Sealed Source Files

F & M SCIENTIFIC CORPORATION

1202 Arnold Avenue, New Castle County Air Base
New Castle, Delaware
EAst 8-6606

6602 mk

December 6, 1960

Ref: L&R:IB:CMK
(29727)

Mr. Robert E. Brinkman
Senior Licensing Reviewer
Isotopes Branch
Division of Licensing and Regulation
U. S. Atomic Energy Commission
Washington 25, D. C.

Dear Mr. Brinkman:

Thank you for your letter of November 29, 1960 asking that we forward the information required relative to our Application for Byproduct Material License dated October 6, 1960.

I feel that clarification of the use to which we are going to put this material is important for your evaluation. We design and manufacture scientific instruments. One possible product that we are considering for manufacture is a gas chromatographic detector based on excitation of argon to a metastable state by bombardment with Beta radiation. This detector is very similar to that manufactured by the Barber-Colman Company and the Jarrell Ash Company. Tritium is a common source of the required radiation.

Our manipulation of the radioactive material will be limited to the simple placement of the foil into the detector cell. We have already been instructed by our contemplated supplier, U. S. Radium Corporation, on the care required for this manipulation. We will purchase the foil already cut to our exact dimensions. The placement of the foil into the cell will be done in a fume hood or gas tight dry-box. Attached is a more detailed description of our contemplated use of the tritium foil.

Concerning the training and experience with radiation of Messrs. Martin, Buston and Debbrecht, it is true that there has not been a large amount of experience specific to handling radioactive materials; however, as stated in our application of October 6, 1960, the three gentlemen involved have earned their Ph.D's in Chemistry which included physical chemistry courses dealing partly with radioactive materials. Also, some

9504210033 950410
PDR RC *
SSD PDR

9

14pp.

Sealed Source Files

Mr. Robert E. Brinkman
U. S. Atomic Energy Commission

Dec. 6, 1960

specialized shortcourses on radiation chemistry were included in the training. The industrial experience of the three gentlemen did not directly involve radiation chemicals, but indirectly we were exposed to the handling of such materials. A complete radiation laboratory at the establishment was up to date in the way of equipment and knowledge. In view of the minimum handling we plan to do, and the information provided by U. S. Radium Corporation, we feel that we are qualified to handle this material.

I hope this information will be sufficient to allow you to grant us the license. If not would you please call me collect to get any more information required.

Very truly yours,

Aaron J. Martin

Aaron J. Martin
Director of Research

AJM:mm

Enc.

RECEIVED
DEC 8 1960
U.S.A.E.C.
Isotopes Branch
Div. of L & R

Sealed Source Files

DETAILS OF CONTEMPLATED USE OF TRITIUM

The requested byproduct material (tritium foil) will be obtained from the supplier (probably U. S. Radium Corporation) in the size required, which is a strip 1/4" x 1" with stainless steel backing. No further cutting will be required. On receipt these strips will be placed in ready made brass blocks having inside dimensions of about 0.4" high and a diameter of 0.4". For this a slight amount of bending of the foil will be required. This will be done in a fume hood using tweezers. At no time will the foil come in contact with individuals. The spring tension of the foil will hold it in place around the circumference at the base of the brass block. This will be the only operation performed with the foil itself. Occasionally it may be necessary to remove the foil for purposes of repositioning electrodes on the foil in the cell or for transfer to cells of similar construction but different geometry. In these cases the same care will be used as in the original foil placement. If the fume hood for handling of the foil itself is not a satisfactory protection from minute particles of the titanium tritide, we would use a completely enclosed glove box flushed with filtered air for all handling of the foil.

The brass block containing the foil will be used as an ionization detecting system for gas chromatographic units similar to those constructed by Lovelock (see Journal of Chromatography, Vol. 1, page 35, 1958; Nature, Vol. 181, page 1460, 1958; Nature, Vol. 182, page 1663, 1958). In these units the cell containing the foil is flushed with argon at 50-200 ml./min. The cell would

Sealed Source Files

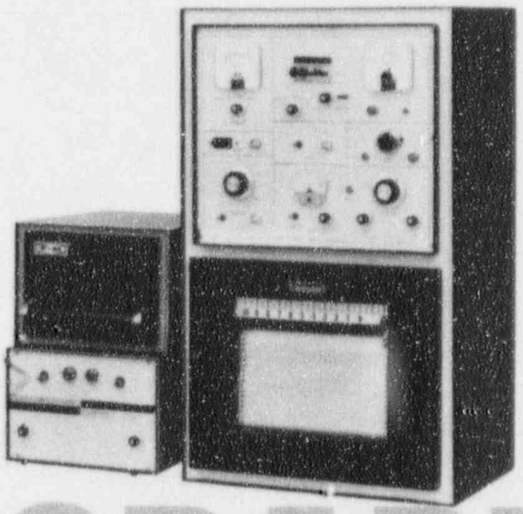
be operated at various temperatures depending upon the types of bompounds being analyzed. However, this temperature would never exceed 200°C to prevent significant desorption of tritium.

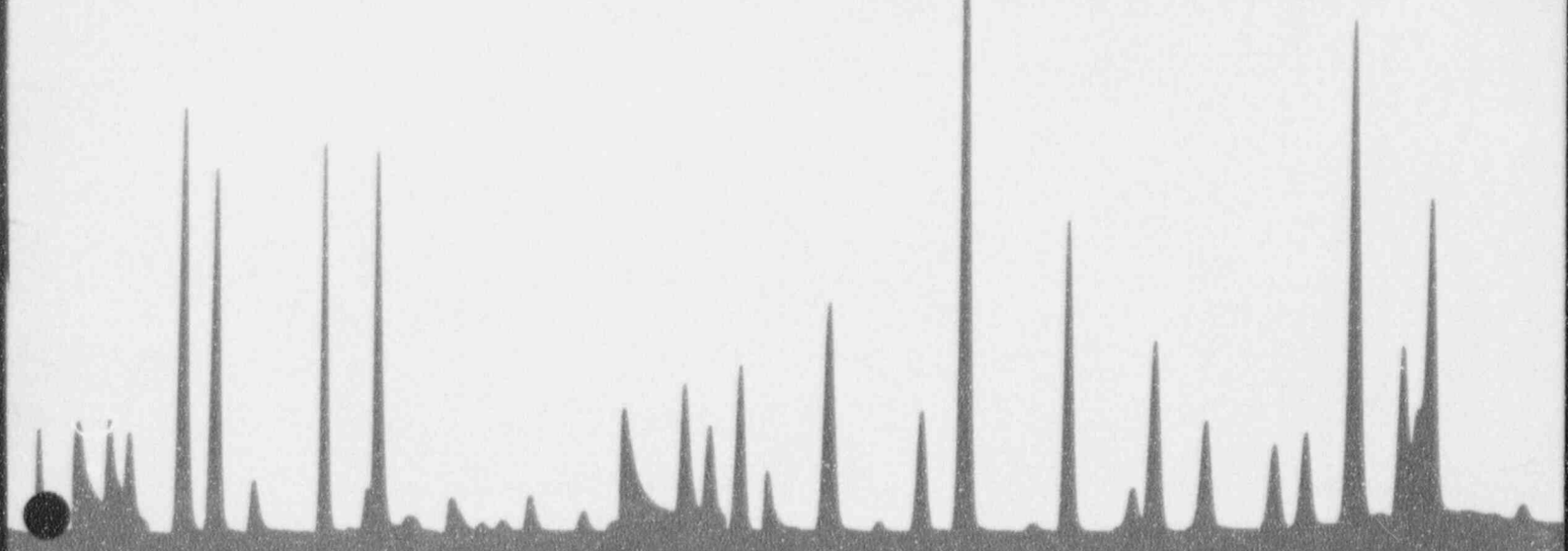
designed for performance, versatility and convenience

F&M

MODEL 720

GAS CHROMATOGRAPH





F & M SCIENTIFIC CORPORATION, AVONDALE, PENNSYLVANIA BULLETIN 7200

MODEL 720

. . . a significant contribution to gas chromatography for the research and control laboratory

Totally in keeping with F & M's established policy of introducing new instruments only when a significant contribution can be made, the Model 720 brings new standards of performance, versatility and convenience to gas chromatography.

