

Danalyzer
Gas Chromatograph



High accuracy

Fast analysis

Superb repeatability

Choice of analysis

DANIEL

A world of experience in CV measurement units

An overview of the CENELEC Daniel Danalyzer

The Danalyzer measures the calorific value (CV) of natural gas to within +/- 0.05%* over the full temperature range of -18°C to +55°C.

The instrument comprises:

- n Model 500 Analyser with sample stream selection
- n Model 2350 controller

Inputs

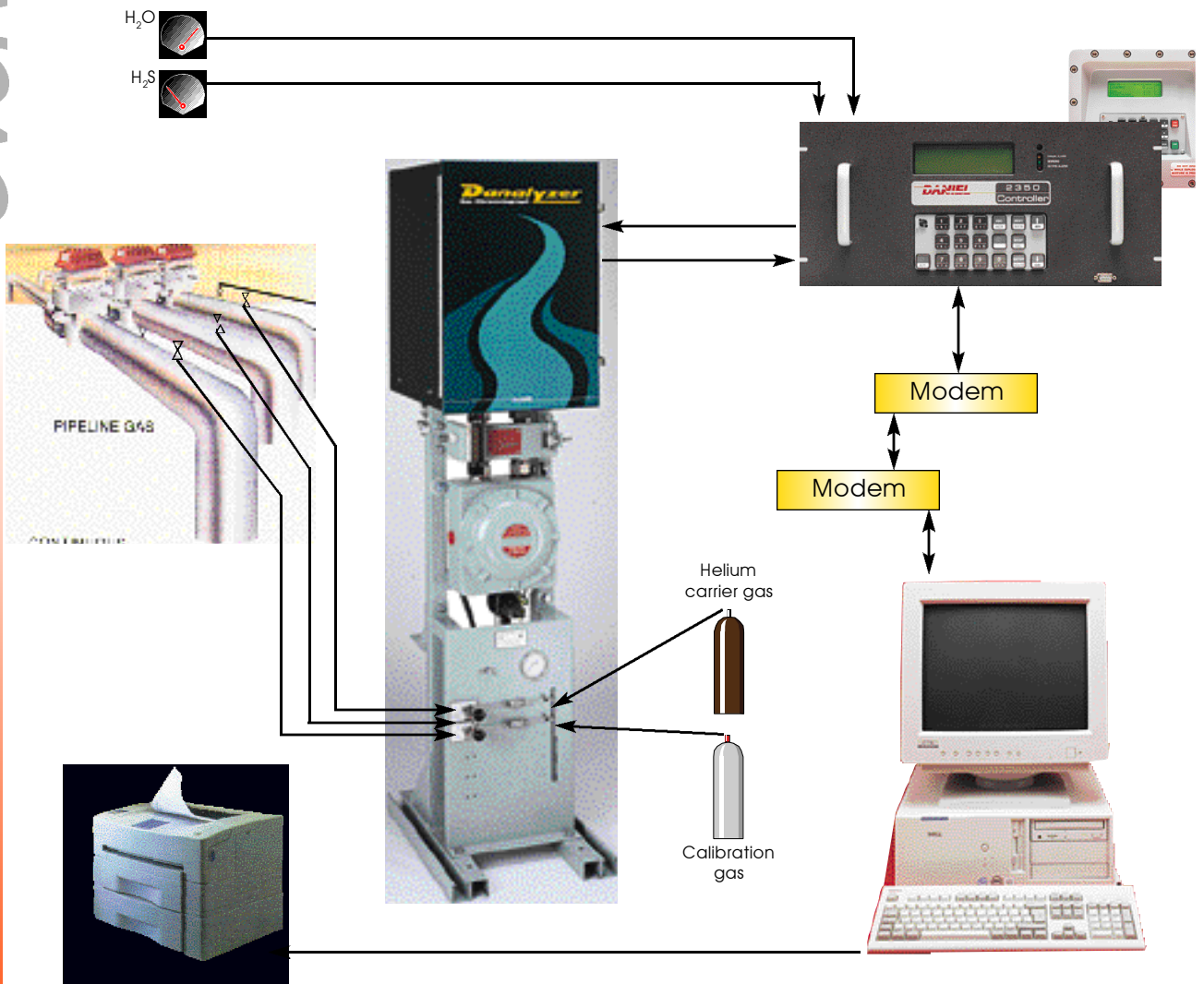
- n Up to 12 sample streams from the pipeline or sample cylinders. Four of the streams can be for calibration gases
- n Four 4-20 mA signals from external continuous analysers such as water or hydrogen sulphide (H₂S) analysers
- n Full remote operation of the instrument from a PC or supervisory computer using any one of the four independent bi-directional communications links
- n Five discrete digital inputs for status/alarm functions

Outputs

- n Two analogue 4-20 mA outputs as standard, expandable to ten 4-20 mA analogue outputs in the 2350. Using or analogue output as a bar graph up to four analogue expander modules may be connected externally to the 2350 to give 25 analogue outputs in total
- n Five discrete digital programmable open collector drives
- n Parallel output for printer
- n Four serial communications ports

* Based on a gas of 40 MJ/m³

Overview



The CENELEC Danalyzer features and benefits

For high accuracy, fast analysis, long term reliability and repeatability that saves you money, choose the CV measurement GC from Daniel - The "Danalyzer".

