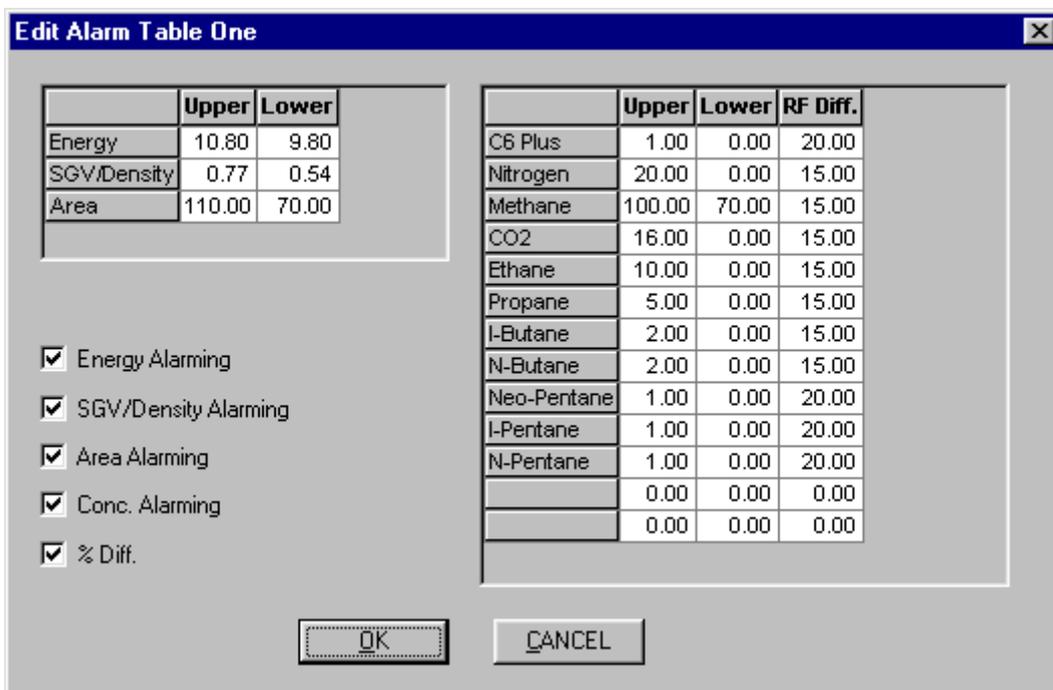
	Upper	Lower
Energy	10.80	9.80
SGV/Density	0.77	0.54
Area	110.00	70.00

	Upper	Lower	RF Diff.
C6 Plus	1.00	0.00	20.00
Nitrogen	20.00	0.00	15.00
Methane	100.00	70.00	15.00
CO2	16.00	0.00	15.00
Ethane	10.00	0.00	15.00
Propane	5.00	0.00	15.00
I-Butane	2.00	0.00	15.00
N-Butane	2.00	0.00	15.00
Neo-Pentane	1.00	0.00	20.00
I-Pentane	1.00	0.00	20.00
N-Pentane	1.00	0.00	20.00
	0.00	0.00	0.00
	0.00	0.00	0.00

☑ Energy Alarming

☑ SGV/Density Alarming

☑ Area Alarming

☑ Conc. Alarming

☑ % Diff.

OK   CANCEL

Figure 7-8 Edit Alarm Table One Window

The following alarms can be set:

- **Energy alarm** – allows the user to specify limits used to identify a heating value alarm condition.

- **SGV/Density alarm** – allows the user to specify limits used to identify a density value alarm condition.

- **Area alarm** - allows the user to specify limits used to identify a total peak area alarm condition.

- **Concentration alarm** - allows the user to specify limits used to identify concentration alarm conditions for all components.

- **% Difference alarm** – allows the user to specify a maximum allowable difference in terms of percentage between the response factors which are momentarily used and newly calculated response factors of a performed (automatic) calibration procedure.

  If a calibration is performed and the % difference alarm is activated the response factor differences will be compared with the settings in the alarm table.

If the difference of one or more of the response factors exceeds the allowable limits the calibration will be discarded and the analyser will continue working with the ´old' response factors.

If the Online monitor was active during the calibration procedure the response factor differences in terms of percentage can be found in the RSP files which are stored in the Reports directory. If the % difference alarm was active and a % difference alarm occurred, the RSP file will indicate the following line:

´Response factor difference exceeded. Factors not stored.'

If the % difference alarm is disabled, newly calculated response factors will always be excepted and stored

The alarms can be activated or deactivated by clicking the check boxes for the different alarm types. The alarm status is shown in red in the Online Monitor.

7.4.5 Edit Response Factors

The stored response factors can be edited manually by selecting *Edit Response factors* in the *Analyser* menu. The following window will appear.
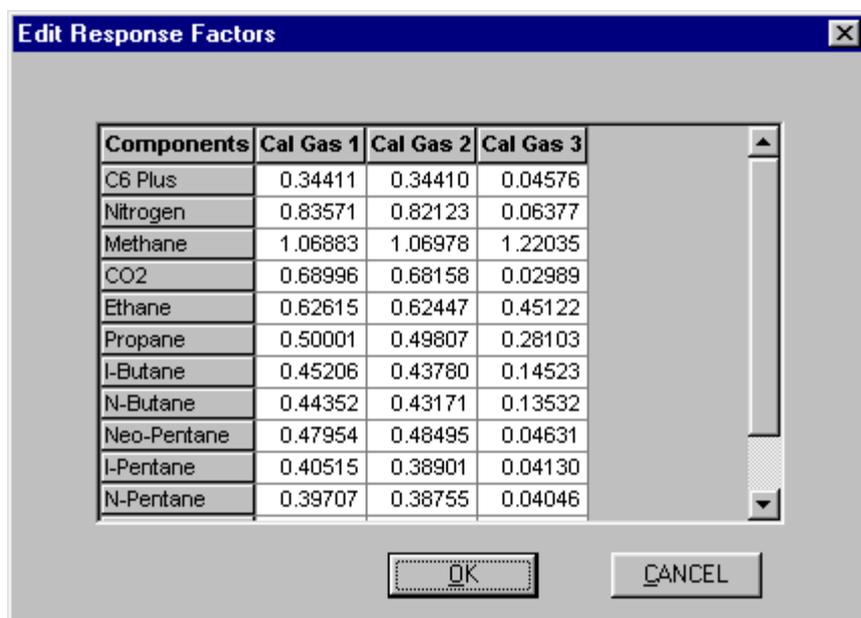
Figure 7-9 Edit Response Factors Window

In the three columns the response factors are given for the maximum available three calibration gasses.

WARNING !!

Changing the response factors manually will result in differences in analysis results that will not be consistent with a calibration.

7.4.6   Configure Analyser

If *Configure Analyser* in the *Analyser* menu is selected the following window will appear:
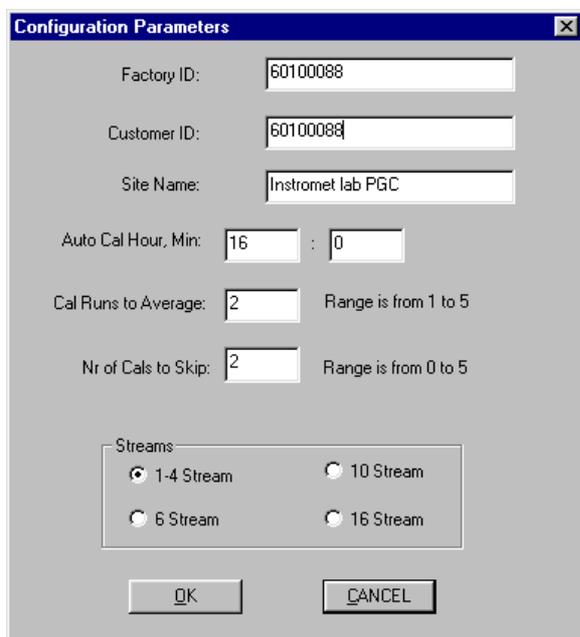
Figure 7-10 Configure Analyser window

- **Factory ID** – This is the serial number of the analyser

- **Customer ID** – This is a customer identification number. The field must be filled with an integer with maximum 10 digits. This number is used for the name of the directory in which the analysis data is stored.

- **Site name** – Descriptive location of the ENCAL 2000 PGC analyser

- **Auto Cal, Hour, Min.** – Hour and minute setting at which a daily automatic calibration will be performed for each of the Calibration gasses.

- **Cal runs to average** - Specifies the number of calibration runs that is to be averaged

- **Cal runs to skip** – Specifies the number of CAL analysis, which will precede the calibration runs. These calibration results will not be used in the calculation of the response factors but are meant to make sure the system is sufficiently flushed with the calibration gas.

- **Streams** – This is not applicable to the ENCAL 2000 PGC and should always have the 1-4 radio button selected.

7.4.7 Edit Stream Names

To identify the sample stream connected to the analyser select the *Edit stream names* command in the *Analyser* menu. The following window will appear:
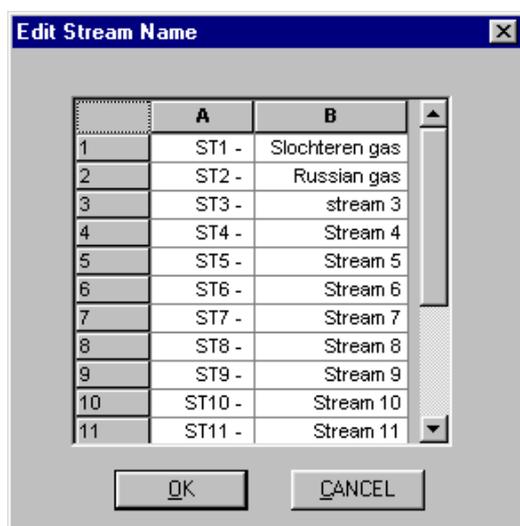
Figure 7-11 Edit Stream names window

The stream names assigned to the different streams are used in the data storage files and will also be shown on the chromatogram printouts.

7.4.8 Set Time

The analysers clock time can be set using the *Set Time* command in the *Analyser* menu.
If the command is given RGC will ask for confirmation to write the PC time to the analyser.
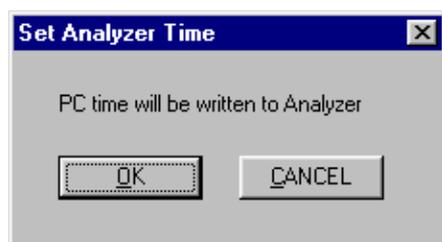
Figure 7-12 Set Analyser Time window

To edit the analyser time, the user must first edit the PC time and then perform the Set Time action.