To wit: F & M's original instrument in 1957 was the first commercial high temperature chromatograph. Two years later, the company marketed a new model, the first with temperature programming and a breakthrough in chromatographic versatility and performance. In 1960, the Model 500 was introduced, the first to combine *all* the state-of-the-art improvements. It has since become the standard of comparison. Now, the Model 720 extends the performance and versatility of the chromatograph by incorporating in a single dual column instrument all the features required for research as well as routine analyses. All F & M gas chromatographs are equally suitable for low temperature analysis of compounds such as permanent gases, gaseous hydrocarbons and other low boiling materials. Complete temperature versatility is an important feature of all F & M chromatographs.

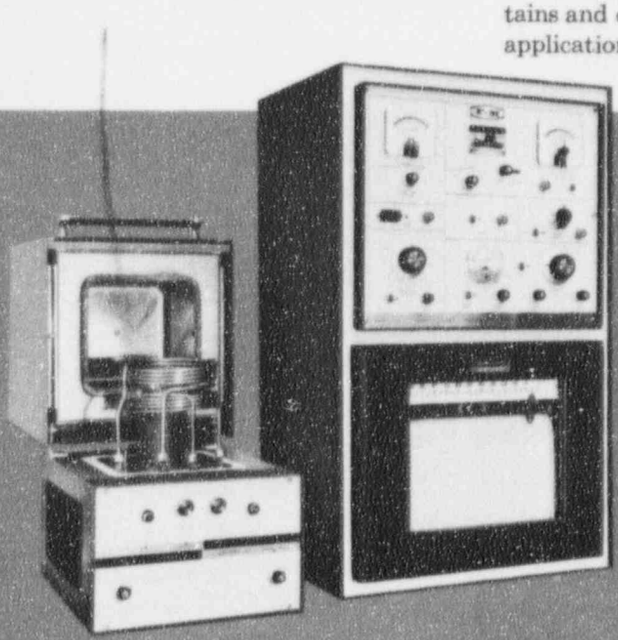
TRIPLE ASSURANCE OF PERFORMANCE

When you order an F & M instrument, the new 720 or any other, you participate in a unique three-way assurance of performance that is backed by the full skill and reputation of F & M Scientific Corporation.

1. *Laboratory-proved*—Every new F & M instrument is field-tested and proved before it is marketed. For example: the Model 720 was 18 months in development and 12 months in field trials in major laboratories across the country.

2. *No planned obsolescence*—To protect its customers against premature obsolescence, F & M has a standing policy to modify existing instruments to incorporate the functional improvements of its new models. For example: a kit is available to convert the Model 500 to dual column operation; another accessory permits the use of flame ionization detection with a thermal conductivity instrument.

3. *Performance guarantee*—F & M guarantees the essential functions of its instruments and supports their proven performance with maintenance and technical service. For example: the F & M Applications Group maintains and continually adds to a comprehensive file of gas chromatography applications which is at the disposal of customers at any time.



MODEL 720 Dual Column Gas Chromatograph

Table of Contents

Triple Assurance of Performance 2

Characteristics 3

Operating Controls 4-5

Dual Columns: 5 Ways to Use Them 6-7

Temperature Program and Control Systems 8

Attachments and Accessories 9-10

Specifications 11

Copyright 1962, F & M Scientific Corporation

MODEL 720 CHARACTERISTICS *performance and versatility*

For more than two years, the F & M Model 500 has been accepted as the performance standard against which all chromatographs are measured. The new Model 720 is a direct descendant of the 500 and thus retains or improves upon its two most important characteristics:

Temperature Programming—The F & M temperature programming system permits the analysis of all types of samples including wide boiling and complex materials (see Page 8 for details). This analytical method gives shorter retention times and narrower peaks which result in a more rapid analysis, better resolution and easier integration of peak areas for quantitative determinations.

Wide Temperature Range—The F & M system of temperature controls permits the use of the Model 720 for the analysis of compounds from room temperature to 500°C. Column, detector and injection port temperatures are independently controlled for complete flexibility of operation.

The 720 offers many other useful features that significantly improve its versatility and performance:

VERSATILITY

Full choice of column operation—The 720 is a dual column chromatograph with a choice of five column flow paths (p. 6):

(1) dual compensating
(2) dual independent
(3) two in series
(4) single
(5) preparative

Full choice of operating controls

(1) Programmed or isothermal
(2) Linear or step programs or both
(3) Independent temperature control of columns, detector, and injection port
(4) Digital and meter readout of column temperature
(5) Dual flow control
(6) Manual or automatic (optional) attenuation.

Full choice of accessories—F & M accessories are all specifically engineered for top performance with F & M chromatographs (p. 9 & 10). These include:

integrators
attenuators
gas, liquid and solid sampling accessories
preparative columns
collection devices.

Multiple detectors—For wide range of operation and high sensitivity, several detection systems are available. The thermal conductivity detector is standard, with high sensitivity W-2 filaments optional. The Model 1609 flame ionization detector attachment, which is also optional, is easily and quickly connected (p. 9).

PERFORMANCE

Upper liquid phase limit extended 50-100°C. The dual compensating columns eliminate baseline drift by canceling out the effect of substrate bleeding at temperatures up to 100°C higher than single column operation. The columns need not be the same length since independent flow controllers for the two columns can be adjusted to equalize the amount of substrate bleed.

No column temperature cycling because the power proportioning controller provides continuous power to the heater, but only in the amount needed; no relays, no contacts, no off-on cycling (p. 8).

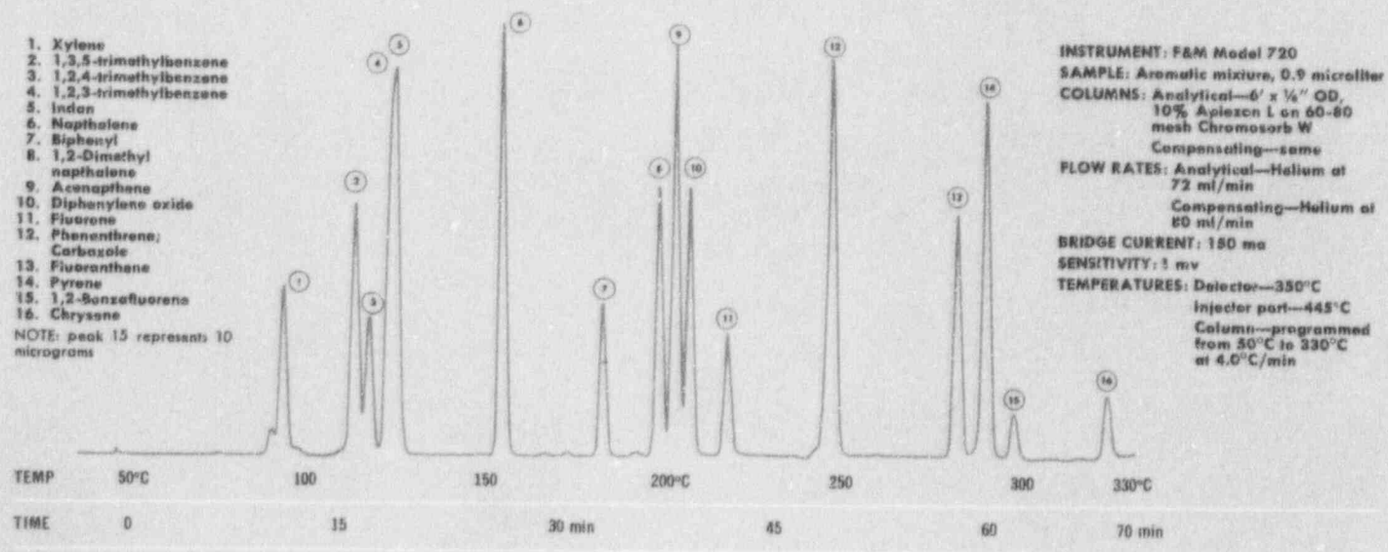
Baseline stability guaranteed by F & M because of:

(1) improved 4-wire hot filament detector design
(2) new solid-state power supply
(3) power proportioning controller for detector
(4) shielding and isolation of wiring circuits eliminate a-c pickup.