HIGH ACCURACY - means that you can be sure that you are getting the full value for your product. For sales of 150,000 m³ per hour at 12 kWh/m³, for every 0.01 of a Euro per kWh, the difference between 0.2% and 0.1 % accuracy can save approximately Euro 150,000 per year. Each analyser is now multilevel calibrated to give +/- 0.1% of full scale on CV over the measurement range of 7kWh to 14 kWh.

FAST ANALYSIS - means that your energy calculations are always up to date. Four minute cycle times.

SUPERB REPEA TABILITY - confidence that the results you get now will be the same time and time again, even with fluctuations of temperature. The repeatability of the Danalyzer operating at a stable temperature measuring C1 to C6+ with N₂ and CO₂ is +/- 0.005% of measured CV and +/- 0.05 % operating over the complete temperature range of -18°C to +55°C.

HIGH RELIABILITY - means that your maintenance costs are kept low and you can be sure that the Danalyzer will perform for you to high standards over many years. Long life sample inject and column switching valves (good for 5 million operations), long life sample shut off valve and rugged microthermal conductivity detectors that do not burn out if the carrier supply fails all help to ensure high reliability.

HELPS KEEP YOUR RUNNING COSTS DOWN - low carrier gas consumption, low routine maintenance requires no compressed air supply.

EASY TO ACCESS INFORMATION USING MONITOR SOFTWARE - easy to use trending, on line views of chromatograms and extensive archiving enable you to keep track of the current and past status of your supply and spot any trends or changes.

Summary

The Danalyzer is now available in two versions to meet all the requirements of the natural gas industry.

Model 571 analyser with 2350 controller for C1 to C6+ and N₂ and CO₂.
Four minute analysis with 0.005%* repeatability on CV.

Model 591 analyser with 2350 controller for C1 to C9+ and N₂ and CO₂.

* At ambient temperature.

PTB, BRML, CMI, SDM, OMH and numerous gas companies have approved the Danalyzer for the determination of calorific value, normal density, carbon dioxide content and nitrogen content of natural gas.

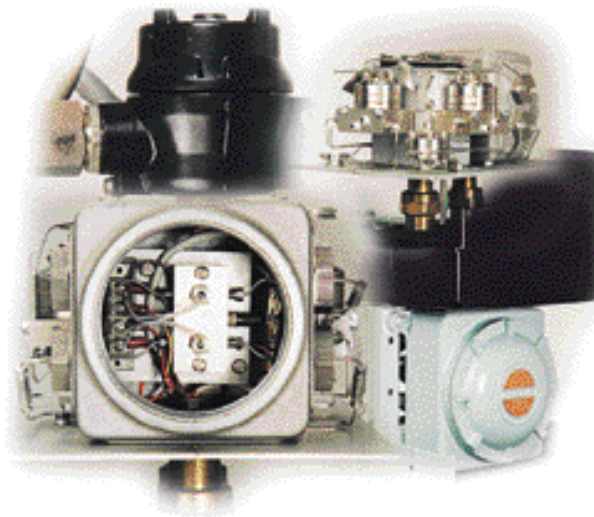


Features...

The CENELEC Danalyzer features and benefits (continued)

The Danalyzer features include :

- n Sample stream selection system
- n Heat sink oven which does not require compressed air
- n Long life sample inject and column switching valves
- n Long life sample shut-off valve
- n Rugged microthermal conductivity detector
- n Stable micropacked columns



Sample stream selection system - routes the externally conditioned sample to the sample valve for up to 12 streams.

It includes:

2 micron guard filter

Sample flow meter with needle valve

Solenoid operated double block and bleed valves for stream switching and automatic calibrations

Heat sink oven - requires no compressed air so there is no need for expensive high maintenance compressors. Reliable and accurate temperature control ensures repeatable results to within +/- 0.05% over the full temperature range of -18°C to +55°C.

Long life Daniel valves - six-port sample inject and column switching valves with a proven life of over five million actuations. The sample shut-off valve minimises the variation in the sample being injected.

Micropacked columns with five year warranty - provide separation of all measured components to ensure repeatability better than +/- 0.05% over the full ambient temperature range of -18°C to +55°C. Micropacked columns reduce carrier gas consumption. One 50 litre cylinder of carrier gas at 200 bar pressure will last for at least six months. Columns are warranted for five years under normal operating conditions.

Microthermal conductivity detectors - use thermistors to measure the concentration of each component. The use of thermistors which are unaffected by carrier gas failure or vibration ensures that the Danalyzer is highly reliable in the field.

Column switching valves - fast analysis - For a C1 to C6+ analysis the six-port column switching valves provide a fast four minute analysis cycle with separation of all components.

