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PARTICLE SAMPLERS

LONDON

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CATALOGUE 930

1963

The Casella Range of Instruments

This catalogue covers only part of the range of equipment manufactured. Literature is available to describe instruments under the following headings:

METEOROLOGICAL

Wind Velocity and Direction
Atmospheric Pressure
Temperature
Humidity, Dew Point and Frost Point
Precipitation and Evaporation
Sunshine, Solar Radiation and Cloud

INDUSTRIAL

Humidity, Dew Point and Frost Point
Pressure Measurement
Airborne Dust, Bacteria and Spore Samplers
Photogrammetry
Thermometers and Hydrometers
Laboratory Mills
Water Sampling in Rivers or Wells
Airflow Measurement

Contents

Introduction

Airborne particles may be broadly defined as material in a very finely divided state, so small that it can remain freely suspended in the air for long periods without settling. The particles may be man-made from operations in mines and factories, or they may be natural, such as spores and pollen. Often they are combined when bacteria, fungi or virus germs are spread on dust particles.

They may be of widely different form, size, chemical make-up, concentration, density, opacity, etc. These parameters may vary together or singly, so that no one sampling instrument is suitable for all cases. Furthermore, the hazard may vary, sometimes it is health, as in pneumoconiosis or epidemics, sometimes safety, as in dust explosions, sometimes the quality of the product, as in photographic film.

In the following pages we show which parameters are covered by each sampler. From this we hope that prospective users may be able to make appropriate choices. In many cases two samplers may have to be used to obtain all the information needed.

To clarify terms used throughout, we define below the most important:

Flow or Aspiration Rate—
the rate of flow through the instrument of the contaminated air from which the particles are deposited.

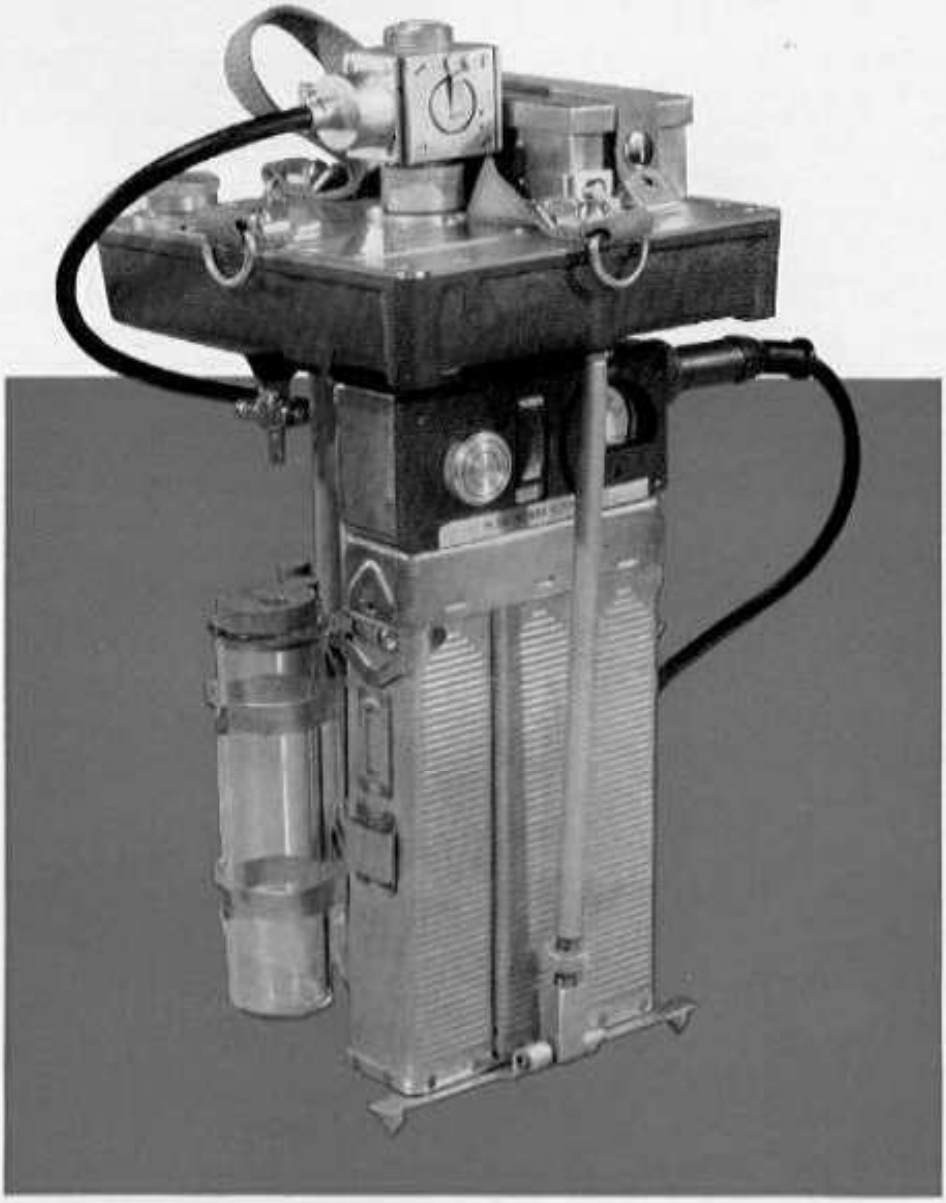
Sampling Efficiency—
the ratio of particles deposited to those drawn into the instrument, expressed as a percentage.