Independent flow controllers keep mass flow constant at each column regardless of changes in column temperature or viscosity.

Overall maintenance greatly simplified because:

(1) all components are easily accessible from the front (p. 4)
(2) flip-top oven (p. 4) permits column change in less than 2 minutes
(3) solid-state circuitry increases life of components
(4) plug-in printed circuits speed trouble-shooting and replacement
(5) electronic power supplies eliminate batteries.

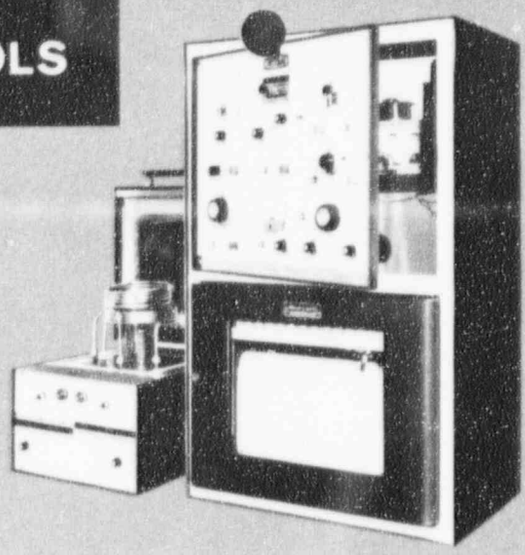


MODEL 720 OPERATING CONTROLS

Designed for operating ecse

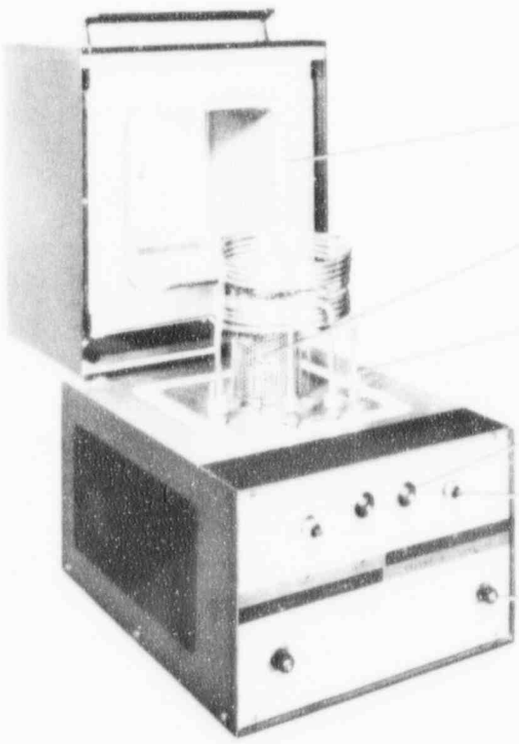
The F & M Model 720 was designed to afford:

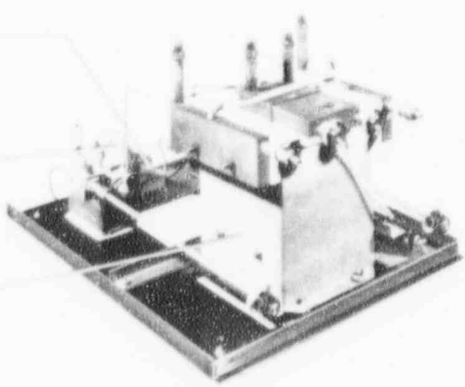
- the best possible analytical performance
- all the controls that aid the analyst
- convenient access to all components
- good looks with outstanding performance.



Model 720 with cabinet door ajar (door swings out full 180°)

DETECTOR COLUMN OVEN Module





Base plate of Detector Module

1 **Flow Adjustments**: one for each column, for independent setting of the two flow controllers

2 **Exit Ports**: one for each column, accept soap film flowmeter (provided with instrument) for accurate measurement of carrier gas flow rate through each column

3 **Injection Ports**: one for each column, hold silicone rubber septums for direct syringe injection, include septum cooler to prevent deterioration of septums at high operating temperatures, accept solid sample injection accessory (p. 10)

4 **Dual Columns and Fittings**: completely accessible, change of column takes less than 2 minutes

5 **Column Heater** and cage protector: high capacity blower and insulation that exceeds requirements contribute to extremely low temperature gradient, small mass leads to fast heating and cooling (heating from 75°C to 500°C in ten minutes, cooling from 500°C to 100°C in less than ten minutes)

6 **Self-sealing Flip-Top Lid**: Self-adjusting hinge always seals asbestos gasket against oven base

7 **Carrier Gas Fitting** connects carrier gas cylinder to stream-splitter block that directs flow to both columns

8 **Differential Flow Controllers and Valves** accurately maintain flow rate to each column regardless of changes in column conditions. Separate flow controllers are provided for each column to maintain precise flow stability during operation

9 **Detector Block** contains four-filament thermal conductivity detector cell and integral heater, well insulated for outstanding detector stability

CONTROL CABINET / RECORDER Module

10 **Master Switch** with built-in circuit breaker

11 **Pilot Lamp**

12 **Controller Setting** operates variable transformer which controls injection port heater at any temperature to 500°C; actual temperature indicated on detector heater panel

13 **Power Switch**

14 **Pilot Lamp**

15 **Controller Setting** determines control point of detector heater controller; 10-turn precision potentiometer calibrated directly in degree C to 500°C

16 **Power Switch**

17 **Pilot Lamp**

18 **Indicator:** thermocouple pyrometer gives direct indication of temperature in degrees C and F

19 **Selector Switch:** for selecting injection port or detector temperature readout on indicator

20 **Selector Switch:** controls power to oven for isothermal, linear-programmed, or step-wise non-linear programmed operation

21 **Program Rate Selector:** single knob controls linear program at any one of 12 discrete rates of 0.5 to 30°C/min.; can be changed at any time, even during a run

22 **Reset Knob:** sets initial temperature for programmed operation, thus establishing lower limit of program; or sets control point for isothermal operation

23 **Digital Indicator** indicates oven control point at all times, whether programmed or isothermal

24 **Indicator:** thermocouple pyrometer gives continuous indication of oven temperature; also has integral upper limit controller that sets high limit of program

25 **Pilot Lamp**

26 **Meter Reset:** push button releases integral upper limit controller and permits resetting by turning knob on indicator

27 **Power Switch** operates blower for both heating and cooling; interlocks with oven selector switch to prevent heating without blower

28 **Pilot Lamp**

29 **Power Switch:** on-off control of line power to integral transistorized d-c power supply for detector bridge

30 **Indicator:** milliammeter continuously indicates bridge current

31 **Bridge Current Adjustment** permits continuous adjustment

32 **Polarity Switch** reverses polarity of detector output to permit positive peaks on recorder regardless of which side of detector is being used for analysis

33 **Coarse and Fine Adjustments** accurately set zero position of bridge output to recorder

34 **Attenuator:** divides the bridge output by factors of two. This allows both trace and major components to be presented as optimum sized peaks on a single span recorder

35 **Full Size Recorder:** ¼ of 1% calibrated accuracy; 11 inch calibrated chart width; Zener diode regulated power supply; plug-in measuring circuit; ink pen; optional 8-speed chart drive; provision for integrators and automatic attenuators