Separation systems

The analysis begins with a representative sample being taken from the process stream. It is passed through the sample conditioning system and via the sample shut-off valve to the sample valve. The sample shut-off valve stops the flow of the sample to allow the gas in the sample loop to go to atmospheric pressure. The sample valve then operates and the helium carrier gas sweeps the sample out of the sample loop into the separation system. The separation system consists of three columns, a sample injection valve and two column switching valves, all mounted in a temperature controlled oven.

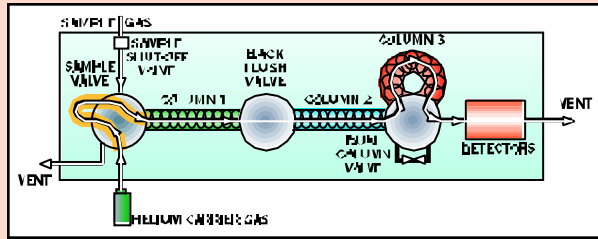
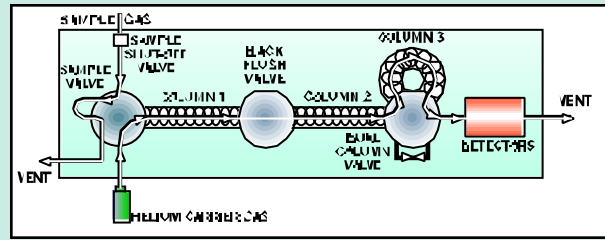
For a C1 to C6+ analysis the first column separates the heavy components, C6+ (hexane plus). The second column separates the intermediates, C3 (propane), C4 (isobutane, n-butane), C5 (iso-pentane, n-pentane, neo-pentane). The third column separates the light components, N₂ (nitrogen), C1 (methane), CO₂ (carbon dioxide) and C2 (ethane).

Flow analysis

Model 571 C1 to C6+ with N₂ and CO₂ four minute analysis

STAGE ONE: 0 TO 5 SECONDS

Prior to injection, the process sample is run through to purge the sample loop. Then the sample shut-off valve stops sample gas flow to allow the gas in the sample loop to go to atmospheric pressure prior to sample injection. Helium flows through the columns and the detector system is zeroed automatically. The analysis is ready to begin.

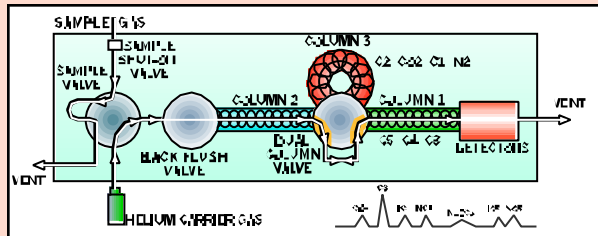
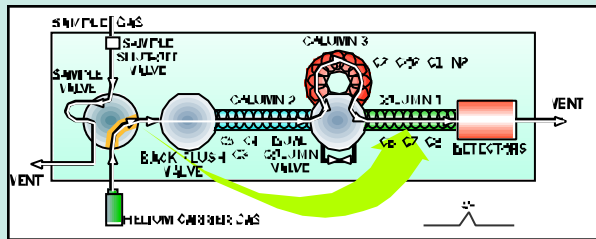


STAGE TWO: 5 TO 10 SECONDS

The sample valve is switched ON to capture a precise volume of the sample and allow the carrier gas to sweep this sample from the valve into the columns.

STAGE THREE: 10 TO 40 SECONDS

The sample valve is switched OFF and the carrier gas pushes the sample through the column. When complete C6+ separation has occurred, the backflush valve then operates, re-routing the connections to column one and reversing the direction of carrier flow through column 1. The C6+ peak comprises C6, C7, C8 and above.

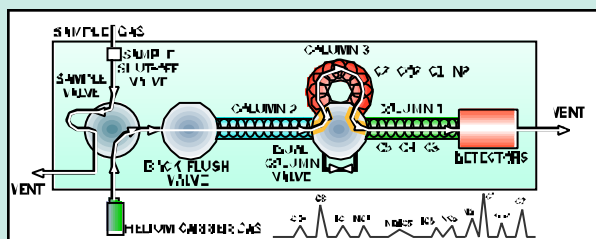


STAGE FOUR: 40 TO 135 SECONDS

The dual column valve switches to allow the components in column 2 to bypass column 3 and go to the detector via column 1. Meanwhile the light components in column 3 are trapped, waiting their turn to elute.

STAGE FIVE: 135 TO 225 SECONDS

The dual column valve switches again to allow the carrier gas to sweep the components which are held in column 3 through column 1 to the detector.

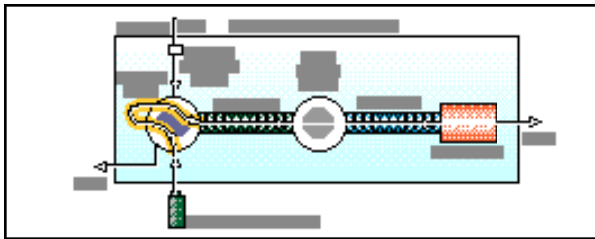
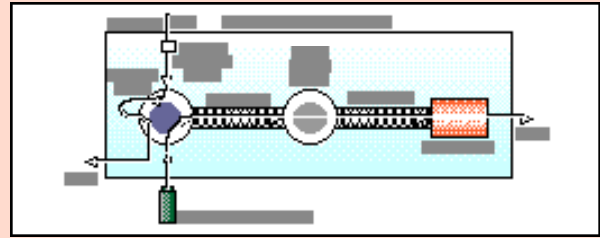


Flow analysis (continued)

Model 591 C1 to C9+ with N₂ and CO₂ five minute analysis.