Size of Particles—
expressed in microns (μ)
1 μ = 0·001 mm
= 0·00004 in

Concentration—
number of particles per unit volume of air.

Elutriation—
the separation of particles by size, density, surface area, terminal velocity or other property.

Thermal Precipitator



This instrument is primarily for sampling high concentrations of man-made dust, where the size range is up to about 20 μ. Its most valuable results are obtained where the concentration of dust does not vary greatly with time. It will, however, sample dust of a high or low concentration with the same efficiency.

A most valuable feature is its ability to collect the dust in the same form in which it is present in the air. It will not break up natural aggregates, shatter fragile dust, or alter the relative proportions of fine to coarse fractions. This feature is not found in many other dust sampling instruments. The collected sample is subsequently viewed for counting or sizing under a microscope.

APPLICATIONS

For collecting samples of airborne dust in mines, factories, foundries, quarries, etc., to assess the efficiency of, or establish the necessity for, dust suppression. This is often necessary to combat a health hazard such as pneumoconiosis, or to avoid contamination of a product.

It can be used to establish a complete size distribution of the dust, or to trace areas of high concentration by short period sampling in different locations. Means are available to take 6 samples on one glass disc for quick comparison. Adaptors are made to take samples for electron microscopy.

The instrument is certified by the Ministry of Power as intrinsically safe for use in a methane/air mixture.

PRINCIPLE OF OPERATION

The instrument uses the phenomenon of the dust free space which surrounds a hot body (Fig. 1). A current is passed through a fine resistance wire running horizontally along the length of a narrow vertical slot, the side walls of which are microscope cover glasses. A dust repellent zone is created round the hot wire. The air to be sampled is drawn down through the slot at a speed such that the particles are unable to pass through the dust free zone and are deflected and deposited on the glasses, where they adhere by molecular attraction. The cover glasses can then be removed, suitably mounted on a slide, and the dust evaluated.