Note: The analyser time might be overruled by the Control Unit depending on the settings of the clock synchronisation. For details refer to paragraphs 3.4.3 and 10.3

7.4.9 Balance Bridge

This menu item allows the user to balance the detector bridge manually. Upon selection of this menu item, the following Dialog Box is displayed:
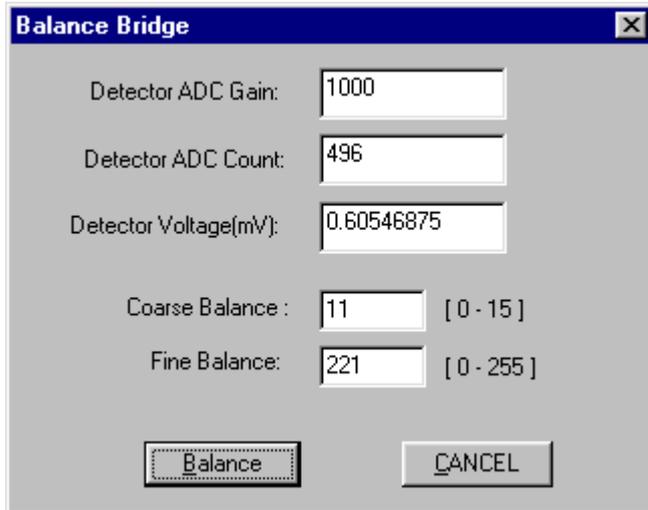
Figure 7-13 Bridge Balance window

- **Detector ADC Gain** - current setting of programmable gain amplifier stage that drives the ADC (Analogue–Digital-Converter)

- **Detector ADC Count** - current ADC reading.

- **Detector Voltage (mV)** - current detector voltage.

- **Coarse Balance** - used to get detectors close to being in balance. Valid entries are 0 through 15.

- **Fine Balance** - used to set final balance point. Valid entries are 0 through 255.

- **Balance Pushbutton** - when the operator presses this button, the balance Edit Boxes are read, the data validated and then sent to the analyser as its new setting. User feedback of successful operation is the new detector balance point as indicated by the detector voltage.

- **Cancel Pushbutton** - terminates this dialog box.

The bridge is considered to be in balance when the detector voltage reading is between 0.4 en 0.9 mV at a gain of 1000.

Warning !!

The bridge should not be balanced during an analysis run.

During normal operation it should not be necessary to balance the bridge because in the TSC table the balance command will check if the detector is correctly balanced. If an unbalance is found which exceeds the allowable limits the bridge will be automatically balanced. Since Automatic bridge balancing is done in small steps it might not be completed in the time available. The balance command is normally set in the TSC table at about −25 second. Adjustment of the detector balance will stop at 0 seconds since the analyses start at that time. If the bridge is still unbalanced RGC will continue to adjust it in the following analyses.

7.4.10 Preferences

7.4.10.1 General

One of the data files that are stored is the AVG-file. In this file averages are calculated for three different time intervals. The first one is a daily average (24 hours). The time interval for the other two averages is selectable. The selection and activation of the averages is done by selecting *Preferences* in the *Reports* menu. The *General* tab is the default tab that will be displayed.
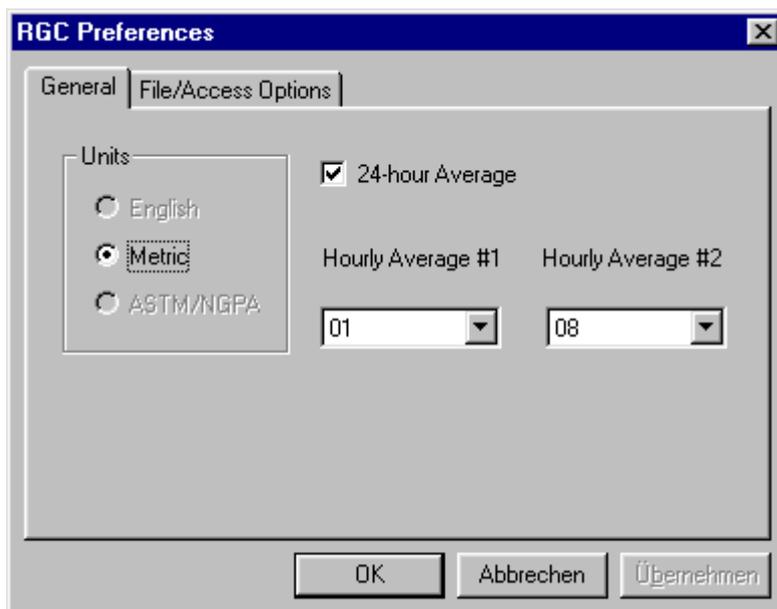
Figure 7-14 RGC Preference window

The 24 hours selection allows the user to disable the 24 hours averaging. The Hourly average 1 and 2 can be set to the following time intervals: 1,2,3,4,6,8 or 12 hours. These averages can also be disabled by selecting a time interval of 0 hours.

The units are pre-selected as being Metric units. This refers to the calculation method that is used.

7.4.10.2 File Access Options

If the *File Acces Options* tab is selected the following window will be displayed:
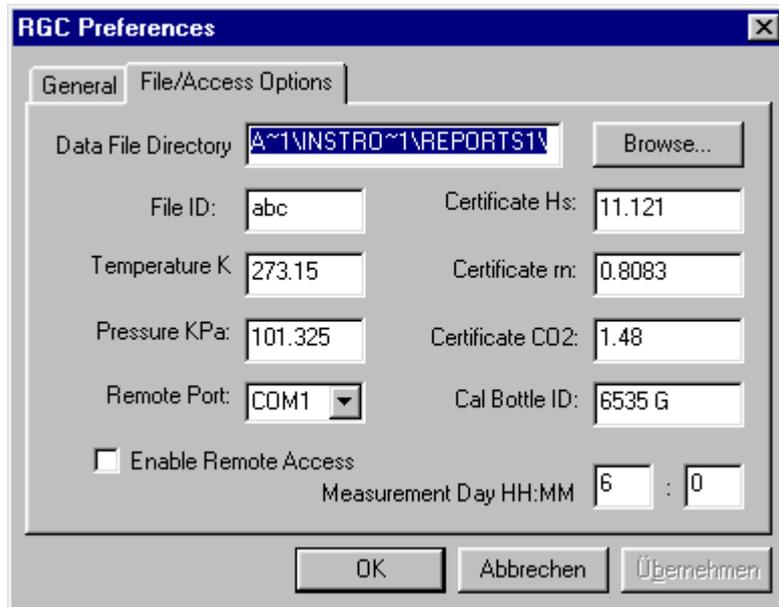
- **Data file Directory** – This is the directory in which the "Customer" files will be stored (see also paragraph 9.2)

- **File ID** - This is a three-letter file name prefix. The names of all Customer files stored will start with these three letters.

- **Temperature K** – Reference Temperature required to calculate normal density for the "customer files" storage

- **Pressure KPa** – Reference Pressure required to calculate normal density for the "customer files" storage

- **Remote Port** – For factory use only

- **Certificate Hs** – Superior Heating value of the calibration gas

- **Certificate rn** – Normal density of the calibration gas

- **Certificate CO$_2$** – CO$_2$ concentration of the calibration gas according to the certificate

- **Cal Bottle ID** – Serial no. of the calibration gas bottle

- **Enable Remote Access** - For factory use only

- **Measurement Day** – This is the starting time of a new day (daily averages will start and end at this time)

7.4.11 Edit Non Measured Components

RGC 2000 offers the possibility to enter fixed concentrations for four components; Hydrogen, Helium, Oxygen, Carbon monoxide. To activate the use of these unmeasured components the *´Edit Non-Measured Components'* in the *Advanced* menu must be selected. The following window is displayed.
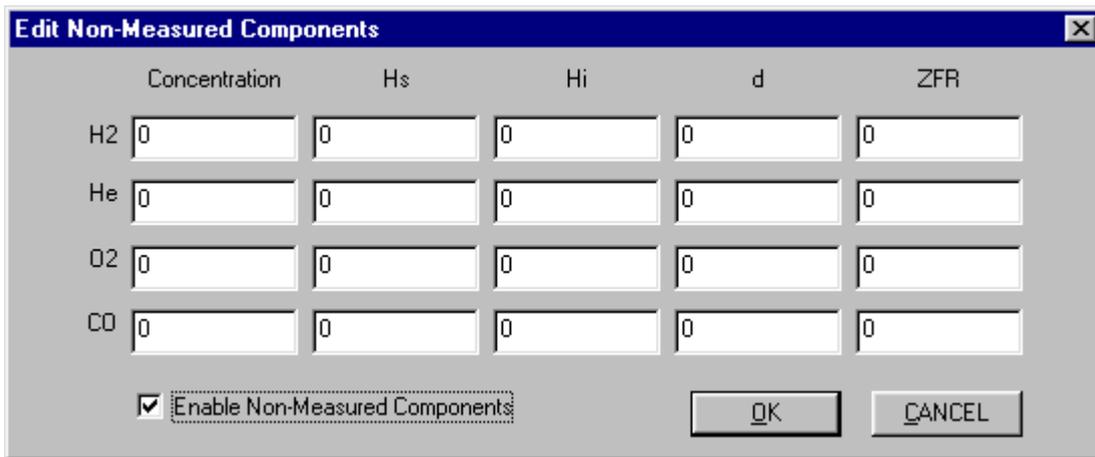
Figure 7-15 Edit Non-Measured Components window

The Hs, Hi, d and ZFR columns have the same functions as those in the Method table. In the concentration Column the user can enter the concentrations of the components as they are present in the sample gas. These values are considered to be valid for all sample gasses connected to the analyser (STR 1 and STR 2).

If the checkbox is not selected the non-measured components can not be edited and will be discarded in the calculations of heating value.