STAGE ONE: 0 TO 5 SECONDS

Prior to injection, the process sample is run through to purge the sample loop. Then the sample shut-off valve stops sample gas flow to allow the gas in the sample loop to go to atmospheric pressure prior to sample injection. Helium carrier gas flows through the columns and the detector system is automatically zeroed. The analysis is ready to begin.

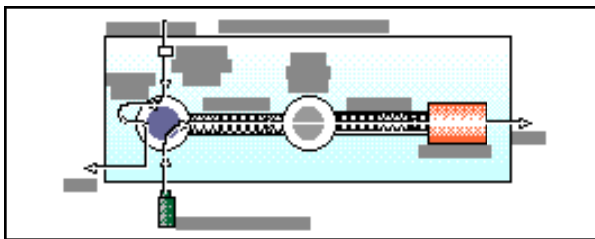
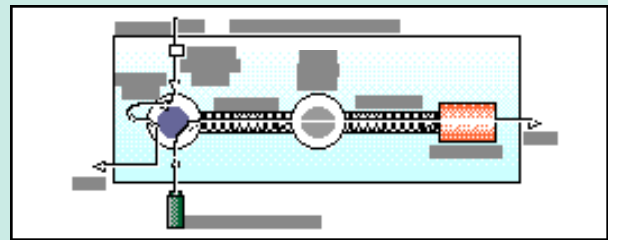


STAGE TWO: 5 TO 10 SECONDS

The sample injection valve operates and captures a precise volume of the sample and allows the carrier gas to sweep the sample from the valve into the columns. The columns are specifically selected to separate C₉+, C₈s, C₇s and C₆s. C₁ to C₅ together with N₂ and CO₂ are measured on a separate set of columns in a different analyser.

STAGE THREE: 10 TO 24 SECONDS

The gas sample that has been injected travels through column 1 and the lighter components elute from column 1 to column 2. No components have eluted to the detector. The sample shut-off valve has opened again allowing the sample loop to purge.



STAGE FOUR: 24 TO 260 SECONDS

The back flush valve operates and leaves only C₉+ in column 1. The carrier flow is changed so that flow is reversed in column 1 and column 1 is now nearest the detector. C₉+ elutes first. A composite peak follows of C₁ to C₅ together with N₂ and CO₂ which is not measured. Then the C₆s elute followed by the C₇s and lastly the C₈s.

Measurement Range of a C₁ to C₆+ Danalyzer

The standard Danalyzer is designed to measure the following components over the measurement range shown:

Methane.....	65 to 100 mole%
Ethane.....	0 to 20 mole%
Propane.....	0 to 10 mole%
N-Butane	0 to 5 mole%
Iso-Butane	0 to 5 mole%
N-Pentane	0 to 1 mole%
Iso-Pentane	0 to 1 mole%
Neo-Pentane.....	0 to 1 mole%
Hexane+	0 to 0.7 mole%
Nitrogen	0 to 20 mole%
Carbon Dioxide.....	0 to 20 mole%

Measurement range of a C₁ to C₉+ Danalyzer

The ranges of measurement remain the same as the C₁ to C₆+ analyser with the exception of:

Hexanes.....	0 to 1 Mole%
Heptanes.....	0 to 1 Mole%
Octanes.....	0 to 0.5 Mole%
Nonan+	0 to 0.5 Mole%

The 2350 Controller



The 2350 controller is available in three hardware configurations - including the explosion proof version of the 2350 controller which is certified EEx d IIB T6 to CENELEC standards for installation in a Zone 1 hazardous area adjacent to the analyser .

There are two 19 inch rack mounting versions, one with keyboard and display and one without. These versions are suitable for safe area mounting only.

Standard PC interface - The controller can be set up and maintained using Daniel's MONITOR software - locally or remotely. No third party software or special interface devices are required.

Communications - There are four serial communications ports which can be set up as RS232, RS422 or RS485. They are individually configurable for printer reports, Modbus ASCII or Modbus RTU communications, model 2251 & 2551 Modbus register duplication or user assignable Modbus registers.

Four auxiliary analogue inputs - can be named and scaled by the user for any variable. Auxiliary input information from other analysers [e.g. H₂S and/or water] can be read and used in analysis calculations.

Five digital outputs - for dedicated alarms or as come/send signals to a DCS or SCADA System.

Five digital inputs - These are provided as status inputs which can be used to monitor on/off status switches which can then be used for alarms.

Security - Three levels of security, sealable switch, password and personal identification number, are available.

Calculations - Calculations of calorific value, density, relative density and Wobbe index are made to ISO 6976 -1995, with the full choice of calculation methods.