ACCESSIBILITY—Ease of Set Up

36 All components are easily accessible from the front of the instrument: detector module has flip-top cover, control cabinet and recorder have swing-out doors

37 There are only three electrical interconnections: (1) between detector and control cabinet, (2) line power and control cabinet, (3) accessories and control cabinet

38 Instrument readily set up for operation with only one gas line connection required

power panel

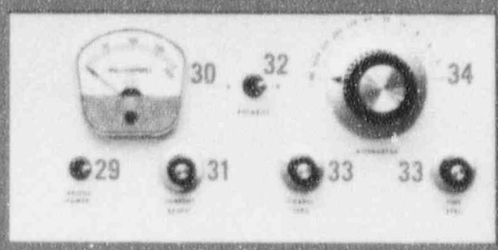
injection port heater panel

detector heater panel

temperature readout panel

column oven panel

blower panel

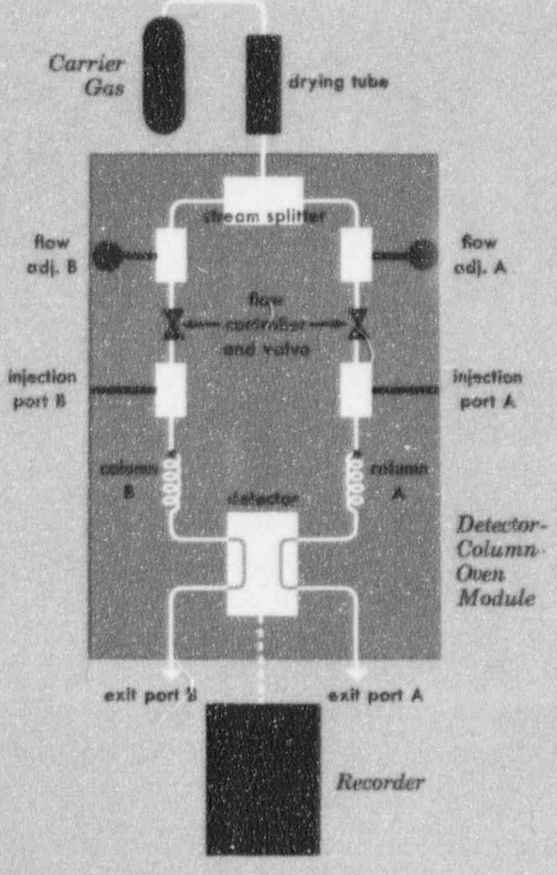


detector bridge panel

MODEL 720
DUAL COLUMNS

The Model 720 has a dual flow system as shown in the illustration below. In normal operation, carrier gas first flows through a stream splitter that divides it into separate but similar flow paths. Two differential flow controllers and valves regulate the carrier gas flow to each column at precisely the rate selected by their individual adjustments (on the front of the detector module) regardless of changes in column conditions during the temperature program. The flow system also includes dual injection ports and dual exit ports.

After eluting from the column, the two streams are directed to the sample and reference chambers of the thermal conductivity detector. Because of an integral polarity switch, positive peaks are always possible on the recorder regardless of which chamber receives the sample flow.



The Basic Flow System

FIVE WAYS TO USE THEM

Although the main purpose of the 720 flow system is to permit a dual compensating column arrangement, the F & M designers did not stop at that. Without compromising their main objective in any way, they equipped the 720 for a total of five flow systems, each of which has its proper place in the field of gas chromatography analysis.

1 SINGLE COLUMN

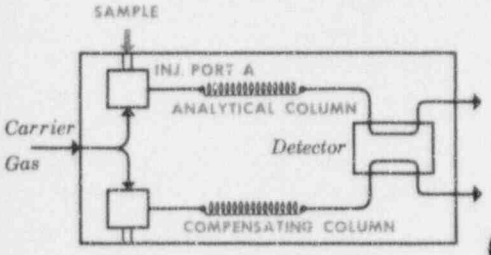
Although designed especially for dual column operation, the 720 serves equally well as a single column chromatograph. In such a use, an empty jumper tube replaces one of the columns, exactly as shown in the drawing for the Preparative Column.

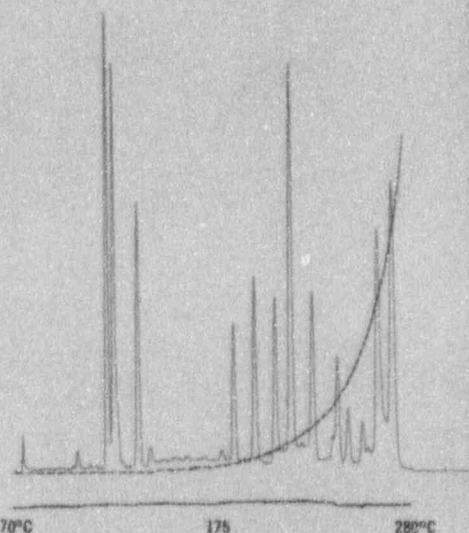
2 DUAL COMPENSATING COLUMNS

USE: To extend by 50 to 100°C the upper limit to which a column can be programmed without baseline drift. Here's how: substrate bleeding from the compensating column is equal to that from the analytical column. The conductivity in both legs of the detector cell is equal and thus cancels out, resulting in a straight baseline.

METHOD: The two columns are prepared with the same packing and the carrier gas flow rates are adjusted to give identical bleed rates from the two columns. The sample is injected into the analytical column and the chromatogram is produced in the normal fashion.

EXAMPLE: The synthetic raspberry oil dual column chromatogram (below) is superimposed on a baseline that was produced by a single column (dashed line) and on its own compensated baseline (solid line). Dual column operation extends the baseline by more than 100°C in this instance.





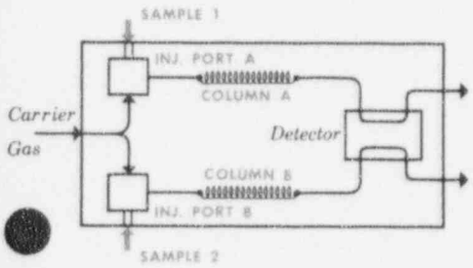
INSTRUMENT: F & M Model 720
SAMPLE: Raspberry Oil (synthetic), 0.5 microliter
COLUMNS: Analytical—6' x ¼" OD copper, 25% nonylphenoxy poly (ethyleneoxy) ethanol on water washed 60-80 mesh Chromosorb W
Compensating—2' x ½" OD, same packing
FLOW RATES: Analytical—Helium at 72 ml/min
Compensating—Helium at 23 ml/min
BRIDGE CURRENT: 150 ma
SENSITIVITY: 2 mv
TEMPERATURES: Detector—300°C
Injection port—315°C
Column—programmed from 70°C to 280°C @ 7.5°C/min

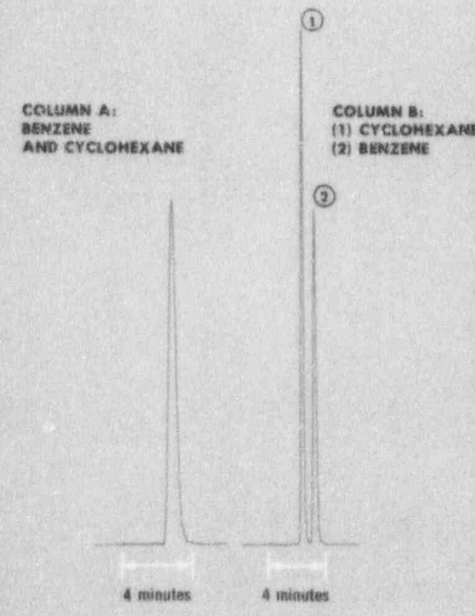
3 DUAL INDEPENDENT COLUMNS

USE: To analyze a sample that requires two different columns for a complete analysis of its components. Or: qualitative analysis by plotting retention volumes on columns of different polarity. References: Research, **8**, 8 (1955); Anal. Chem., **28**, 1370, (1956); Anal. Chem., **34**, 903 (1961). Or: analysis of two successive samples without downtime between analyses.