7.4.12 Configure Analyser Advanced

Upon selection this menu item, the following window is displayed:
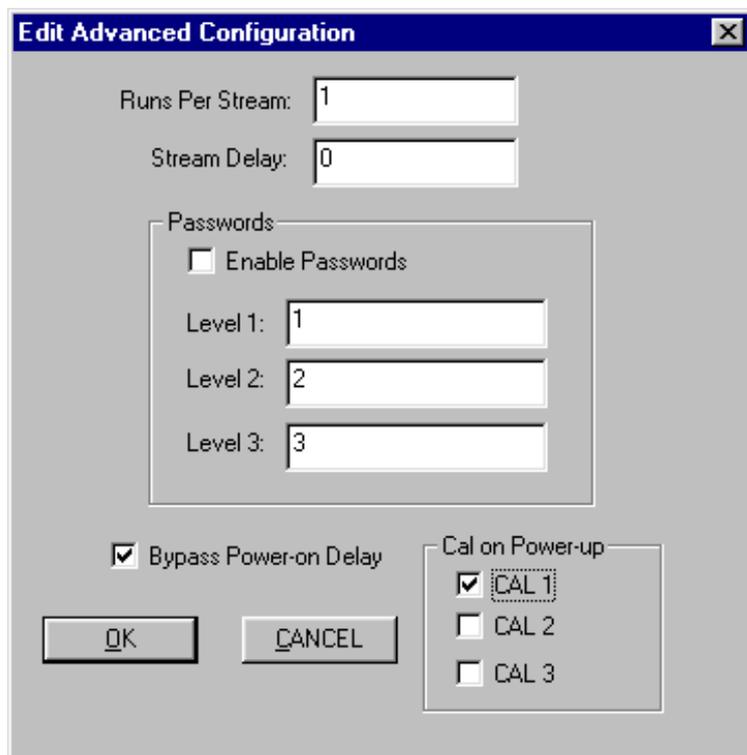
Figure 7-16 Edit Advanced Configuration window

- **Runs Per Stream** – This field allows the user to enter the number of times each activated stream in a sequence will be analysed.

- **Stream Delay** – This field allows the user to enter a delay between consecutive analyses in a sequence. The delay is expressed in seconds.

- **Check box Enable Passwords** – Not active in this software version

- **Level 1,2 and 3** – Not active in this software version

- **Bypass Power-on Delay**- When activated this setting results in a delay after a power up. This delay of 1½ hour allows the analyser to warm up and stabilise.

- **Cal on power up** – Allows the user to select 1 to 3 calibration gasses which will be used to auto calibrate the analyser after a power up situation. If activated the Power on Delay will precede the auto calibration procedure(s). Make sure the selection contains only those calibration gasses for which hardware/gas is available.

7.4.13 Edit Relative Response factors

If this menu item in the *Advanced* menu is selected the following window is displayed:
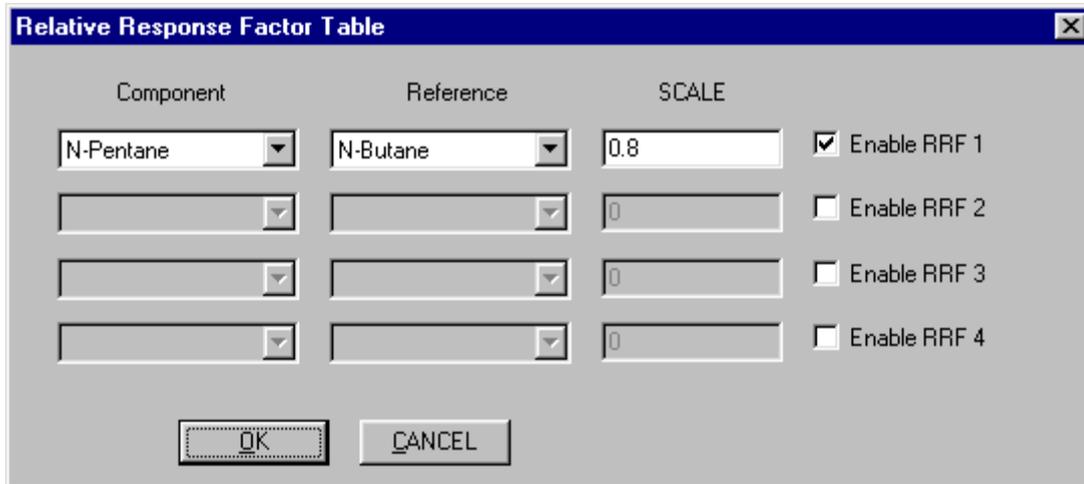
Figure 7-17 Relative Response Factors window

The relative response factors enable to relate the response factor of a certain component to the response factor calculated for an other component. In the example above the normal Butane component is available in the calibration gas. During a calibration the response factor for n-Butane is calculated. The response factor for n-Pentane will be set at 0.8 x $Rf_{(n\text{-}Butane)}$ Using this method makes it possible to use calibration gasses with fewer components.

- **Component** – This is the component name for which the relative response factor is calculated.

- **Reference** – This is the name of the component whose response factor is used to calculate the relative response factor

- **Scale** – This is the multiplication factor

The relative response factor is calculated as follows:

Relative RF "component" = RF "reference" x Scale

7.5   Normal Operating Procedures

The following paragraphs describe general procedures that are used to perform normal operations like starting analysis, activating calibrations and printing chromatograms.

7.5.1   On Line Monitor (mode)

Starting the *On-line Monitor* selection in the *Reports* menu will display the "ONLINE MONITOR" Window as shown below.

Figure 7-18 Online Monitor window

As described earlier in chapter 5 the Online Monitor is linked to data storage. As long as the Online-Monitor is active the PC software will communicate actively with the analyser and collect all analysis data. The data will be stored on the PC's hard disk. To prevent unintended interruption of the data storage the following message will be displayed when the operator closes the Online Monitor. Only after confirmation will the Online Monitor be closed.
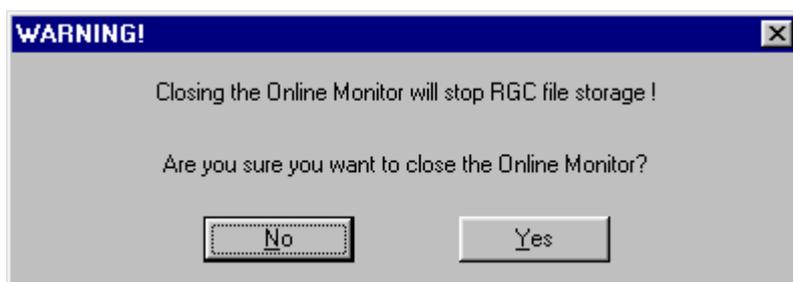
Figure 7-19 Warning text

Information in the Online Monitor:

- **Site Name** – The first line shows the site name as entered in the configuration menu.

- **Analysis** – This line shows: stream number, stream name, date, time, analysis number of the last performed.

- **Alarms** – This line shows the alarm status. If one of the selected alarms as described in paragraph 7.4.4 is active this will be shown on this line. An extra alarm that can be found here is the "*unknown*" alarms. For more detail, see chapter 8.

- **Hs** – Superior heating value expressed in either kWh/m^3, MJ/m^3, kJ/m^3, $kCal/m^3$ and always as a secondary unit in Wobbe.

- **Hi** - Inferior heating value expressed in either kWh/m^3, MJ/m^3, kJ/m^3, $kCal/m^3$ and always as a secondary unit in Wobbe.

- **rn** – normal density expressed in kg/m^3

- **d** – relative density

- **Z** – compressibility (or compression factor) of the gas (Z_{base} according to ISO 6976)

- **Unnorm Sum** – total of unnormalised component values

- **Peak Area** – total of the integrated peak area's

- **Analysis time** – time into the analysis

- **Analysis state** – current state of the analyser (idle, running, flushing etc.)

- **Stream** – indicates the stream which is currently analysed

- **Next Stream** – indicates what stream will be analysed next, this stream is all ready being flushed through the sample loop during the current analysis.

- **Streams** – all available stream can be activated or deactivated here

- **Print Chromatogram** – activating this button will result in an automatic print-out of all analysis chromatograms (streams CCK's or Calibration analyses)

- **CAL Buttons** – for each available calibration stream a button is available to initiate a calibration

- **Store Chromatogram** – allows the user to store a chromatogram in a file. (For detailed information refer to paragraph 9.2).

In the analyser results table the following columns are displayed:

- **Column 1 - Component name** – these contain the component names which are the same as entered in the method table which is used for the last performed analysis

- **Column 2 – Time** – elution time of the components

- **Column 3 – Concentration** – component concentrations (normalised)

- **Column 4 – Area** – integrated peak areas for all components

- **Column 5 – Response factor** – the response factors used for calculation of the concentrations

- **Column 6 – Hs** - the heating value contribution of the components

- **Column 7 – d** – the relative density contribution of the components

- **Column 8 – AVG. RF.** - This column is only filled after the last calibration run of a calibration procedure. The response factors of the single calibration runs will be averaged and displayed in this column.

7.5.2 Activate Stream Analysis

Activation of streams can be done directly from the Online Monitor. For all available streams a selection button is available which if activated will set the stream as being active in the SST table. If a stream is activated the analyser will first finish the current analysis and the "next" analysis (because the sample loop was already being flushed with the gas of the "next" stream). If more then 1 stream is activated all activated streams will be analysed sequentially.

7.5.3 Activate Calibrations

If the CAL1 or CAL2 button in the Online monitor are activated the ENCAL will start a calibration procedure using the calibration gas 1 or 2. The number of calibration runs that will be performed is the number that is set in the *Configure Analyser* menu (paragraph 7.4.6). If the CAL Buttons are activated a pop-up window will indicate how many CCK runs (to flush the system) and how many calibration runs (to average) are set in the C*onfigure Analyser* menu. This is done to inform the user how much time the calibration procedure will take. At this point the user can still cancel the calibration and change settings in the *Configure Analyser* menu if he wants to change the number of calibration runs.

ATTENTION! ✕

This calibration will take 1 CCK runs and   2   Cal runs.

Are you sure you want to continue?

[<u>O</u>K]   [<u>C</u>ANCEL]

Figure 7-20 Calibration Acknowledge

7.5.3.1 Calibration chromatograms

It is important that the Online monitor stays activated during a calibration. If the Online monitor is closed during a calibration the calibration will still be performed correctly but the information in the chromatograms (if printed) will differ. If the Online monitor is active the chromatograms will (among other derived parameters) contain the following information:

(The example below is based on a calibration of two three cal- runs which are to be averaged.)