CONSTRUCTION

The instrument is built around a water aspirator. Mounted on the top of the aspirator is the sampling head and a box carrying spare sampling plugs. Underneath is a tap carrying a glass jet for providing a constant flow rate. Fitted to the bottom of the aspirator is a tubular framework on which the instrument stands and which provides support for the power unit and stowage positions for the sampling head, two

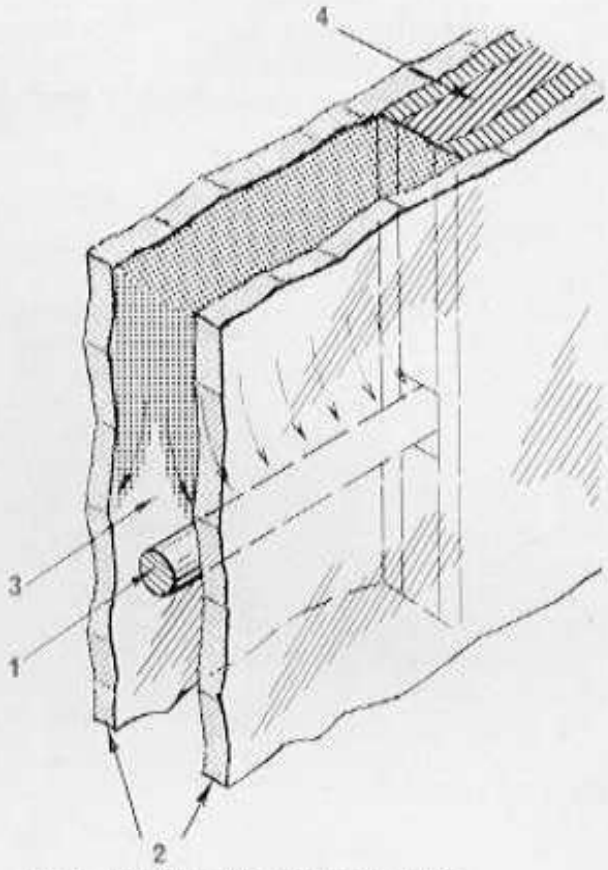


Fig. 1 Method of thermal precipitation

1. Hot wire
2. Cover glasses
3. Dust repellant zone
4. Spacers

jets and two glass measuring cylinders. For transit the whole instrument fits into a strong aluminium alloy case.

THE SAMPLING HEAD

The head is made from two gunmetal blocks screwed together to form a cube (Fig. 2). The two blocks are separated by thin strips of insulating material, known as 'spacers', arranged to form a vertical slot. An electrical resistance wire, heated from the power unit, passes horizontally across the slot. In the face of each half block a hole accepts a close fitting solid brass plug which holds a cover glass in position against the 'spacers' at the correct distance from the wire. The upper and lower ends of the brass

cube are extended and threaded, the slots being carried through these extensions. The lower extension screws into the aspirator. The slot in the upper extension is opened out to form a straight-sided smooth-surfaced mouth.

POWER UNIT

Two types of battery may be used, lead acid or alkaline, both approved miners' hand- or cap-lamp types. A special battery lid incorporates a switch, ammeter and limiting resistance, making the unit intrinsically safe for use in a methane/air mixture. It is therefore permissible to incorporate a socket in the power unit to connect the flexible wire from the head. This increases the usefulness of the outfit, since the power unit need not be locked into the instrument and the sampling head may be up to 9 ft (2·75 m) away. A power unit fitted with an alkaline battery is always recommended for over-sea users.

OPERATION

The aspirator is filled with clean water, the head screwed into its gland, a jet attached to the tap, and the battery (fully charged) is connected to the head. Clean cover glasses are loaded into the head, the current switched on, the tap opened and the time noted. At the end of the appropriate time the water is turned off and the current switched off. The water collected is noted and checked to see if it agrees with the time run. The glasses are removed and placed in a special transit box and subsequently mounted and examined in a clean room.

To avoid random contamination while changing the glasses in the head, a box of spare plugs in special containers is pre-loaded with glasses in a clean area. The plug containers are designed to facilitate the removal and replacement of the plugs and glasses without exposing the collecting surfaces to the atmosphere. As an alternative the cover glasses may be lightly stuck to special plugs with small knobs fitted to their outer ends. These can then be rotated between sampling times to provide a series of deposits arranged 'spoke-wise' on the glass. These rotatable plugs were developed by the Pneumoconiosis Research Unit of the Medical Research Council in South Wales and are called PRU plugs.