Averages - The 2350 provides hourly, daily, weekly, monthly or variable [0-167 hours] averages by operator selection.

Two archives - The 2350 averages up to 64 items and archives the last 64 records of each average. Any of the averaged data can be archived. The 2350 controller also holds the last 900 analyses and 300 calibrations in memory.

Trend - The MONITOR [MON] software allows any single variable from the 900 analysis data values to be trended graphically on a PC or Printer.

Export - Archived data can be exported to a ASCII delimited file for use with spreadsheet programs.

On screen chromatograms - are produced, eliminating the need for a chart recorder.

Maintenance log - This is a "scratch pad" for keeping track of maintenance or testing performed on a chromatogram system.

Event log - Any changes made to the 2350 configuration are time and date stamped and stored in the 2350 automatically.

Calling directory - The MONITOR software allows users to build a directory of communication parameters for a group of analysers, including phone numbers for long distance communications.

Alarms - There are 20 user configurable limit alarms for any component being measured or any calculated value.

Laptop/PC based diagnostics

MONITOR (MON) Software

The Daniel MON software is designed to run on a PC. The MON software allows the user to take complete control of a Danalyzer either locally or remotely. Some of the facilities offered by the MON software are :

Diagnostics

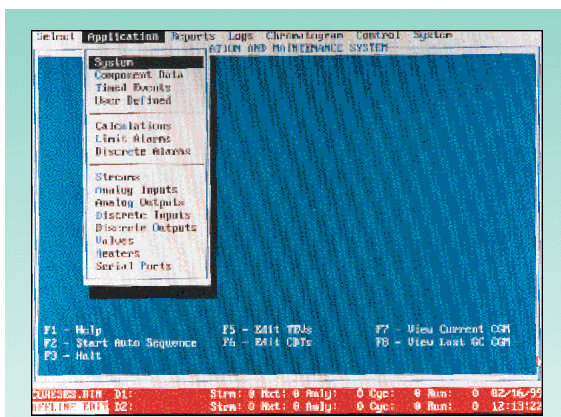


Fig 1 MENU

- n Application configuration
- n Communications set up
- n Report selection/control
- n Archiving

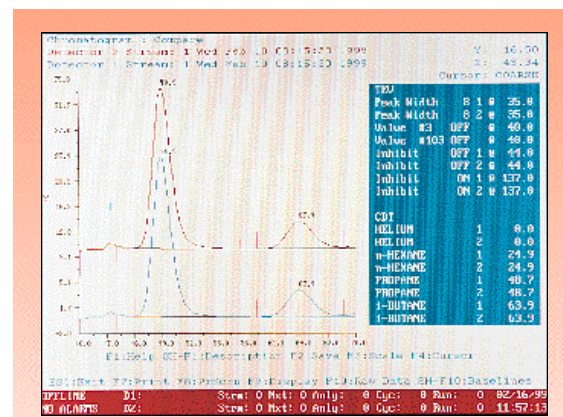


Fig 3 CHROMATOGRAM COMPARISON

- n Compares any two chromatograms
- n Check the original calibration against the last
- n Virtually unlimited possibilities for advanced troubleshooting and analysis

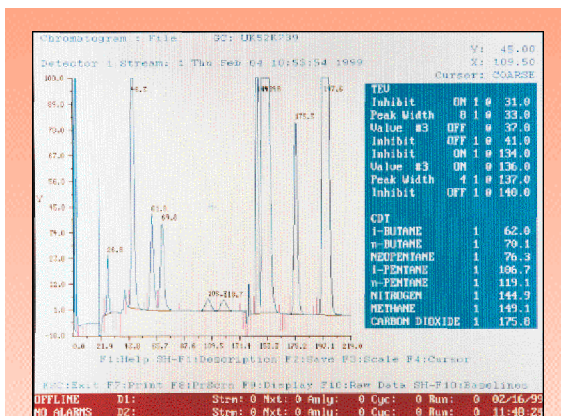


Fig 2 SIMPLIFIED TROUBLESHOOTING

- n Current chromatogram on screen, last analysis and last calibration chromatogram stored in the controller
- n Unlimited storage of chromatograms to disc as files
- n Timed events, peak integration parameters and chromatograms on one screen
- n Zoom function

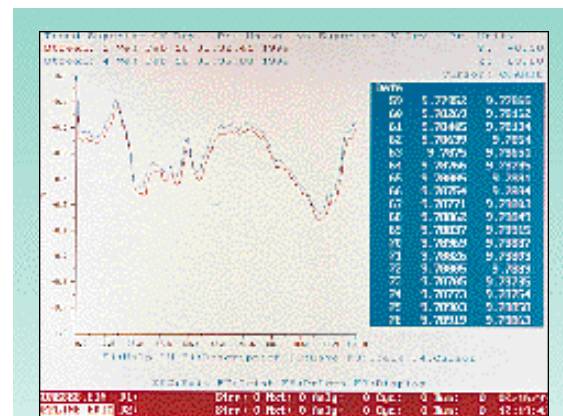


Fig 4 TREND

- n Trending of any component or calculated value
- n Trend can be stored as files
- n Trends can be compared to check for long term stability
- n The trend is made from the archive data held in the 2350 controller

Other applications

In addition to the applications mentioned in this brochure, which are C1 to C6+ with N₂ and CO₂ with a four minute analysis cycle time and C1 to C9+ with N₂ and CO₂ with a five minute analysis cycle time, a number of other standard applications are available. Some common ones are listed below :-

C1 to C6+ with N₂, CO₂ and O₂. The addition of oxygen to the analysis requires an additional column switching valve and a molecular sieve to separate the O₂ from N₂. The analysis cycle time is ten minutes.