Chromatogram Calibration run 1:

This chromatogram will show the exact calibration gas composition and the response factors that are calculated out of this composition and the peak areas found during the calibration analysis run 1.

Chromatogram Calibration run 2:

This chromatogram will show the exact calibration gas composition and the response factors that are calculated out of this composition and the peak areas found during the calibration analysis run 2.

Chromatogram Calibration run 3:

This chromatogram shows the response factors as calculated out of the calibration gas composition and the peak area's found during the calibration analysis run 3. In the column AVG RFs the average response factors are shown calculated from three sets of response factors resulting from the three calibration runs. The composition in this chromatogram is calculated from the average response factors.

If any of the above calibration chromatograms is retrieved and printed with the Online monitor closed the response factors will be the response factors as they are stored in the analyser (the former response factors). All derived parameters (concentration / Heating value density etc. etc. are calculated using these response factors.

7.5.4 Status Window

If the *Status* command in the *Analyser* menu is selected the following window will be displayed:

Figure 7-21 Analyser Status window

- **Time Into Analysis** - displays the time in seconds of the current analysis run.

- **Running Analysis** - status of Analyser. Displays 'Running' when a stream is being analysed and 'Idle' when an analysis is not running. Shows 'Power-up Delay' after a power fail or power has been cycled. This is a built-in wait loop to allow any components in the columns to elute prior to the next sample being injected.

- **Stream** - identifies the current stream being analysed.

- **Feature State** - displays the current state of the feature detection routine.

- **TSC State** - displays the last TSC step to be executed.

- **Amplifier Gain** - shows the current gain setting of the programmable gain amplifier.

- **ADC Count** - shows the current value of the ADC.

- **Detector Voltage(mV)** - shows the current detector voltage in mV.

- **Feature Count** - shows the number of peaks detected thus far.

- **Analyser Time** - current Analyser time and date.

- **Next Stream** - indicated the next stream to be analysed. May show None if all streams are de-activated.

7.5.5 Get Last Chromatogram

To visualise the analysis result the chromatogram can be displayed using the *Get Last Chromatogram* command in the *Analyser* menu. The chromatogram displayed always belongs to the last completed analysis.
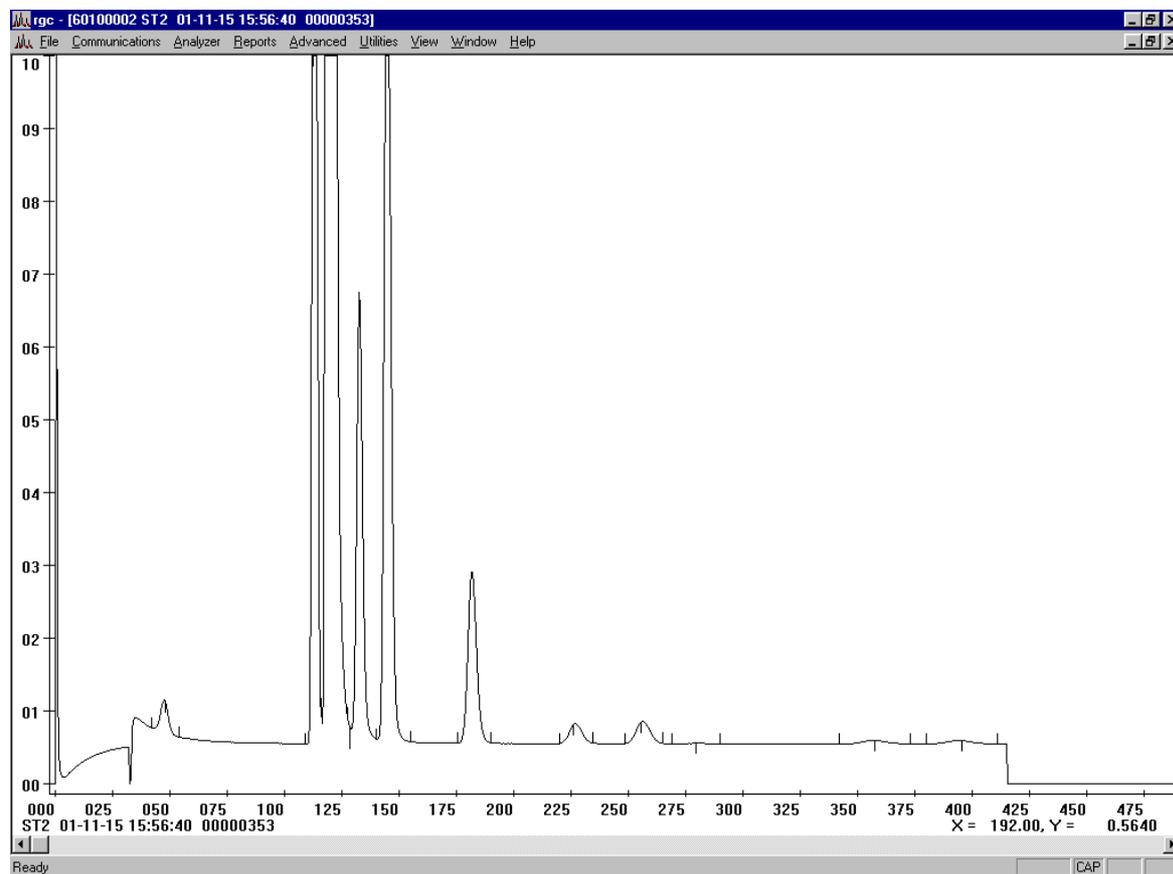
Figure 7-22 Chromatogram window

To optimise the integration settings it is sometimes necessary to know the exact start and end time of the peak. This can be read from the chromatogram using the X and Y reading in the lower right corner of the window. The X value (time) will change with the cursor position in the window; the Y value (detector signal in mV) is the detector signal level belonging to the X-value as indicated by the cursor.

In the title bar of the window the chromatogram is identified by the stream number, the date and start-time of the analysis and the analysis number.

7.5.6   Print Chromatogram

When *Print chromatogram* in the *File* menu is selected the chromatogram with report will be printed.

In the following figure an example of such a report is given.
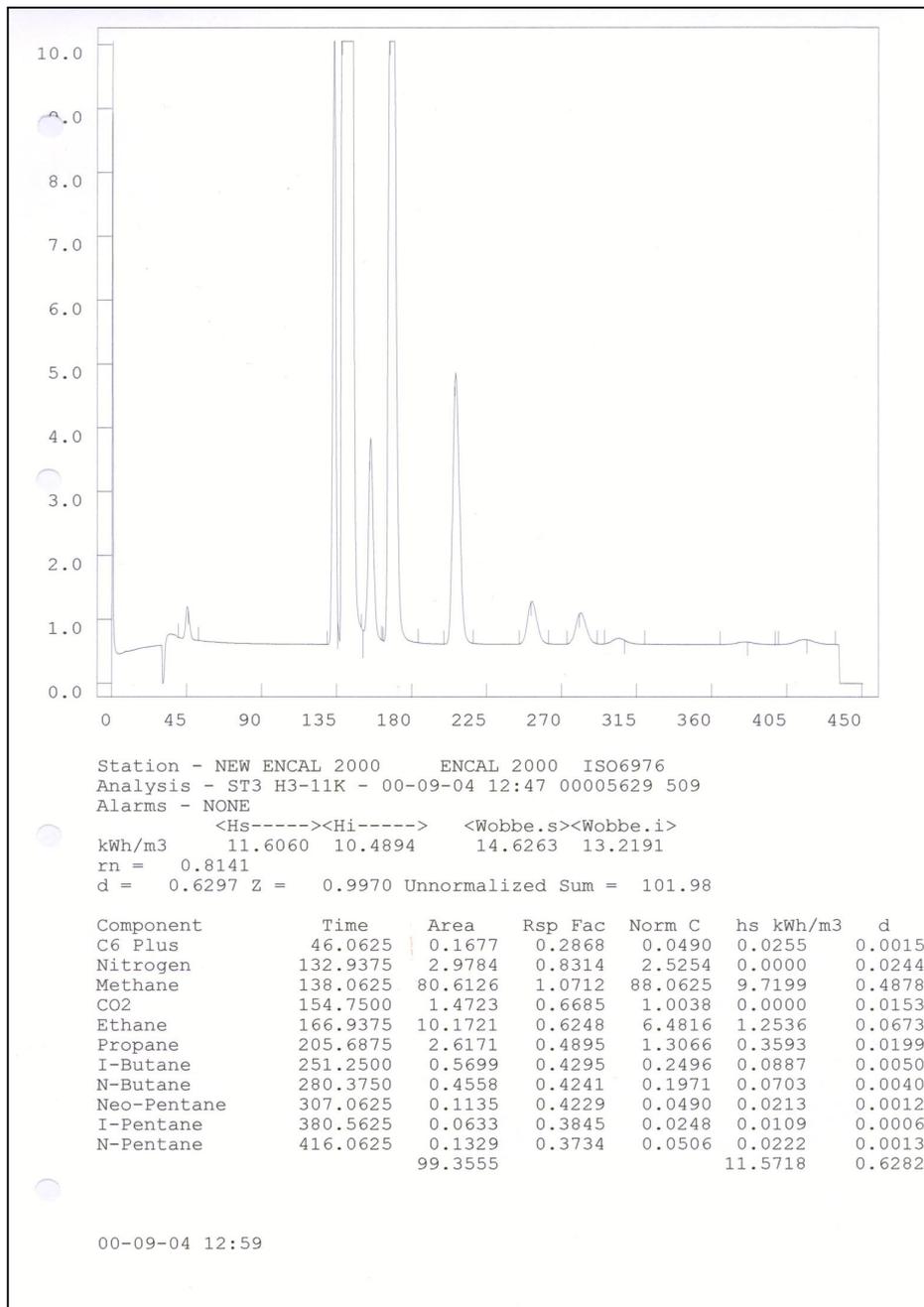
Figure 7-23 Chromatogram printout

8 Alarms explanation

The RGC 2000 Software can indicate several alarms in the On-line monitor. The following table summarises the alarms and gives some information concerning the cause and how to resolve the alarm situation.