For sampling, the instrument may be stood on its own feet, raised on telescopic legs, or suspended by chains. Extension tubes may raise the head above the aspirator or the head may be detached entirely and connected to the aspirator with rubber tube. This latter provision allows an operative to wear the head at or near breathing level, or for the head to be inserted into a small space.

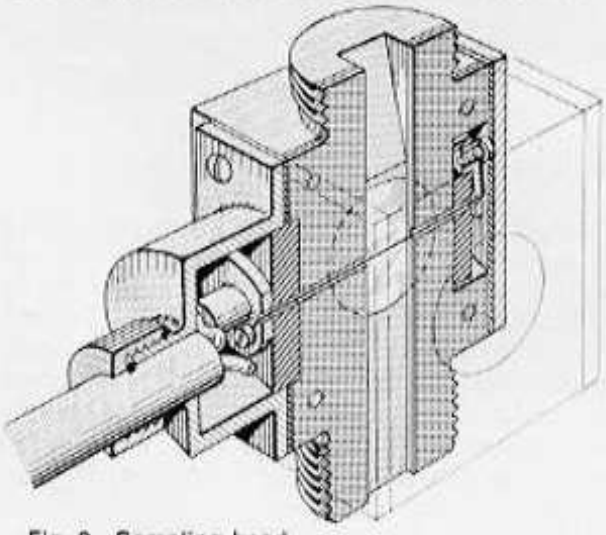


Fig. 2 Sampling head

EVALUATION

Basically this involves mounting the cover glass, dust side downwards, on a glass slide and examining the deposit under a high power microscope. Counts are made in strips of known width across the deposit. Then by using the formula given in the instruction manual the concentration may be calculated. A size analysis may be made by using one of the special sizing graticules (Figs. 3 & 4) placed in the microscope eyepiece.

MAINTENANCE

Standard maintenance procedures for the battery, including recharging after about 8 hours

use. The aspirator tank must be washed out at intervals and the jets kept clean. If the heating wire in the sampling head becomes contaminated during storage it must be 'burnt-off' by passing the usual heating current until no deposit is found on a clean glass.