METHOD: Carrier gas flow is established in the usual fashion, and the sample is injected into port A. After the chromatogram has been completed, the polarity switch is reversed and a second sample injection is made, but this time into port B.

EXAMPLE: When a 1 microliter mixture of benzene and cyclohexane (below) was run through Column A with a non-polar packing of Apiezon L, it produced a single peak. The same amount of sample was then run through Column B with a polar packing of Nitrile Silicone: the two components were separated and each yielded a useable peak.





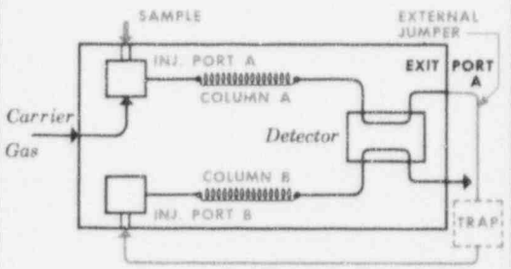
INSTRUMENT: F & M Model 720
SAMPLE: 1 microliter mixture of Benzene—B.P. 80.1°C Cyclohexane—B.P. 80.7°C
COLUMNS: A—6′ x ¼″ OD, 20% Apiezon L on 60-80 mesh Chromosorb W
B—6′ x ⅛″ OD, 20% XF 1150 Nitrile Silicone on 60-80 mesh Chromosorb W
FLOW RATES: A—Helium at 65 ml/min
B—Helium at 67 ml/min
COLUMN TEMPERATURE: 80°C isothermal

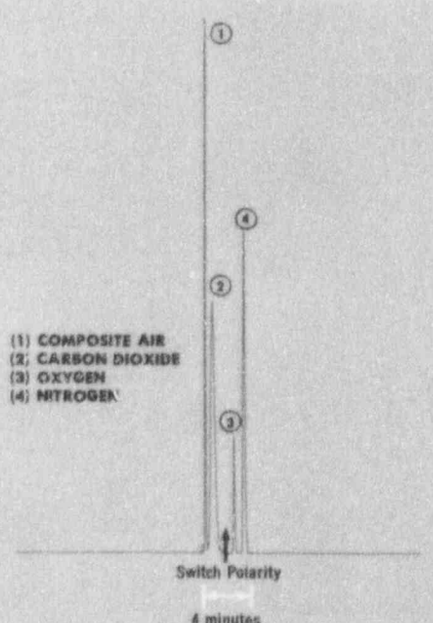
4 TWO COLUMNS IN SERIES

USE: To perform a separation that cannot be done on either of the individual columns. In series operation, the first column separates a component that would overlap on the second, and the second column separates components not separated on the first.

METHOD: An external jumper tube is positioned between exit port A and injection port B. The jumper can be equipped with a trap to remove certain components, or a column to provide additional separation. The sample is then injected into port A. A chromatogram is produced after elution from column A and again after elution from column B. (The polarity switch is normally reversed between elutions.)

EXAMPLE: A typical example (below) is the 2-column molecular sieve to separate CO_2, O_2 and N_2 in natural gas, respiratory gases, air pollution samples, smoke analyses, etc. The first column (silica gel) separates the CO_2 which is then removed in the external trap. Sample flow then continues to column B (molecular sieve 5A) where O_2 is separated from N_2.





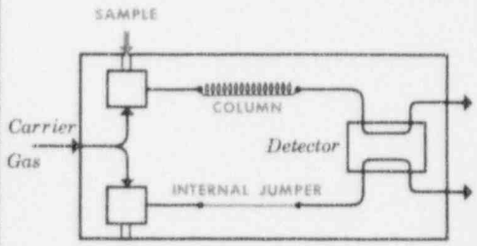
INSTRUMENT: F & M Model 720
SAMPLE: Air—CO_2 mixture, 0.3 ml
COLUMNS: A—1′ x ¼″ OD, silica gel
B—6′ x ¼″ OD, Molecular Sieve 5A, 30-60 mesh
FLOW RATE: A—Helium at 55 ml/min
B—Helium at 55 ml/min
COLUMN TEMPERATURE: 80°C isothermal

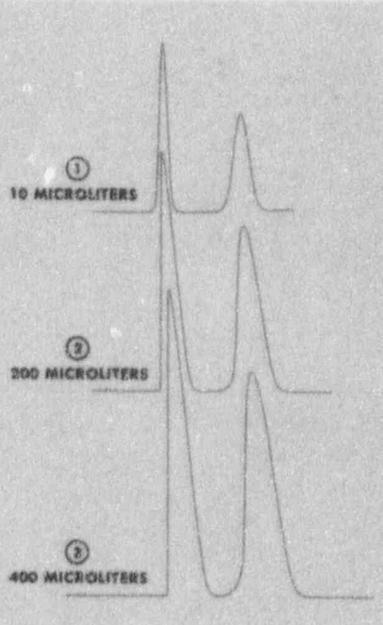
5 PREPARATIVE COLUMN

USE: To collect very pure components, in volumes of a few microliters up to 3 ml.

METHOD: The special preparative column for the Model 720 permits the injection of samples up to 3 ml, directly and in a single injection. The desired pure component is collected at the exit port which is conveniently located at the front of the instrument. If a small microliter sample is to be collected, the capillary collection method described in Facts & Methods, Vol. 2 No. 2, is used. For larger samples, an accessory is available which fits the exit port directly.

EXAMPLE: In the example below, there were three separate injections of benzene and toluene mixture: 10, 200, and 400 microliters respectively. In all three cases, the first peak is benzene and the second toluene.





INSTRUMENT: F & M Model 720
SAMPLE: Benzene and Toluene—(1) 10 microliters; (2) 200; (3) 400
COLUMN: Preparative—8′ x ½″ OD stainless steel coil, 20% Apiezon L on 60-80 mesh Chromosorb P
FLOW RATE: Helium at 160 ml/min
BRIDGE CURRENT: 100 ma
SENSITIVITY: (1) 1mv (2) 8mv (3) 8mv
TEMPERATURES: Detector—200°C
Injection Port—250°C
Column—130°C

MODEL 720 Temperature Program and Control Systems

Beginning with the first one, every new F & M chromatograph made a significant contribution to temperature control in chromatography. The Model 720 continues this tradition by offering the analyst greater versatility in temperature control and programming at a higher performance standard than any other chromatograph.

Separate and Independent Temperature Controllers. The column, detector, and injection port heaters all have separate controllers through which each heater can be controlled at the individual temperature that suits it best. Thus:

1 the *injection port* temperature can be set high enough for instantaneous vaporization of the sample but low enough to prevent decomposition;

2 the *detector* temperature can be controlled at any constant temperature up to 500°C, even during a column change, to promote stability, prevent condensation and obtain optimum sensitivity.

3 the *column temperature* is precisely controlled for best separation and elution of components either by isothermal or programmed temperature operation.

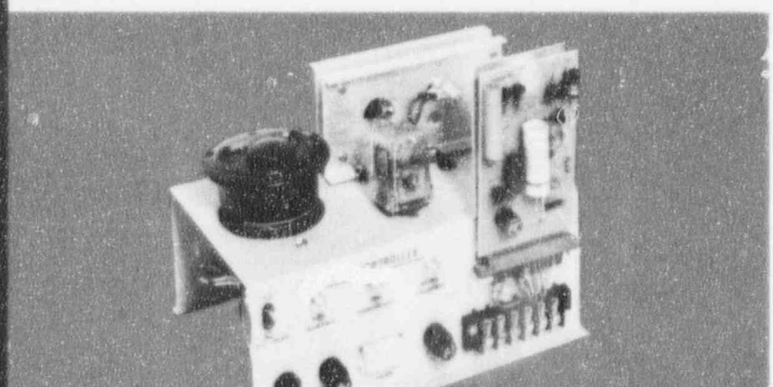
Separate Temperature Indicators. All three temperatures can be indicated independently at any time on the thermocouple pyrometers (p. 5).