ALARM	CAUSE
Unknown x (x = 1,2 or 3 and indicated the stream which is in alarm)	This means that a peak has been found that is not declared in the method table. - time drift - low Helium pressure - Oven temperature deviation - Fault in the method table information - Unexpected component in the sample gas.
% Difference	This is a calibration alarm that indicates that the deviation in response factors of the last calibration compared to the one of the previous calibration is higher than allowed. The limits are set in the (applicable) Alarm Table. - Drift of the components out of the integration gatings (especially the pentanes). - Low carrier gas pressure - Oven temperature deviation - Calibration gas composition does not match the composition as entered in the method table. - Allowable limits are set too tight.
Energy alarm Density alarm	Alarm situation to indicate that the calculated value (heating value, density) of an analysis exceeds the alarm limits as set in the applicable alarm table. - Operational alarm (Heating value or density of the gas to be measured is actually to low or to high). - Drift of the components out of their gatings - Low (or no) sample flow
Area	Alarm situation to indicate that the total area of all peaks exceeds the alarm limits as set in the applicable alarm table. - Low (or No) sample flow - Wrong integration setting in TSC table
Concentration alarm	Alarm situation to indicate that the calculated concentration of a component exceeds the alarm limits as set in the applicable alarm table. - Operational alarm (one of the components in the gas is really to low or to high) - Component is drifted out of its integration gatings

Table 1 RGC 2000 Alarms

9 Data storage

As long as the RGC 2000 Software operates in the Online Monitor Mode, RGC data files will be stored on the PC's Hard disk.. There are two groups of data files that are stored. The first group is referred to as the "RGC files". The other group has been specially created for a German customer and are referred to as the "Customer files"

9.1 RGC Files

As described in paragraph 3.3 the data is (default) stored in the following directory;
C:\Instromet\Reports1

The following files are generated and stored:

FILENAME (Extension)	DESCRIPTION
Report file (.RPT)	This file gives a full report of a single analysis indicating stream ID, date and time, calculated values, component names, elution times, response factors and normalised concentrations.
Short report file (.SRP)	Same as RPT file, without single component information.
Concentration file (.CNC)	Per analysis, one string of data containing stream ID, date and time, stream number, heating value, density, component concentrations and retention times.
Response factors file (.RSP)	This file shows response factors before and after a calibration including the difference in terms of percents.
Average file (.AVG)	Contains the 24 hours average, the hourly average #1 and the hourly average #2, for heating value, density, and component concentrations.
Calibration Report file (.CLB)	Same as CNC file however for calibration analysis results
Calibration Concentration file (.CAL)	Same as RPT file however for calibration analysis results.

The file names are derived from the current date in a yymmddnv.xxx format:

yy - year
mm - month
dd - day
n   - stream identifier, 1, 2 , 3 or n (Calibration files and RSP files are independent of
       stream number and therefore the identifier will be "n"
v   - this is the version number of the file in case more then one file will be made on the
       same day.

The stored data files can be viewed and edited using any sort of editor (e.g. Microsoft
"WORD") or can be imported in a spreadsheet like "Excel".

In attachment 1 to 7 an example is given of all of the above files.

9.2 Customer files

The customer files will only be stored if RGC 2000 operates in the Online Monitor mode.

The files that are stored are listed below. Since the file storage facility is created for German
customers some file text will appear in German language only. Also the file extensions are
German abbreviations.

File extension	German text	English text
*.DAT	Analyse DATen Datei	Analysis Data file
*.SMW	StundenMittelWert Datei	Hourly AVG Data file
*.TMW	TagesMittelWert Datei	Daily AVG Data file
*.MMW	MonatsMittelWert Datei	Monthly AVG Data file
*.KAL	KALibrierdaten Datei	Calibration Data file
*.Bxx	Betriebsgas Chromatogram	Stream chromatogram
*.Kxx	Kalibriergas Chromatogram	Calibration chromatogram

The first five file types contain analysis results from stream and calibration runs. The last two
file types are chromatogram files. These will be stored automatically after a calibration
(*.Bxx) or by activating the "*Store chromatogram*" button in the On-line monitor. (*.Kxx)

9.2.1 Customer File Formats and Locations

As described in paragraph 3.3 the data is (default) stored in the following directory;
C:\Instromet\Reports1

The addition "1" to the "Reports" directory will be 2, 3 and 4 for the second third and fourth
application of RGC that is installed. It is assumed that the default installation is applicable
and will therefore refer to the "Report1" directory.

The sub-directory "Reports1" contains sub-directories, created in such a way that the first three characters contain the Station ID (e.g. TST = Test) and the next four digits specify the year (e.g. TST1998). The Station ID can be altered in the RGC32: Report, Preferences, File access/options sub menu. (see paragraph 7.4.10.2)

The year sub-directories contain monthly sub-directories (Name: Station ID + Month number, e.g. TST10 = October).
The monthly sub-directories contain the data files of the corresponding month to be saved.

Sample sub-directory path: C:\Program Files\Instromet\Reports\Tst1998\Tst11\

File names and extensions as defined:

File names and extensions as defined:		±size kb	Number of Records
XYZJMMDD.DAT	Stream Analysis Data	36	Depending on the analysis time per measurement day (e.g. 450 sec analysis time = 192 records)
XYZJMMDD.SMW	Hourly Average Data	5	24 hourly average data records
XYZJMM.TMW	Daily Average Data	6	Depending on day's in month (max. 31 records)
XYZJMM.MMW	Monthly Average Data	1	12 monthly average data records
XYZJMM.KAL	Calibration Data	18	Depending on day's in month and number of Auto-calibrations per measurement day. Normally if ones a day auto-calibration is set The maximum number of records will not Exceed: 31
XYZJMMDD.Bxx	Stream Gas Chromatogram	27	See chromatogram files (attachment 12)
XYZJMMDD.Kxx	Calibration Gas Chromatogram	27	See chromatogram files (attachment 12)

Table 2 Customer files details

In attachment 8 to 13 the file formats and headers of the above file types are explained.

10 Related Control Unit Settings

Some of the settings in the ENCAL 2000 control-unit are related to settings that are done by the software. The following paragraphs describe these relations.

10.1 Units Selection

During the installation of the RGC 2000 software the user can select the units in which the heating value will be expressed. Since the control unit functions as a display unit of the analyser, these units must conform to the units selected in the control unit. The setting of the units in the control unit is done in memory location 0,0,17,0 as described in appendix 1 of the Control Unit Manual V3.0.

10.2 Remote Access Security setting

In some countries, government regulations (e.g. PTB Germany) dictate a certain level of security of the data in the gas chromatograph. This means that the customer is not allowed to change certain data after the system has been sealed. The ENCAL 2000 PGC provides this option by setting a switch in the Control Unit of the analyser. This is described in paragraph 4.2 of the Control Unit Manual V3.0. It concerns switch 8 on the back of the CU's front panel. If this switch is in the "On" position the analyser is set in the so-called "secure mode".

The RGC 2000 software detects the position of the switch when the connection between the RGC PC and the analyser is established. If the analyser detects the secure mode this will be indicated in the lower right corner of the screen by the indication "SECURE".

In the secure state the RGC 2000 software will have limited access to the analyser. Some menu items are greyed while others will be still selectable (data can be viewed) but the OK button will be greyed (data can not be edited).

10.3 Clock synchronisation

A clock is built into the Control Unit that gives the time and date shown on the display and is used with the error, print and serial facilities to give accurate timing of events. The clock is set in the data mode using the keyboard. Indication of the time is given at the top right-hand edge of the display in normal operation and access to the time and date is given by location **0.0.02** using the data push-button in the run mode. The clock is powered by an internal lithium battery when the Control Unit power is removed. The battery will power the clock for 10 years with the Control Unit un-powered. The clock setting in the ENCAL Control Unit can be achieved in a number of different ways depending upon the mode switches 9 and 10.

ClkCU>AN *(MS 9)*	clkAN>CU *(MS 10)*	Master Clock	Application
OFF	OFF	None	No requirements for clock synchronisation. Both clocks (Control Unit and Process Gas Chromatograph) are not synchronised and are free running.
ON[1]	OFF	Control Unit	Control unit will synchronise Process Gas Chromatograph clock. This is used if the clock signal is written to the Control Unit via the MODBUS communication ports (e.g.: DSf-GC unit with an atomic clock receiver)
OFF	ON[2]	Process Gas Chromatograph	Process Gas Chromatograph will synchronise Control Unit clock. This is used if the clock signal is written to the Process Gas Chromatograph via RGC software using a PC (e.g.: PC with atomic clock receiver) (e.g.: In RGConfig.ini TG TIME-UPDATE = ON)
ON	ON	Not allowed	It is not recommended to use both mode switches 9 and 10 in the ON position because duplicate master clocks can conflict in the ENCAL 2000 System.

General remark:
The Status flags On or Off on the CU display (programmed data) for the Mode-Switches 9 & 10 indicate the switch positions On or Off.

Note 1:
If Mode-Switch 9 (clkCU>AN) is in the ON position: The Process Gas Chromatograph clock will be synchronised to the CU clock every 1 minute interval (LOAD_TIME packet).

Note 2:
If Mode-Switch 10 (clkAN>CU) in the ON position: The CU clock will be synchronised to the Process Gas Chromatograph clock every time the CU reads a valid STATUS packet from the Process Gas Chromatograph.