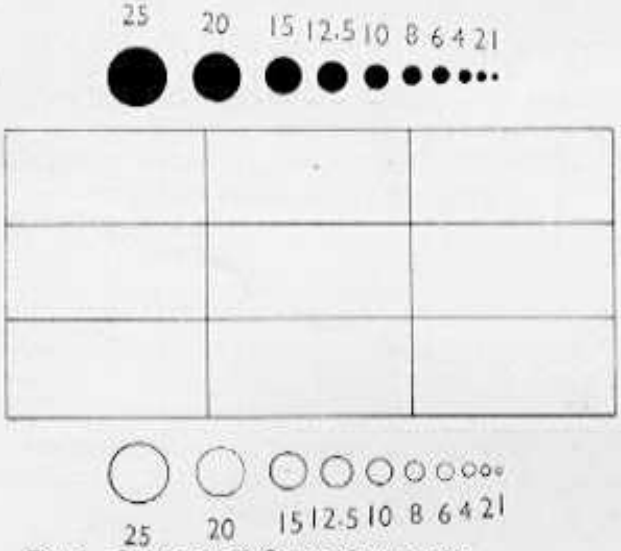


Fig. 3 Patterson & Cawood graticule

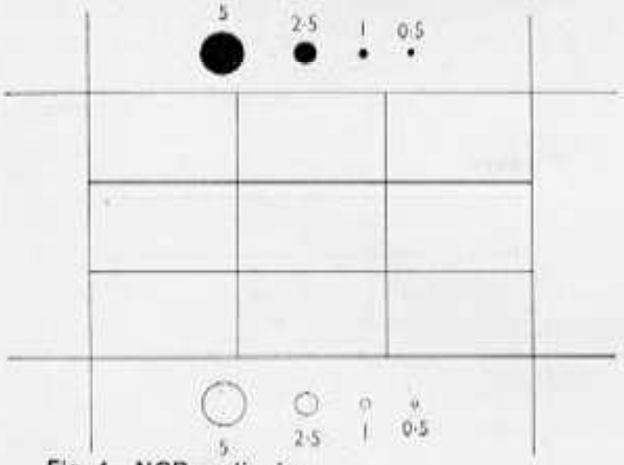


Fig. 4 NCB graticule

CONDITIONS OF USE UNDERGROUND

For use underground in Great Britain we hold a Certificate issued by Her Majesty's Ministry of Power. A condition of this Certificate is that the flexible wire attached to the instrument head must not be more than 9 ft long and must be in one length.

Furthermore, the power unit must not be connected to any other piece of apparatus unless prior approval has been obtained from the Ministry of Power.

GENERAL SPECIFICATION

Sampling Efficiency

Up to 5 μ 100%
" " 10 μ 99%
" " 20 μ 95%

Aspiration Rate

7 ml/min from self contained water aspirator of 300 ml capacity. Volume measured by glass cylinder to ± 0·5%

Current Consumption

1·3 amps from 12 aH battery

Weight in Case

With lead acid battery	17 lb 4 oz	9·64 kg
With alkaline battery	16 lb 2 oz	8·16 kg

Dimensions in Case

$7\frac{1}{4} \times 7\frac{1}{4} \times 14\frac{1}{2}$ in 18·5 × 18·5 × 37 cm

CATALOGUE REFERENCES

Basic Equipment

T12500 Thermal Precipitator complete in case with the following items:
- (i) Head fitted with standard plugs and 9 ft (2·75 m) of flexible wire
- (ii) Power unit incorporating an Oldham 'M' type lead acid battery, charging lead and keys for battery top and filler plug
- (iii) Two glass jets in tube cases
- (iv) Two measuring cylinders
- (v) One metal box containing 8 standard plugs and 8 holders numbered 1A to 4B

T12504 As T12500, but fitted and supplied with PRU rotatable plugs

T12512 As T12500, but with MSA Edison type alkaline battery

T12520 As T12504, but with MSA Edison type alkaline battery

T12524 Charger for Oldham battery

T12528 Charger for MSA battery

Accessories for Different Methods of Using the Thermal Precipitator

T12564 Set of three telescopic legs
T12568 Set of three suspension chains with hooks
T12572 Metal tube for raising head above aspirator, in 10 in (25 cm) lengths
T12576 Harness and clip for carrying Thermal Precipitator head on chest
T12584 Pair of adaptors to connect head and aspirator with rubber tube
T10876 Rubber tubing, per foot (30 cm)
T12592 Set of 8 standard plugs in holders, numbered 5A–8B, in metal carrying box
T12600 As T12592, but with PRU rotatable plugs
T12688 2 plugs for electron-microscope (please state type of specimen holder used)