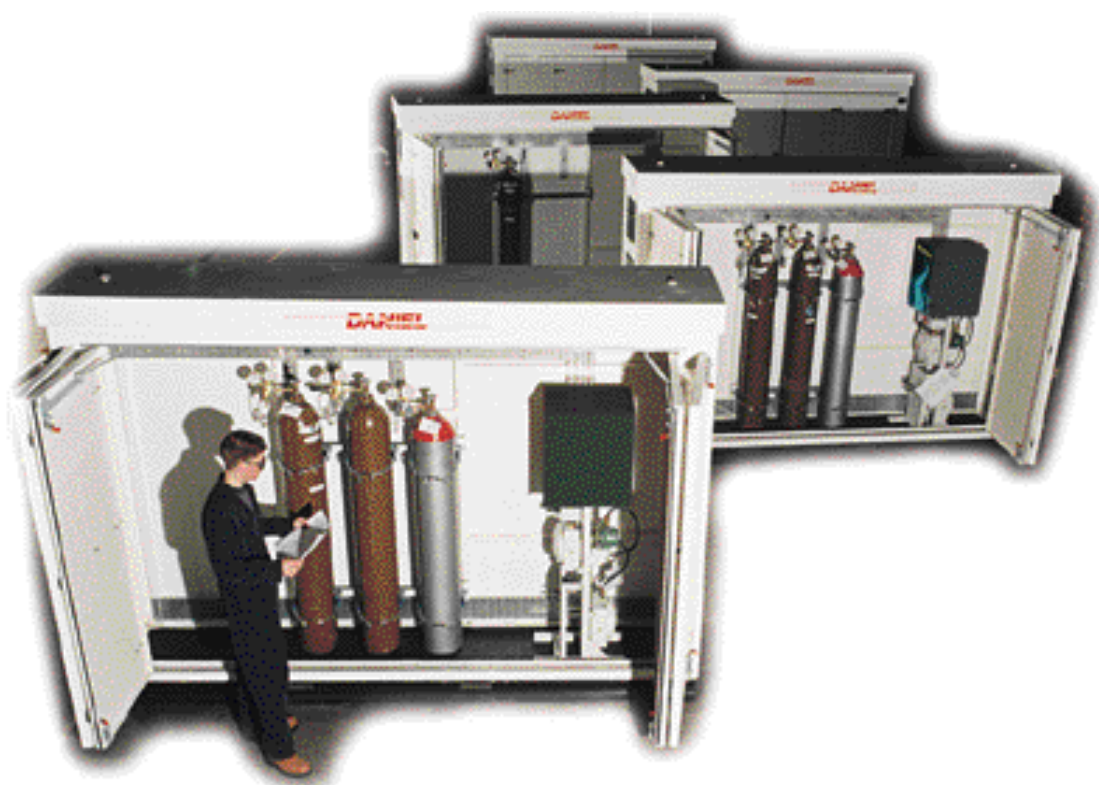
C1 to C6+ with N₂, CO₂ and H₂S. This application requires the use of two analysers and one 2350 controller. One analyser separates the C1 to C6+ with N₂, and CO₂. The second analyser separates the H₂S and will detect H₂S down to 3 ppm. The analysis cycle time is four minutes.

C1 to C7+ with N₂ and CO₂. This application uses a single analyser with the 2350. Analysis cycle time is six minutes.

C1 to C4+ with N₂ and CO₂. This application requires the use of a single analyser and a 2350 controller and is for a faster analysis where no or very little C5+ exists. Analysis cycle time is three and a half minutes.

N₂. This application is to detect the concentration of N₂ in natural gas. Analysis cycle time is one minute.

Standard analyser houses which are designed and manufactured by Daniel Europe Ltd.



The 2350 specification

The main hardware consists of an NEC V53 16-bit processor running at 16 MHz with memory addressing capabilities of up to 16 megabytes.

Nominal operating temperature range

Ambient: -20 to +55°C.
Humidity: 5-95% RH (non condensing)

Mechanical specification

EEx d IIB T6 - Meets CENELEC EN50-014 and EN 50-018 electrical apparatus for potentially explosive atmospheres Parts 1 and 5.

The card cage system is housed inside an enclosure approved for Nema 7, class 1, division 1, groups C and D areas. It meets UL 1203 explosion-proof and dust-proof electrical equipment for use in hazardous (classified) locations for class 1, division 1, groups C and D, and C.S.A. 22.2 No. O-M1962, Part II and C.S.A. C22.2 No. 30-M1986 for class 1, division 1, group C and D.