11 Appendices

Appendix 1: Reports file (.RPT)

```
Station - ENCAL 2000 TEST PGC      ENCAL 2000   ISO6976
Analysis - ST1  Stream 1 - 02-01-21 08:39:00  00000032 032
Alarms -Unknowns Area Energy SGV
          <Hs-----><Hi----->    <Wobbe.s><Wobbe.i>
kWh/m3     0.7832   0.7192      3.3209   3.0493
KCAL/SMC     11.2333 10.3147     47.6307  43.7356
d =   0.0556 Z =   1.0000 Unnormalized Sum =   40.76


Component         Time    Rsp Fac    Norm C
C6 Plus          45.5625   0.2965    0.0430
Unknown         128.1875   1.0000   38.7878
Unknown         135.8125   1.0000   56.9639
CO2             149.9375   0.5638    0.8481
Ethane          162.8750   0.6234    2.4299
Propane         201.1250   0.4956    0.5936
I-Butane        246.1875   0.4440    0.1111
N-Butane        275.8750   0.4320    0.1143
Neo-Pentane     301.5625   0.4975    0.0329
I-Pentane       380.0625   0.4864    0.0377
N-Pentane       413.0625   0.4816    0.0376
Total Peak Area:  45.8026
```

Appendix 2: Short Report File (.SRP)

```
Station – ENCAL 2000 TEST PGC      ENCAL 2000  ISO6976
Analysis - ST1  Russengas - 02-02-28 14:08:39  00000003 003
Alarms - NONE
          <Hs-----><Hi----->    <Wobbe.s><Wobbe.i>
kWh/m3     10.9494   9.8826     14.0242  12.6578
KCAL/SMC    157.0446 141.7436    201.1449 181.5472
d =   0.6096 Z =   0.9974 Unnormalized Sum =   98.24

Station - ENCAL 2000 TEST PGC      ENCAL 2000  ISO6976
Analysis - ST1  Russengas - 02-02-28 14:20:19  00000005 005
Alarms - NONE
          <Hs-----><Hi----->    <Wobbe.s><Wobbe.i>
kWh/m3     11.0903  10.0005     14.6521  13.2123
KCAL/SMC    159.0645 143.4338    210.1503 189.4997
d =   0.5729 Z =   0.9975 Unnormalized Sum =   97.31

Station - ENCAL 2000 TEST PGC      ENCAL 2000  ISO6976
Analysis - ST1  Russengas - 02-02-28 14:25:10  00000006 006
Alarms - NONE
          <Hs-----><Hi----->    <Wobbe.s><Wobbe.i>
kWh/m3     11.0931  10.0030     14.6588  13.2183
KCAL/SMC    159.1051 143.4700    210.2465 189.5857
d =   0.5727 Z =   0.9975 Unnormalized Sum =   97.07
```

Appendix 3: Concentration file (.CNC)

```
60100006 ST1  02-01-21 18:34:03  00000111   11.1179  10.0408 159.4609
144.0117   0.6247   0.9972     95.11  72.7747    0.0494   4.0350  88.9455
1.4736   3.9609   0.9921   0.1973   0.2001   0.0507   0.0486   0.0468
0.0000   0.0000 Stream 1  44.5625 117.3125 122.6250 137.2500 149.3750
186.1875 231.9375 260.5000 287.0625 363.0625 399.5625   0.0000   0.0000

60100006 ST1  02-01-21 18:41:33  00000112   11.1188  10.0416 159.4738
144.0236   0.6248   0.9972     95.08  72.7605    0.0502   4.0337  88.9342
1.4716   3.9797   0.9909   0.1964   0.2001   0.0483   0.0477   0.0473
0.0000   0.0000 Stream 1  44.5625 117.3125 122.6250 137.2500 149.3750
186.1875 231.8750 260.5625 287.0625 363.0625 399.5625   0.0000   0.0000
```

The CNC files consist of a single string (space delimited) per analysis run. Since there are no headers available in the file the following table shows these headers.

HEADERS:

Analyser ID
Stream ID
Date
Time
Analysis no.
Hs
Hi
Hs(kCal)
Hi(kCal)
Rn
d
Unnorm Sum
Total Peak Area
Concentration component 1
2
..
..
Concentration component 13
Stream name
Retention time component 1
2
..
..
Retention time component 13

Appendix 4: Response Factors file (.RSP)

```
Station - ENCAL 2000 TEST GC
Analysis - CAL1 02-01-21 17:11 00000100
Number of Calibrations Averaged = 2

Component          Time    Old Ftr  New Ftr   Diff.     %Diff.    Area
C6 Plus          44.5625   0.3120   0.3108   0.0012    0.3877    0.1257
Nitrogen        117.0000   0.8393   0.8389   0.0004    0.0424    3.6912
Methane         122.2500   1.0685   1.0681   0.0005    0.0454   63.7188
CO2             136.9375   0.6482   0.6522  -0.0041   -0.6313    1.7349
Ethane          149.0000   0.6345   0.6341   0.0004    0.0575    4.8008
Propane         185.7500   0.5027   0.5020   0.0007    0.1390    1.5211
I-Butane        231.3125   0.4418   0.4417   0.0000    0.0011    0.3409
N-Butane        259.9375   0.4396   0.4391   0.0005    0.1237    0.3512
Neo-Pentane     287.0625   0.4309   0.4648  -0.0340   -7.8825    0.0827
I-Pentane       363.0625   0.3869   0.4200  -0.0331   -8.5435    0.0889
N-Pentane       399.5625   0.3887   0.4376  -0.0488  -12.5660    0.0911
Total Peak Area -  76.5473
```

Appendix 5: Average file (.AVG)

```
Station - ENCAL 2000 TEST PGC
Stream  - ST1 - Stream 1
First Analysis - 02-01-22 06:05 00000203
Last Analysis - 02-01-23 05:52 00000393
Alarms -   5


Avg.     Interval  Runs   hs kWh/m3   hi kWh/m3    d
         24 Hour:  168    11.1305     10.0527      0.6256 0.0504 4.0401 88.8765 1.4744 3.9728 1.0022 0.2219 0.2113 0.0501 0.0499 0.0504 0.0000 0.0000

AVG 1 - Hourly
06:00 - 07:00   8     11.1387     10.0601      0.6257 0.0499 4.0349 88.8825 1.4596 3.9604 0.9951 0.1995 0.2702 0.0494 0.0497 0.0487 0.0000 0.0000
07:00 - 08:00   8     11.1197     10.0424      0.6247 0.0499 4.0391 88.9473 1.4612 3.9651 0.9960 0.1981 0.1947 0.0500 0.0494 0.0493 0.0000 0.0000
08:00 - 09:00   5     11.4196     10.3220      0.6416 0.0493 3.9932 87.7515 1.4409 3.9834 1.2050 0.9923 0.4446 0.0383 0.0272 0.0743 0.0000 0.0000
09:00 - 10:00   4     11.1229     10.0454      0.6252 0.0502 4.0459 88.8948 1.4786 3.9748 0.9986 0.1985 0.2032 0.0512 0.0513 0.0529 0.0000 0.0000
10:00 - 11:00   5     11.1225     10.0450      0.6251 0.0505 4.0394 88.9134 1.4756 3.9718 0.9947 0.1978 0.2017 0.0538 0.0505 0.0507 0.0000 0.0000
11:00 - 12:00   4     11.1218     10.0444      0.6251 0.0504 4.0405 88.9150 1.4752 3.9717 0.9937 0.1978 0.2025 0.0524 0.0509 0.0499 0.0000 0.0000
12:00 - 13:00   8     11.1219     10.0445      0.6251 0.0506 4.0397 88.9159 1.4755 3.9707 0.9948 0.1972 0.2018 0.0523 0.0507 0.0509 0.0000 0.0000
13:00 - 14:00   8     11.1218     10.0444      0.6251 0.0501 4.0402 88.9133 1.4748 3.9742 0.9950 0.1977 0.2026 0.0515 0.0505 0.0501 0.0000 0.0000
14:00 - 15:00   3     11.1220     10.0446      0.6251 0.0504 4.0391 88.9158 1.4746 3.9729 0.9941 0.1980 0.2026 0.0511 0.0494 0.0521 0.0000 0.0000
15:00 - 16:00   8     11.1218     10.0444      0.6250 0.0504 4.0386 88.9214 1.4733 3.9698 0.9936 0.1980 0.2031 0.0506 0.0501 0.0510 0.0000 0.0000
16:00 - 17:00   5     11.1249     10.0473      0.6252 0.0506 4.0367 88.9103 1.4740 3.9742 0.9934 0.1983 0.2038 0.0534 0.0529 0.0524 0.0000 0.0000
17:00 - 18:00   7     11.1211     10.0438      0.6251 0.0504 4.0414 88.9050 1.4785 3.9792 0.9965 0.1976 0.2005 0.0501 0.0505 0.0503 0.0000 0.0000
18:00 - 19:00   8     11.1207     10.0434      0.6251 0.0505 4.0418 88.9109 1.4784 3.9728 0.9958 0.1985 0.2004 0.0505 0.0516 0.0488 0.0000 0.0000
19:00 - 20:00   8     11.1209     10.0436      0.6251 0.0505 4.0428 88.9066 1.4787 3.9749 0.9964 0.1987 0.2004 0.0505 0.0513 0.0493 0.0000 0.0000
20:00 - 21:00   8     11.1214     10.0441      0.6251 0.0505 4.0424 88.9057 1.4786 3.9740 0.9962 0.1988 0.2016 0.0505 0.0513 0.0501 0.0000 0.0000
21:00 - 22:00   8     11.1208     10.0435      0.6251 0.0508 4.0424 88.9078 1.4785 3.9744 0.9973 0.1986 0.2006 0.0495 0.0510 0.0490 0.0000 0.0000
22:00 - 23:00   8     11.1207     10.0434      0.6251 0.0505 4.0427 88.9090 1.4785 3.9727 0.9970 0.1985 0.2004 0.0497 0.0513 0.0498 0.0000 0.0000
23:00 - 00:00   8     11.1216     10.0443      0.6251 0.0506 4.0417 88.9052 1.4779 3.9771 0.9962 0.1990 0.2010 0.0506 0.0510 0.0499 0.0000 0.0000
00:00 - 01:00   8     11.1213     10.0440      0.6251 0.0507 4.0421 88.9064 1.4786 3.9750 0.9962 0.1988 0.2008 0.0511 0.0511 0.0491 0.0000 0.0000
01:00 - 02:00   8     11.1202     10.0429      0.6250 0.0508 4.0440 88.9097 1.4774 3.9741 0.9965 0.1979 0.2002 0.0499 0.0508 0.0488 0.0000 0.0000
02:00 - 03:00   8     11.1201     10.0428      0.6250 0.0507 4.0442 88.9117 1.4771 3.9723 0.9966 0.1974 0.1994 0.0502 0.0505 0.0497 0.0000 0.0000
03:00 - 04:00   8     11.1186     10.0414      0.6250 0.0506 4.0452 88.9136 1.4780 3.9720 0.9973 0.1976 0.1999 0.0484 0.0496 0.0479 0.0000 0.0000
04:00 - 05:00   8     11.1188     10.0417      0.6250 0.0501 4.0439 88.9154 1.4770 3.9721 0.9972 0.1983 0.1998 0.0492 0.0495 0.0475 0.0000 0.0000
05:00 - 06:00   7     11.1195     10.0423      0.6250 0.0503 4.0441 88.9133 1.4769 3.9722 0.9964 0.1991 0.2002 0.0493 0.0500 0.0481 0.0000 0.0000


AVG 2 - 8 Hrs
06:00 - 14:00   50    11.1541     10.0745      0.6268 0.0501 4.0348 88.7967 1.4673 3.9705 1.0163 0.2775 0.2362 0.0500 0.0480 0.0526 0.0000 0.0000
14:00 - 22:00   55    11.1215     10.0441      0.6251 0.0505 4.0410 88.9101 1.4772 3.9740 0.9956 0.1983 0.2014 0.0506 0.0511 0.0501 0.0000 0.0000
22:00 - 06:00   63    11.1201     10.0429      0.6250 0.0505 4.0435 88.9105 1.4777 3.9734 0.9967 0.1983 0.2002 0.0498 0.0505 0.0489 0.0000 0.0000
```

The right 13 columns of the AVG files are the component concentrations of
component 1 to 13.