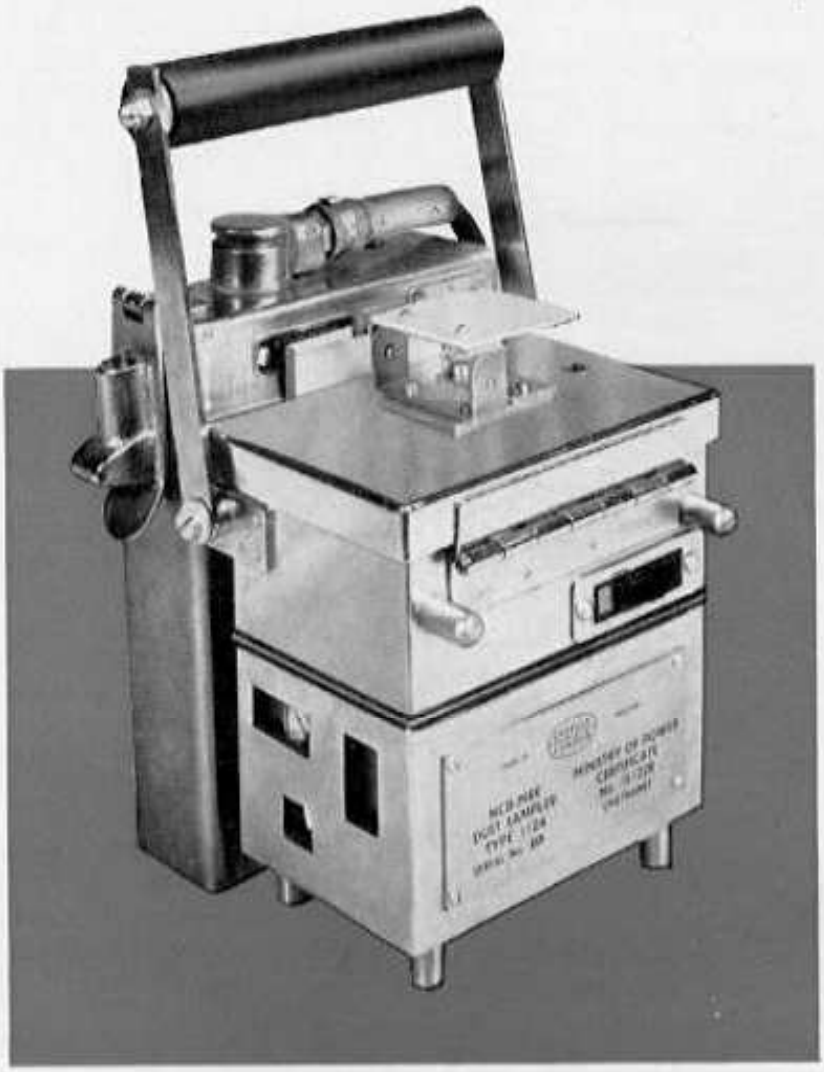
Accessories for Taking, Mounting and Counting the Sample

T12640 Box of 100 cover glasses, 0·74 in. diameter
T12652 Wooden box to carry cover glasses
T12656 Box of 100 microscope slides, 3 × 1 in (75 × 25 mm)
T12660 Book container to take 100 microscope slides
T12664 Box of 50 card rings
T12668 Box of 50 metal rings
T12672 Tube of liquid glue
T12692 Patterson and Cawood eyepiece graticule (Fig. 3)
T12696 NCB 4-dot eyepiece graticule (Fig. 4) for use with Ramsden eyepiece
T12700 NCB 4-dot eyepiece graticule (Fig. 4) for use with Huygenian eyepiece
T12704 Stage micrometer scale (1 mm into 100 divisions)

A push button operated counter to assist the counting and size analysing of the particles is described on page 36.

The instrument is the result of development over many years from the first models designed by H. L. Green and H. H. Watson.

Long Period Dust Sampler Type 112A



This instrument covers many of the applications of the Thermal Precipitator, but is more suitable for estimating the health hazard of a dust cloud. It samples continuously for periods of up to 8 hours and during that time collects only the respirable fraction of the dust. Since the concentration and size distribution of dust can vary widely during a worker's day, this 'long period' sampling gives a more accurate indication of the dust concentration to which a worker has been exposed.

The principle of thermal precipitation is used to ensure efficient sampling of particles in their original state, without shattering fragile dust or breaking up natural aggregates. To achieve a good separation of the particles a low sampling rate is used and the dust is spread over the collecting surface. The upper size range is

restricted to about 7 μ by an elutriator. The collected sample is subsequently viewed for counting or sizing under a microscope.

APPLICATIONS

To measure the desirability of installing dust suppression equipment in a mine or factory, or for use as a control to ensure that the agreed standards are being maintained after such equipment has been installed.
Since the instrument was developed in collaboration with the Mining Research Laboratory of the National Coal Board, full regard was given to its suitability for underground use. It is intrinsically safe for use in a methane/air mixture, it is small and light and is built to stand rough handling without damage. None of these latter features detract from its use in locations other than in mines.