Wide Temperature Control. All three temperatures can be controlled from room temperature to 590°C. This is especially important in dual column chromatographs in which meaningful analyses are possible at higher temperatures without baseline drift from substrate bleeding (see the chromatogram below). The temperature control system also permits precise instrument operation at low temperatures for the separation of low molecular weight compounds and gases. The high-temperature feature also permits the ready removal from the columns of high-boiling components after each run.

Smooth Power-Proportioning Control. Both the detector heater and column oven have power-proportioning controllers that provide smooth, straight-line temperature regulation of a high accuracy (±0.1°C) and completely eliminate on-off cycling.

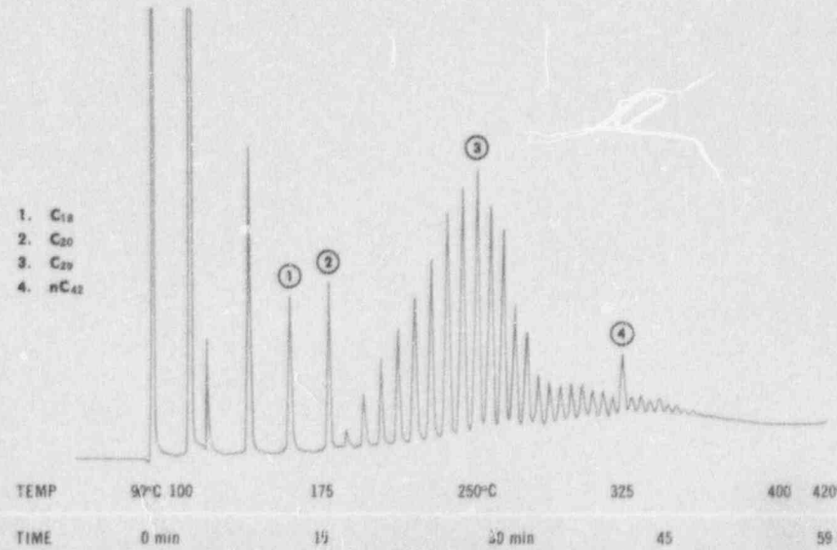
Programmed or Isothermal. The 720 can be operated isothermally or programmed, and the mode can be changed from one to the other at will, even in the middle of a program. Thus the program can be linear, or step-wise non-linear.

Twelve program rates are available, ranging from 0.5°C to 30°C/min.



F & M's (Microsignal Amplifier Converter) MAC* temperature controller is a custom designed unit that continuously compares the actual temperature (thermocouple emf) with the desired temperature (reference bridge emf). The amount of power supplied to the heater is proportional to the difference between these emf's, thus providing true power proportioning temperature control.

Two MAC controllers are used, one for the column oven and one for the detector. The column oven controller incorporates a programmer that drives the reference bridge through a gear train at a specific rate depending on the choice of gear. The oven controller also has a relay that provides "hold" or "off at limit" operation at the end of the program.



INSTRUMENT: F & M Model 720

SAMPLE: Blend of waxes and pure hydrocarbons

COLUMNS: Analytical—6' x ¼" OD, 5% SE-30 silicone gum rubber on 60-80 mesh Chromosorb W

Compensating—same

FLOW RATES: Analytical—Helium at 60 ml/min

Compensating—Helium at 83 ml/min

BRIDGE CURRENT: 150 ma

SENSITIVITY: 1 mv

TEMPERATURES: Detector—350°C
Injection Port—450°C
Column—programmed from 90°C to 420°C @ 5.6°C/min

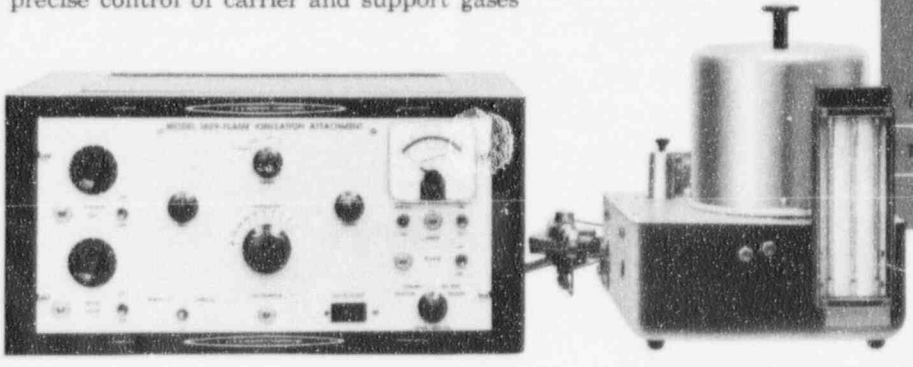
MODEL 720 ATTACHMENTS AND ACCESSORIES

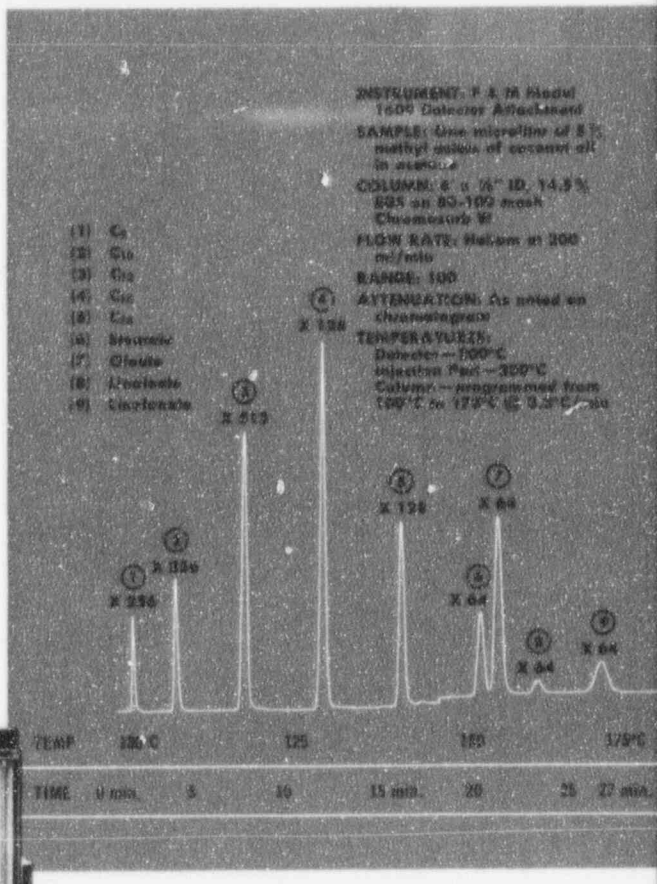
The Model 1609 Flame Ionization Detector This is an ultra-sensitive companion instrument that extends the range and sensitivity of the Model 720. For example, a successful chromatogram was obtained on the 1609 from a sample containing 4 ppb ethylene in nitrogen. Functionally and in terms of performance, the Model 1609 was designed after the important flame instrument variables were determined on the design of a separate flame unit.

The Model 1609 consists of the flame ionization detector, column oven, line-operated electrometer whose basic sensitivity is 4 x 10^{-12} amps full scale, and a full set of independent operating controls. The addition of a column temperature controller and/or programmer makes the 1609 a separate flame unit with the versatility of the 609.

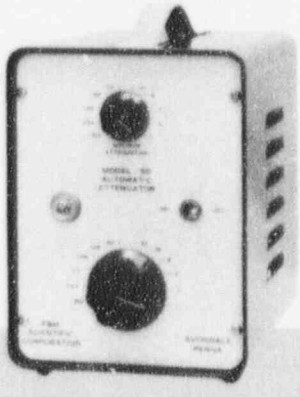
With the attachment of the Model 1609 accessory, the Model 720 Gas Chromatograph can be operated with either the thermal conductivity or flame ionization detector, and switchover from one to the other takes less than one minute.