Appendix 6: Calibration Report file (.CLB)

```
Station - ENCAL 2000 TEST PGC      ENCAL 2000
Analysis - CAL1 02-01-21 10:47 00000049

Component       Retention     Area      Conc.    Cal Wgt   Resp Factor
C6 Plus          45.5625     0.1765    0.1714    0.0510     0.2975
Nitrogen        127.5000     5.0514    4.9060    4.0450     0.8245
Methane         132.8125    85.3915   82.9340   88.8980     1.0719
CO2             149.0625     2.3782    2.3097    1.4800     0.6408
Ethane          161.7500     6.5346    6.3465    3.9770     0.6266
Propane         200.1250     2.0748    2.0151    0.9980     0.4953
I-Butane        245.1250     0.4758    0.4621    0.1980     0.4285
N-Butane        274.6875     0.4873    0.4733    0.2020     0.4268
Neo-Pentane     298.5625     0.1240    0.1205    0.0510     0.4233
I-Pentane       372.5625     0.1387    0.1347    0.0500     0.3713
N-Pentane       407.0625     0.1305    0.1268    0.0500     0.3944


Station - ENCAL 2000 TEST PGC      ENCAL 2000
Analysis - CAL1 02-01-21 10:55 00000050

Component       Retention     Area      Conc.    Cal Wgt   Resp Factor
C6 Plus          45.5625     0.1761    0.1711    0.0510     0.2981
Nitrogen        127.5000     5.0512    4.9062    4.0450     0.8245
Methane         132.8125    85.3829   82.9311   88.8980     1.0719
CO2             149.0625     2.3797    2.3114    1.4800     0.6403
Ethane          161.8125     6.5354    6.3477    3.9770     0.6265
Propane         200.1875     2.0763    2.0167    0.9980     0.4949
I-Butane        245.1250     0.4757    0.4620    0.1980     0.4285
N-Butane        274.6875     0.4885    0.4745    0.2020     0.4257
Neo-Pentane     298.5625     0.1253    0.1217    0.0510     0.4191
I-Pentane       372.5625     0.1373    0.1333    0.0500     0.3750
N-Pentane       407.0625     0.1280    0.1243    0.0500     0.4022
```

Appendix 7: Calibration Concentration file (.CAL)

```
60100006 CAL1 02-01-21 10:47 00000049   0.1765   5.0514  85.3915   2.3782
6.5346   2.0748   0.4758   0.4873   0.1240   0.1387   0.1305   0.0000
0.0000   0.1714   4.9060  82.9340   2.3097   6.3465   2.0151   0.4621
0.4733   0.1205   0.1347   0.1268   0.0000   0.0000   0.2975   0.8245
1.0719   0.6408   0.6266   0.4953   0.4285   0.4268   0.4233   0.3713
0.3944   0.0000   0.0000  45.5625 127.5000 132.8125 149.0625 161.7500
200.1250 245.1250 274.6875 298.5625 372.5625 407.0625   0.0000   0.0000

60100006 CAL1 02-01-21 10:55 00000050   0.1761   5.0512  85.3829   2.3797
6.5354   2.0763   0.4757   0.4885   0.1253   0.1373   0.1280   0.0000
0.0000   0.1711   4.9062  82.9311   2.3114   6.3477   2.0167   0.4620
0.4745   0.1217   0.1333   0.1243   0.0000   0.0000   0.2981   0.8245
1.0719   0.6403   0.6265   0.4949   0.4285   0.4257   0.4191   0.3750
0.4022   0.0000   0.0000  45.5625 127.5000 132.8125 149.0625 161.8125
200.1875 245.1250 274.6875 298.5625 372.5625 407.0625   0.0000   0.0000
```

The CNC files consist of a single string (space delimited) per analysis run. Since there are no headers available in the file the following table shows these headers.

HEADERS:

Analyser ID
Cal Stream ID
Date
Time
Analysis no.
Peak Area component 1
2
..
..
Peak Area component 13
Concentration component 1
2
..
..
Concentration component 13
Response factor component 1
2
..
..
Response factor component 13
Retention time component   1
2
..
..
Retention time component 13

Appendix 8: Analysis Data files Structure

Data File Structure		Field separator = ; (semi colon) Record terminator = @	
Field No.	**Field Parameter description**	**Field Format**	**Field sample data**
1	Record Identifier	See File headers sheet	A
2	Gas Type	See File headers sheet	BETRIEBSGAS
3	Actual Clock	See File headers sheet	6:02:52
4	Actual Date	See File headers sheet	17:12:98
5	He (Helium)	Format #.0000	0.0000
6	H2 (Hydrogen)	Format #.0000	0.0000
7	C6+ (Hexane's)	Format #.0000	0.0686
8	C3 (Propane)	Format #.0000	0.5225
9	IC4 (ISO-Butane)	Format #.0000	0.0971
10	NC4 (N-Butane)	Format #.0000	0.0976
11	Neo-C5 (Neo-Pentane)	Format #.0000	0.0371
12	IC5 (I-Pentane)	Format #.0000	0.0412
13	NC5 (N-Pentane)	Format #.0000	0.0216
14	CO2 (Carbine Dioxide)	Format #.0000	28.7049
15	C2 (Ethane)	Format #.0000	2.5211
16	O2 (Oxygen)	Format #.0000	0.0000
17	N2 (Nitrogen)	Format #.0000	1.9727
18	C1 (Methane)	Format #.0000	65.9157
19	CO (Carbon Monoxide)	Format #.0000	0.0000
20	Hs (kWh/m3)	Format #.0000	8.0852
21	Hi (kWh/m3)	Format #.0000	7.2995
22	Normal Density (kg/m3)	Format #.0000	1.1186
23	Relative Density	Format #.0000	0.8657
24	Superior Wobbe index	Format #.0000	8.6899
25	CRC16 (+@ character)	See CRC-16 calc.sheet	2265@
Sample record with separators and terminators			
A;BETRIEBSGAS;06:02:52;17:12:98;0.0000;0.0000;0.0686;0.5225;0.0971;0.0976;0.0371;0.0412;0.0216; 28.7049;2.5211;0.0000;1.9727;65.9157;0.0000;8.0852;7.2995;1.1186;0.8657;8.6899; 2265@			
Remarks: This record structure is applicable for the next listed files: Analysis Record (*.DAT files) Hourly Average Record (*.SMW files) Daily Average Record (*.TMW files) Monthly Average Record (*.MMW files)			

Appendix 9: File headers for Data and calibration files

File Headers for data and calibration files
Applicable to file extensions: *.DAT, *.SMW, *.TMW, *.MMW and *.KAL
Remark: The file headers for these file types are stored in the first four fields.

Field No.	Field Parameter	Field Format Description	Remarks
1	Record Identifier	A = Analysis Record (*.DAT files) B = Hourly Average Record (*.SMW files) C = Daily Average Record (*.TMW files) D = Monthly Average Record (*.MMW files) G = Calibration Record (*.KAL)	Contains a distinct single character (A,B,C,D or G) to identify the type of Record
2	Gas Type	BETRIEBSGAS = Stream Gas KALIBRIERGAS = Calibration Gas	Identifies Stream or Calibration gas type
3	Actual Clock	Actual Clock in Format hh : mm : ss	hh = Hours mm = Minutes ss = Seconds
4	Actual Date	Actual Date in Format DD : MM : YY	DD = Day MM = Month YY = Year
Remarks	Field separator = ; (semi colon)		

File Headers for stream and calibration chromatogram files
Applicable to file extensions: *.Bxx and *.Kxx

Field No.	Field Parameter		Sample
Header	CHROMATOGRAMM[,] = File type TST[,] = Station ID 17.12.98[,] = Actual date of chromatogram 06:10:33[LF] = Actual time of chromatogram		CHROMATOGRAMM, THY, 17.12.98, 06:10:33
Remarks	This header uses commas to separate items in the header and a LF to terminate the record		
	Space characters (20 hex) are used to fill up positions in the header		
	*.Bxx files are Stream Gas chromatogram files, *.Kxx are Cal. Gas chromatogram files		
Sample	CHROMATOGRAMM, TST, 17.12.98, 06:10:33		