IP65. Nema 4X - Meets, Nema 250, enclosure for electrical equipment (1000 V maximum), for type 4X,

Canadian electrical code, part II, rule 2-400 1 d, and C.S.A. C22.2 No. 94-1967 as C.S.A. enclosure 4, and IEC 144, degrees of protection of enclosure of switchgear.

Electrical specification

Power 230V AC +/- 15% @ 0.275A, 50/60 Hz, 115V AC +/- 15% @ 0.55A, 50/60 Hz

Communications

COM1: RS232 or RS485. Connector:

DB9 or Phoenix Terminal Block

COM2: RS232 or RS485 or RS422

[RS422 when COM1 is RS232 only]

Connector: DB9 or Phoenix Terminal Block

COM3: RS232 or RS485 or RS422

[RS422 when COM4 is RS232 only]

Connector: Phoenix Terminal Block

COM4: RS232 or RS 485 [RS422 when

COM3 is RS232 only]

Connector: Phoenix Terminal Block

Analogue inputs

Four, 4-20 mA filtered with transient protection dedicated to the model 500 analyser and four, 4-20 mA customer inputs with transient protection.

Analogue outputs

Two outputs standard, 4-20 mA (software calibrated)

Optional additional 4 or 8 4-20 mA outputs

Use of up to four AEMs with bargraph to give 25 off 4-20 mA outputs [Note AEM is external to 235 and is suitable for safe area installation only].

Digital inputs

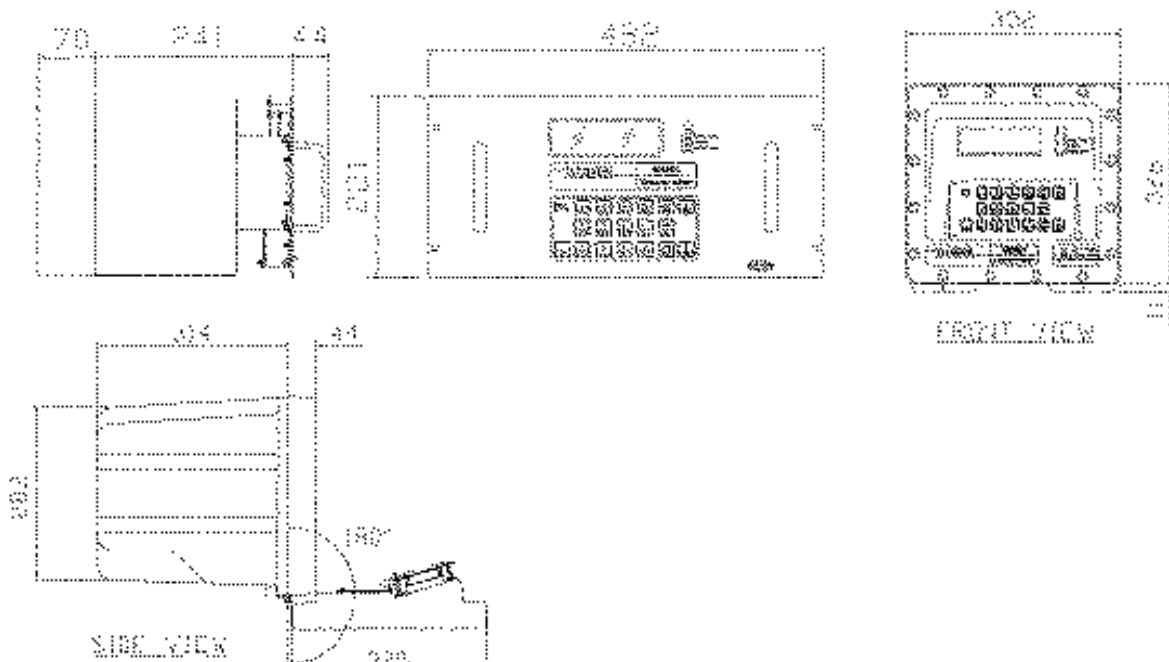
Five user configurable, optically isolated, transient protected

Digital outputs

Five digital outputs

Parallel port

One centronics type parallel port available as a printer output on a DB25 connector



Analyser specification

Sample stream selection system

Double block and bleed stream selection for up to five streams on standard analyser expandable to 12 streams with stream selection expansion option

Airtless heat sink oven

Independent temperature controlled oven and detector enclosure stability throughout wide ambient temperature variations

Power

230 or 110 volts AC +/- 10%, 47 to 63 Hz. 200VA to 300VA

Sample requirements

Sample must be in the vapour phase at a pressure regulated between one and a half bar and three bar.

Micropacked columns

Result in low carrier gas consumption, separation of all components and long term stability. All peaks areas are directly integrated.

Operating limits

Temperature: -18°C to +55°C

Humidity: 0 to 95% RH non-condensing

Utility gas requirement

Carrier and Valve Actuation: N4.5 grade helium i.e. 99.995% pure at nine bar regulated +/- 0.5% As an option, nitrogen or clean dry instrument air may be used to actuate the valves.