Some outstanding features of the 1609 • ppb sensitivity • wide dynamic range • full concentration linearity • automatic hydrogen flame reignition • packed columns to 50 ft. long • accepts capillary columns • separate temperature control of injection port, detector and column • precise control of carrier and support gases

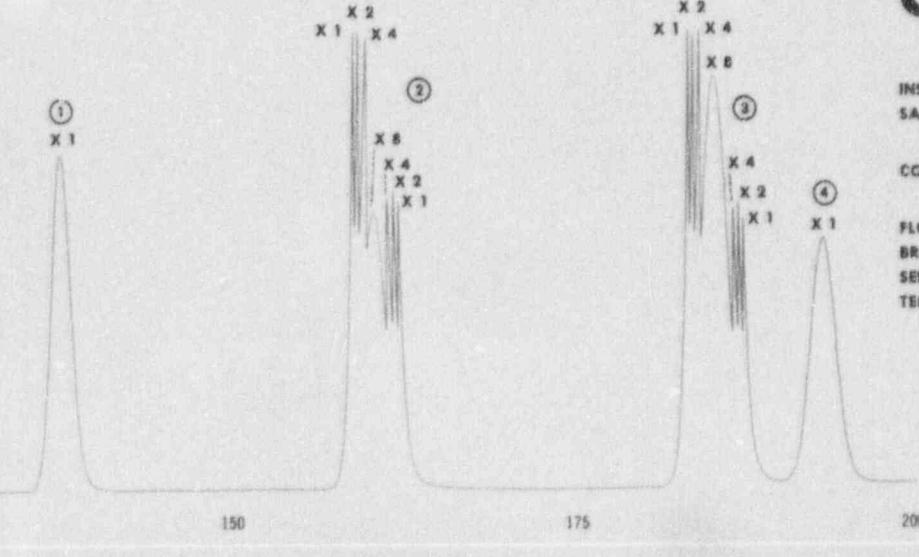




Model 50 Automatic Attenuator About as convenient an accessory as any analyst ever used, the Model 50 makes possible unattended chromatographic operation during the run by automatically holding peaks on scale, regardless of the signal intensity. Here's how: it automatically increases the attenuation factor by two (decreases sensitivity) when the recorder pen reaches 95% of scale, and decreases it by two when the pen reaches 35% of scale returning to the baseline. (Both the upscale and the downscale points are adjustable). Its overall range is 1 to 1024; it has a minimum attenuation dial that can be set between 1 and 512, below which setting it will not deattenuate. In addition to complete automatic operation, there is a manual control switch and dial (Part No. AA-0000).



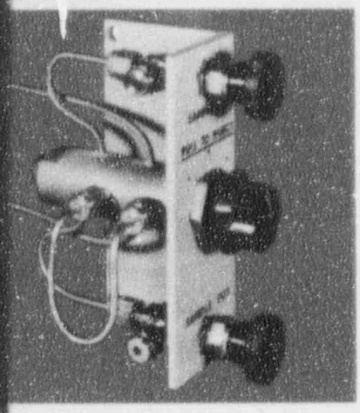
This chromatogram shows the performance of the Model 50 Automatic Attenuator. The peaks for components 2 and 3 were all obtained by automatic attenuation through factors of 1, 2, 4, and 8 and back to 1. Note that the individual peaks are sharp, easily identified as to attenuation, and readily calculated as to quantitative data.

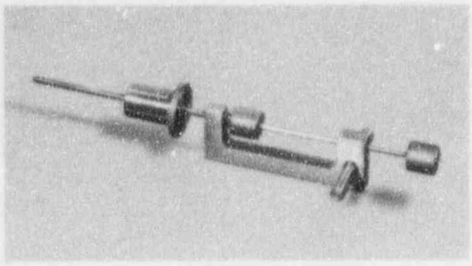


INSTRUMENT: F & M Model 720
SAMPLE: Mixture of (1) benzene (2) toluene (3) p-xylene and (4) o-xylene
COLUMN: 6' x ¼" OD, 20% UCON LB 550X on 60-80 mesh Chromosorb W
FLOW RATES: Helium at 60 ml/min
BRIDGE CURRENT: 150 ma
SENSITIVITY: As indicated
TEMPERATURES: Detector—200°C
Injector Port—315°C
Column—programmed from 125°C to 200°C @ 10°C/min

MODEL 720 ATTACHMENTS AND ACCESSORIES

Gas Sampling Valve





Solid Sample Injector

Detector Protector

To protect the filaments of the conductivity detector against burn-out, the Detector Protector unit automatically turns off the filament current if the carrier gas flow is interrupted for any reason. (Part No. PC-100)

Sampling Accessories

FOR LIQUIDS—a complete line of Hamilton Microliter syringes and Chaney adaptors. These are precision syringes that permit reproducible sampling. (Part Nos. S-7001N to S-750NCH)

FOR GASES—Part No. GV-10/11, for the accurate introduction of gaseous samples; leak-free at temperatures up to 150°C and pressures to 100 psig; all stainless steel.

The GV-10 and GV-11 are the same in every manner except that the GV-11 is provided with shut-off valves on the sample inlet and exit ports. Sample loops available from F & M are:

Size	*Part No.*	*Size*	*Part No.*
0.5 cc	*L-005*	*5.0 cc*	*L-050*
1.0 cc	*L-010*	*10.0 cc*	*L-100*
2.0 cc	*L-020*	*25.0 cc*	*L-250*

FOR SOLIDS—Part No. SI-4 permits the direct analysis of any solid that vaporizes on heating to 500°C or less; useful for the study of degradation products of polymers and for the analysis of entrained volatile components in solid materials; also injects hard-to-handle liquids; uses standard melting point capillaries; attaches directly to Model 720 injection port.

Integrators

F & M offers a complete line of mechanical (ball and disc) and electronic analog and digital integrators for your most exacting requirements. The integrators available from F & M are:

Type	*Part No.*
Daystrom Atten-U-Matic	*IA-6000*
Disc Integrator	*I-3000*
Infotronics Integrator	*IF-9000*

Columns and Packings

F & M stocks a large variety of both analytical and preparative columns for the Model 720 and other instruments. Also available from stock are different types of packing materials, solid supports, liquid substrates, and empty columns. F & M will also quote on any special column and packing requirements.

Set-Up Kits

These two convenient kits contain all necessary reducing valves, tubing and fittings to connect the carrier gas cylinder to the 720. When ordering, please identify kind of carrier gas in addition to the part no.

Type	*Part No.*
For thermal conductivity units	*SK-C*
For flame ionization units	*SK-F*

CUSTOMER SERVICES FROM F & M

F & M offers a variety of services for users of F & M instrumentation. Highly qualified, technically trained representatives in major cities throughout the United States, Canada, and in Europe are available to help customers solve unusual chromatographic problems.

Trained servicemen are on call to assist owners of F & M equipment with service and repair of their instruments.