Appendix 11: Calibration File structure

	Calibration File Structure	Field separator = ; (semi colon) Record terminator = @	
Field No.	**Field Parameter description**	**Field Format**	**Field sample data**
1	Record Identifier	See File headers sheet	G
2	Gas Type	See File headers sheet	KALIBRIERGAS
3	Actual Clock and Date	See File headers sheet	6:10:33
4	Actual Date	See File headers sheet	17:12:98
5	RF old C6+ (Hexane's)	Format #.0000	0.2697
6	RF old C3 (Propane)	Format #.0000	0.5816
7	RF old IC4 (ISO-Butane)	Format #.0000	0.6252
8	RF old NC4 (N-Butane)	Format #.0000	0.6484
9	RF old IC5 (ISO-Pentane)	Format #.0000	0.9390
10	RF old NC5 (N-Pentane)	Format #.0000	4.0800
11	RF old CO2 (Carbon Dioxide)	Format #.0000	0.7910
12	RF old C2 (Ethane)	Format #.0000	0.6530
13	RF old N2 (Nitrogen)	Format #.0000	0.9974
14	RF old C1 (Methane)	Format #.0000	1.1706
15	RF old Neo-C5 (Neo-Pentane)	Format #.0000	0.6738
16	RF new C6+ (Hexane's)	Format #.0000	0.2746
17	RF new C3 (Propane)	Format #.0000	0.5855
18	RF new IC4 (ISO-Butane)	Format #.0000	0.6199
19	RF new NC4 (N-Butane)	Format #.0000	0.6923
20	RF new IC5 (ISO-Pentane)	Format #.0000	0.9497
21	RF new NC5 (N-Pentane)	Format #.0000	9.3185
22	RF new CO2 (Carbon Dioxide)	Format #.0000	0.7897
23	RF new C2 (Ethane)	Format #.0000	0.6494
24	RF new N2 (Nitrogen)	Format #.0000	0.9983
25	RF new C1 (Methane)	Format #.0000	1.1718
26	RF new Neo-C5 (Neo-Pentane)	Format #.0000	0.6796
27	Mol% calc. with old RF, C6+ (Hexane's)	Format #.0000	0.0676
28	Mol% calc. with old RF, C3 (Propane)	Format #.0000	0.5203
29	Mol% calc. with old RF, IC4 (ISO-Butane)	Format #.0000	0.0975
30	Mol% calc. with old RF, NC4 (N-Butane)	Format #.0000	0.0915
31	Mol% calc. with old RF, IC5 (ISO-Pentane)	Format #.0000	0.0309
32	Mol% calc. with old RF, NC5 (N-Pentane)	Format #.0000	0.0097
33	Mol% calc. with old RF, CO2 (Carbon Dioxide)	Format #.0000	28.8165
34	Mol% calc. with old RF, C2 (Ethane)	Format #.0000	2.5702
35	Mol% calc. with old RF, N2 (Nitrogen)	Format #.0000	1.9689
36	Mol% calc. with old RF, C1 (Methane)	Format #.0000	65.7934
37	Mol% calc. with old RF, Neo-C5 (Neo-Pentane)	Format #.0000	0.0334
38	Mol% from Cal. Bottle C6+ (Hexane's)	Format #.0000	0.0687
39	Mol% from Cal. Bottle C3 (Propane)	Format #.0000	0.5250
40	Mol% from Cal. Bottle IC4 (ISO-Butane)	Format #.0000	0.0982
41	Mol% from Cal. Bottle NC4 (N-Butane)	Format #.0000	0.1010
42	Mol% from Cal. Bottle IC5 (ISO-Pentane)	Format #.0000	0.0347
43	Mol% from Cal. Bottle NC5 (N-Pentane)	Format #.0000	0.0344

44	Mol% from Cal. Bottle CO2 (Carbon Dioxide)	Format #.0000	28.7000
45	Mol% from Cal. Bottle C2 (Ethane)	Format #.0000	2.5300
46	Mol% from Cal. Bottle N2 (Nitrogen)	Format #.0000	1.9720
47	Mol% from Cal. Bottle C1 (Methane)	Format #.0000	65.9000
48	Mol% from Cal. Bottle Neo-C5 (Neo-Pentane)	Format #.0000	0.0355
49	Unnormalized Sum	Format #.0000	100.3035
50	Sum of Mol% from Cal. Bottle	Format #.0000	99.9995
51	Old Hs kWh/m3 calc. with old RF	Format #.0000	8.0667
52	New Hs kWh/m3 calc. from Cal. Bottle	Format #.0000	8.0784
53	Old Norm. Density calc. with old RF	Format #.0000	1.1195
54	New Norm. Density calc. from Cal. Bottle	Format #.0000	1.1192
55	Diff. New Hs - Old Hs	Format #.0000	0.0117
56	Diff. New Norm. Density - Old Norm. Density	Format #.0000	-0.0003
57	Mol% calc. with new RF, C6+ (Hexane's)	Format #.0000	0.0688
58	Mol% calc. with new RF, C3 (Propane)	Format #.0000	0.5237
59	Mol% calc. with new RF, IC4 (ISO-Butane)	Format #.0000	0.0966
60	Mol% calc. with new RF, NC4 (N-Butane)	Format #.0000	0.0977
61	Mol% calc. with new RF, IC5 (ISO-Pentane)	Format #.0000	0.0312
62	Mol% calc. with new RF, NC5 (N-Pentane)	Format #.0000	0.0222
63	Mol% calc. with new RF, CO2 (Carbon Dioxide)	Format #.0000	28.7590
64	Mol% calc. with new RF, C2 (Ethane)	Format #.0000	2.5552
65	Mol% calc. with new RF, N2 (Nitrogen)	Format #.0000	1.9699
66	Mol% calc. with new RF, C1 (Methane)	Format #.0000	65.8421
67	Mol% calc. with new RF, Neo-C5 (Neo-Pentane)	Format #.0000	0.0336
68	% diff. New RF and Old RF, C6+ (Hexane's)	Format #.00	-1.77
69	% diff. New RF and Old RF, C3 (Propane)	Format #.00	-0.67
70	% diff. New RF and Old RF, IC4 (ISO-Butane)	Format #.00	0.85
71	% diff. New RF and Old RF, NC4 (N-Butane)	Format #.00	-6.35
72	% diff. New RF and Old RF, IC5 (ISO-Pentane)	Format #.00	-1.13
73	% diff. New RF and Old RF, NC5 (N-Pentane)	Format #.00	-56.22
74	% diff. New RF and Old RF, CO2 (Carbon Dioxide)	Format #.00	0.17
75	% diff. New RF and Old RF, C2 (Ethane)	Format #.00	0.56
76	% diff. New RF and Old RF, N2 (Nitrogen)	Format #.00	-0.08
77	% diff. New RF and Old RF, C1 (Methane)	Format #.00	-0.11
78	% diff. New RF and Old RF, Neo-C5 (Neo-Pentane)	Format #.00	-0.86
79	Hs from Cal. Certificate	Format #.0000	8.0832
80	Norm. Density from Cal. Certificate	Format #.0000	1.1188
81	CO2 from Cal. Certificate	Format #.0000	28.7000
82	Calibration Bottle reference number	Text string 32 characters	Cyl.No.7700195
83	CRC16 (+@ character)	See CRC-16 calc.sheet	26157@
This record structure is applicable for the *.KAL files.			
Sample record with separators and terminators:			

G;KALIBRIERGAS;06:10:33;17:12:98;0.2697;0.5816;0.6252;0.6484;0.9390;4.0800;0.7910;0.6530;0.9974;
1.1706;0.6738;0.2746;0.5855;0.6199;0.6923;0.9497;9.3185;0.7897;0.6494;0.9983;1.1718;0.6796;0.0676;
0.5203;0.0975;0.0915;0.0309;0.0097;28.8165;2.5702;1.9689;65.7934;0.0334;0.0687;0.5250;0.0982;0.1010;
0.0347;0.0344;28.7000;2.5300;1.9720;65.9000;0.0355;100.3035;99.9995;8.0667;8.0784;1.1195;1.1192;0.0117;
-0.0003;0.0688;0.5237;0.0966;0.0977;0.0312;0.0222;28.7590;2.5552;1.9699;65.8421;0.0336;-1.77;
-0.67;0.85;-6.35;-1.13;-56.22;0.17;0.56;-0.08;-0.11;-0.86;8.0832;1.1188;28.7000;Cyl.No.7700195;26157@

Appendix 12: Chromatogram File Structure and Extensions

Chromatogram File Structure		Field separator = LF (line feed, (0A hex)		
Field No.	**Field Parameter description**	**Field sample data**		
Header	CHROMATOGRAMM[,] = File type TST[,] = Station ID 17.12.98[,] = Actual date of chromatogram 06:10:33[LF] = Actual time of chromatogram	CHROMATOGRAMM, TST, 17.12.98, 06:10:33		
1	time = 0.0 sec. Bridge voltage Format #.0000	0.0000		
2	time = 0.5 sec. Bridge voltage Format #.0000	8.4668		
3	time = 1.0 sec. Bridge voltage Format #.0000	0.7397		
4	time = 1.5 sec. Bridge voltage Format #.0000	0.6104		
Etc.	etc.	0.5847		
.	"	0.5762		
.	"	0.5725		
.	"	0.5701		
.	"	0.5688		
.	"	0.5688		
.	"	0.5688		
.	"	0.5676		
858	time = 429.0 sec. Bridge voltage Format #.0000	0.5701		
859	time = 429.5 sec. Bridge voltage Format #.0000	0.5688		
860	time = 430.0 sec. Bridge voltage Format #.0000	0.5713		
	This Example is based on: SON (Sample ON) = 0 sec (TSC table) ESQ (End Sequence) = 430 sec (TSC table)			

-----DATA FIELDS-----

Remarks:
Chromatogram Bridge Voltages are recorded in this file with a time interval of 0.5 sec.
Therefore the number of fields (length of the file) is(are) variable.
Space characters (20 hex) are used to fill up leading positions on data field / header items
The data fields can be easily converted to a graph chromatogram using EXCEL or similar spreadsheet PRG.
Time tick markers (gate open/closed) are implemented in all chromatogram files.
See Sample chromatogram file at the Sample Chroma TAB.

File Headers for stream and calibration chromatogram files
Applicable to file extensions: *.Bxx and *.Kxx

Field No.	**Field Parameter**		**Sample**
Header	CHROMATOGRAMM[,] = File type TST[,] = Station ID 17.12.98[,] = Actual date of chromatogram 06:10:33[LF] = Actual time of chromatogram		CHROMATOGRAMM, THY, 17.12.98, 06:10:33

Remarks
This header uses comma's to separate items in the header and a LF to terminate the record
Space characters (20 hex) are used to fill up positions in the header
*.Bxx files are Stream Gas chromatogram files, *.Kxx are Cal. Gas chromatogram files

Appendix 13: CRC 16 Checksum Function

Checksum Function CRC-16

Definition Function CRC-16 for the Checksum test of the data set.
The checksum result for the transferred string, as referred to by pointer z.
The CRC-16 is calculated from the first character of the first data item to
and included the last field separator [;] of the last data item (not included
the CRC-16 itself and the @ record terminator character).

Generator polynom (g_poly): 0x1021

```
unsigned int crc16(char *z, unsigned int g_poly)
{
unsigned int zlr;
long crc_var=0, g;
g = ((long)g_poly << 8) & 0x00ffff00;
while(*z)      {
               crc_var |= ((long) (*z++) & 0x000000ff);
               for (zlr=0; zlr<8; zlr++)
                              {
                              crc_var <<= 1;
                              if ((crc_var & 0x01000000) != 0) crc_var ^= g;
                              }
               }
return ((unsigned int)((crc_var &0x00ffff00) >> 8));
}
```

Returned value is a checksum in the value 0<=checksum<=65535