Analysis time

Cycle times are:

Four minutes for C1 to C6+,N₂,CO₂

Five minutes for C1 to C9+,N₂,CO₂

For other analysis cycle times please contact Daniel.

Weight

Approx 100 kg. Variable dependant on number of analysis streams

Calibration gas requirements

Blended using gases traceable to primary standard. Certificate of analysis required. Ensure calibration gas is kept above its dew point.

Repeatability of CV

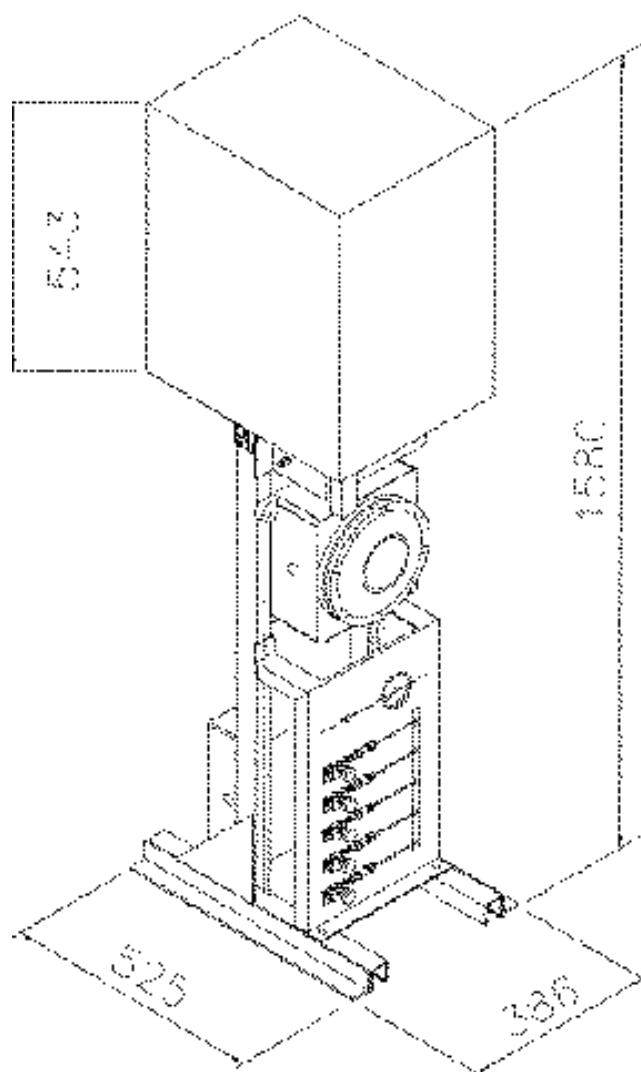
For the C1 to C6+, N₂ and CO₂ analysis at ambient temperature repeatability of +/- 0.005% is typical. Repeatability over

the complete temperature range of -18°C to +55°C is +/- 0.05%.

Certification

Safety: EEx d IIC T4 suitable for use in a Zone 1 area

CE: Complies with the EMC Directive



Supported by the Daniel team - worldwide

- n **High accuracy**
- n **Fast analysis**
- n **Superb repeatability**
- n **Choice of analysis**

From cold to hot, every Daniel Danalyzer CV chromatograph - every one - is factory tested over a complete -18°C to +55°C cycle and is not shipped unless it repeats better than plus or minus 0.05%

By providing the best repeatability over such a wide temperature range, the Danalyzer ensures reliable CV analysis. The user can be confident that the energy value of the gas is accurate.

On request, the complete repeatability data and test conditions for your particular Danalyzer will be provided. You are welcome to visit us at Daniel's factory during the test or at any other times.

Every Daniel system, wherever it is operating worldwide, receives the

same level of lifelong support. Daniel's long term commitment to its clients does not stop at the supply stage. With reliability figures as high as 99.99%, there is minimal requirement for major remedial action, but whenever help is required, a Daniel engineer is available.

Support begins with a telephone call to one of Daniel's customer service centres located at our international offices throughout the world.

Working from our offices or through local joint venture schemes these

centres provide a 24 hour a day helpline, 365 days a year. Remote diagnosis can be used to quickly resolve the problem.

Daniel recognises the need for training if its systems are to be used to their full potential. These are available for all Daniel systems and equipment from courses at Daniel's international offices or at the customer's site.

Daniel Industries - over 65 years as worldwide suppliers to the oil and gas measurement industry.



**Daniel -
investing
for your
future**

DANIEL

MD/087/ED/26.1

The Danalyzer - The CV Gas Chromatograph

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OFFICES AND REPRESENTATIVES WORLDWIDE

www.daniel.co.uk

DANIEL IS A REGISTERED TRADE MARK

All specifications are subject to change without notice as part of a continuous program of product improvement.

Model 571 C1 to C6+ with N₂ and CO₂ four minute analysis.

Model 591 C1 to C9+ with N₂ and CO₂ five minute analysis.

For high accuracy, fast analysis, long term reliability and repeatability that saves you money, choose the CV measurement GC from Daniel - The "Danalyzer".