At the main office, F & M's Applications Laboratory personnel are constantly investigating new chromatographic techniques and improving existing methods. The results of their applications work is made available to in-

MODEL 720 SPECIFICATIONS

FLOW SYSTEM

Dual columns
Dual differential flow controllers
Dual injection and exit ports
Five flow paths:
(1) dual compensating columns
(2) dual independent
(3) two columns in series
(4) single column
(5) preparative

COLUMNS

Standard column sizes available from F & M are: ⅛, 3/16, ¼, and ½ in. OD in lengths up to 50 feet and longer, depending on column OD
Preparative column: 8′ by ½″ OD
Packed or capillary types can be used

DETECTOR

Thermal conductivity type is standard:
four-filament tungsten hot wire
high sensitivity W-2 detectors (optional)
integral solid-state power supply
polarity switch
continuous bridge current adjustment & milliammeter
attenuation switch (12 positions to 1024)
automatic attenuator (with similar specs) is optional
precise zero adjustment (coarse and fine)
Flame Ionization Detector Attachment is optional

TEMPERATURE PROGRAM

Program rates: one knob selector for 0.5, 1, 2, 3, 4, 5, 7.5, 10, 15, 20, 25 and 30°C/min.; can be changed at any time
Limit controls: to automatically turn off column heater, or hold temperature isothermally, when upper limit is reached
Selector control: for isothermal, linear, or linear-isothermal operation

TEMPERATURE CONTROLS

Controllers: separate controllers for detector, column, injection port
Range: all three can be independently set anywhere up to 500°C
Accuracy: detector and column controllers—±0.1°C
Readout: column—digital and meter
detector—meter
injection port—meter
Column heaters: 1200 watts
Column heating rate: from 75°C to 500°C in ten minutes
Column cooling rate: from 500°C to 100°C in less than ten minutes

PHYSICAL

Size: control cabinet/recorder module—22″ wide, 15″ deep, 35″ high
Weight: 185 pounds without recorder or accessories
255 pounds with recorder

ELECTRICAL

Power requirements: 110 volts, 50-60 cycles, 20 amps, a-c
Fuses: main—20-amp circuit breaker integral with master power switch
controllers—oven and detector controllers both have 1/10, 1 and 15-amp fuses

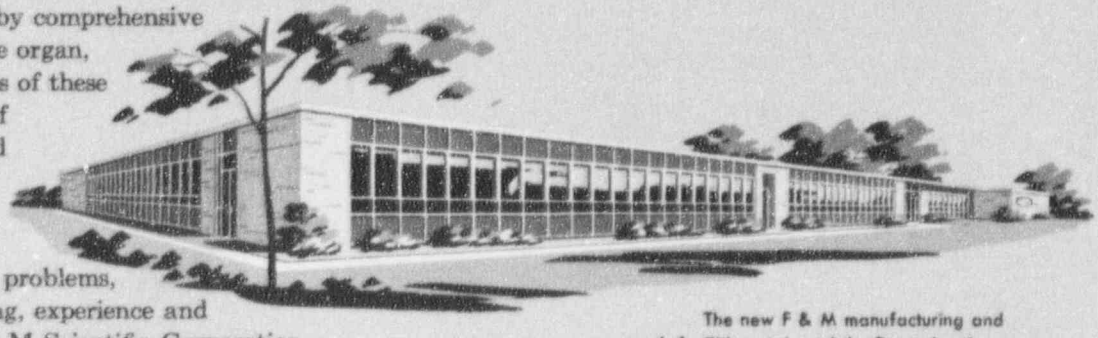
STANDARD ACCESSORIES

Any of the following can be used, without modification to the Model 720 or the accessory:
a. Flame ionization detector attachment
b. Gas sampling valve
c. Solid sample injector
d. Automatic attenuator
e. Prep scale column

• *Specifications subject to change without notice*

dustry through papers presented at technical meetings, in scientific publications and by comprehensive articles in the F & M house organ, "Facts & Methods". Copies of these publications are sent free of charge to anyone interested in chromatography.

For the solution of your gas chromatography and analytical instrumentation problems, call on the depth of training, experience and service available from F & M Scientific Corporation.



The new F & M manufacturing and research facilities at Avondale, Pennsylvania

F & M SCIENTIFIC CORPORATION

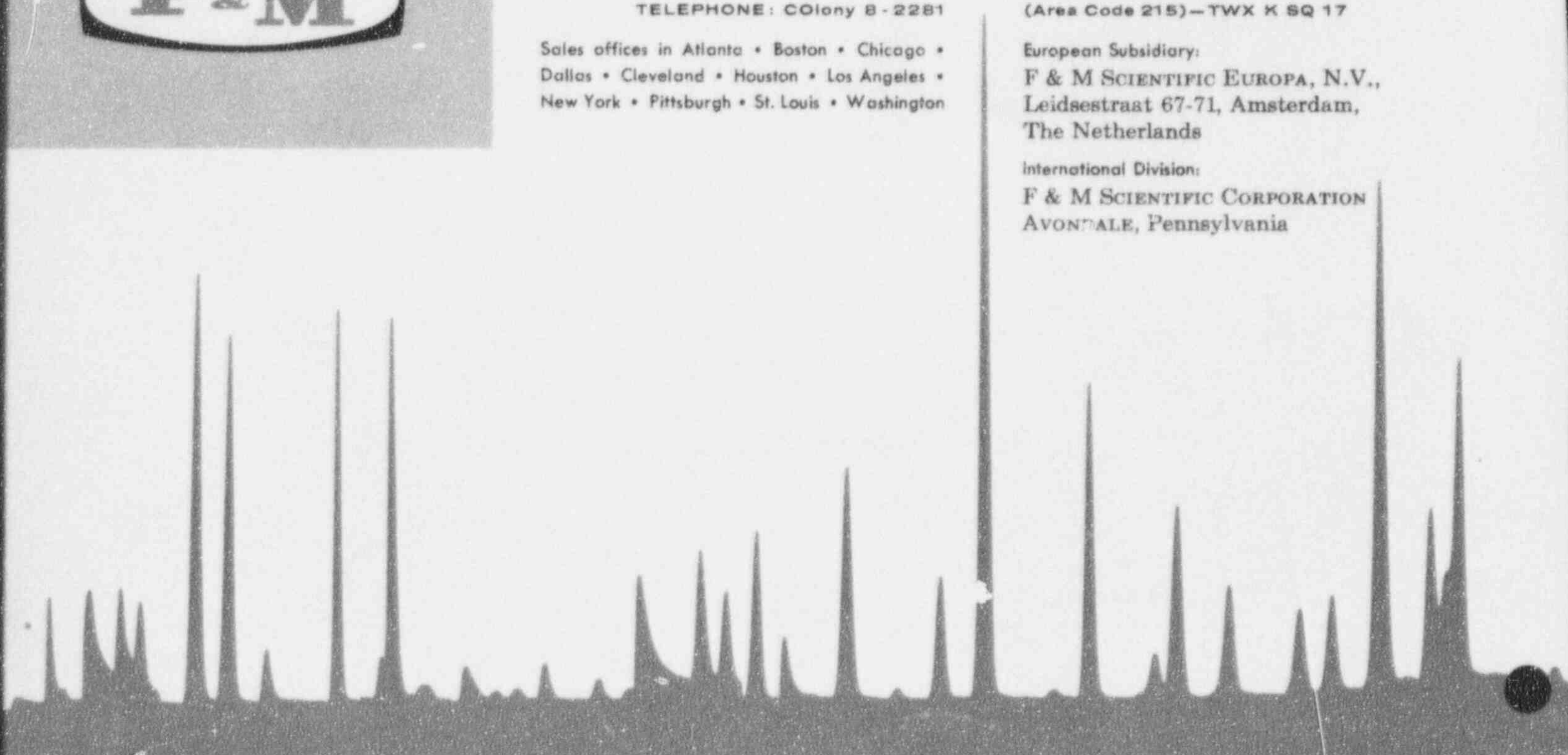
Starr Road and Route 41, Avondale, Pennsylvania

TELEPHONE: COlony 8-2281 (Area Code 215)—TWX K SQ 17

Sales offices in Atlanta • Boston • Chicago • Dallas • Cleveland • Houston • Los Angeles • New York • Pittsburgh • St. Louis • Washington

European Subsidiary:
F & M SCIENTIFIC EUROPA, N.V.,
Leidsestraat 67-71, Amsterdam,
The Netherlands

International Division:
F & M SCIENTIFIC CORPORATION
AVONDALE, Pennsylvania



This design is reproduced from an F&M chromatogram of a 0.5 microliter sample of synthetic raspberry oil.

Printed in U.S.A.

Form No. MP-10M-1067