PRINCIPLE OF OPERATION

The instrument uses the phenomena of the dust free space which surrounds a hot body. A current is passed through a fine resistance wire running horizontally in a slot in an insulating material. A microscope slide placed horizontally under the wire forms a space through which the air is drawn. A dust repellent zone is created round the hot wire. The entrance to this dust free zone is formed by vertical and horizontal surfaces which, in their effect, closely resemble the human nose and upper respirable tract by trapping particles above 7 μ before they enter the zone. The smaller particles pass through this elutriator and are then deflected by the dust free zone to be deposited on the slide where they adhere by molecular attraction. The slide is removed, the sample protected by a cover glass, and the dust evaluated.

CONSTRUCTION

The instrument consists of two basic units, a stainless steel two part box and a modified miners' handlamp battery.
In the upper compartment of the box there is the

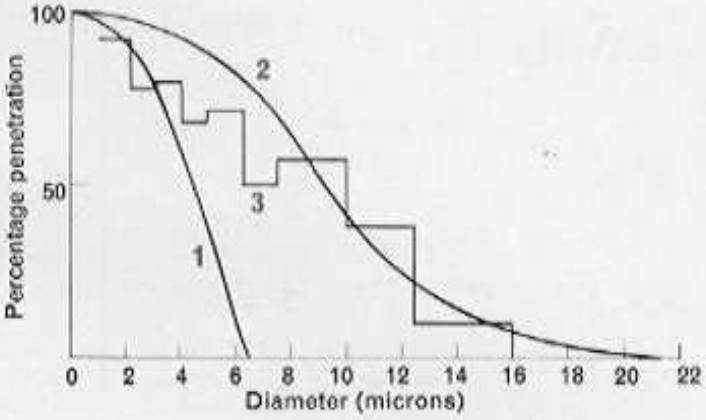


Fig. 1 Horizontal elutriator performance
1. Theoretical, for spheres density 1·3
2. Theoretical, for coal dust
3. Experimental, for coal dust

sampling head attached to the underside of the lid, the knob of the rheostat for controlling the sampling head heater wire, the connection to the aspirating pump and a counter reset knob. The compartment is sealed against dust but is vented to atmosphere, the sampling orifice of the head projecting through a slot in the lid.
The lower compartment contains a pump driven by a reduction gear from a governed electric motor with a current consumption of about 35–40 mA. Geared to the pump is a light-weight counter which indicates directly the number of millilitres aspirated. A small indicator is provided which shows whether or not the motor is working. The counter, the indicator and an ammeter are visible through small openings protected by a sealed glass window.
The pump is a piston type with a capacity of two millilitres per stroke. Careful design and low operating speed ensure maintenance of initial accuracy throughout the life of the instrument. The piston sealing gland is PTFE (polytetrafluoroethylene), a long lasting self lubricating material which needs no attention.

OPERATION

With the lid open a clean glass slide is loaded into the head; the lid is then closed; the battery

is attached by its interlocking device and the battery lid placed in position and, if necessary, sealed.
The unit is now carried to the sampling location, set down at the appropriate position and switched on. The ammeter and motor indicator are observed to check on correct functioning, and the instrument left unattended until the end of the sampling time. After switching off, the instrument is carried to a suitably clean location for unloading the head. The elutriator is cleaned out and any dust removed from the inside and outside of the case, the counter reset to zero and the battery put on charge.

EVALUATION

Basically, this involves mounting a cover slip over the deposit and then examining it under a highpower microscope. Counts are made in strips of known width across the deposit. Then, by using the formula given in the instruction manual the number present per unit volume can be calculated. The particles may be sized at the same time by using one of the special sizing graticules placed in the microscope eyepiece. If desired, the sample may be taken on a cover glass held in a metal strip and the cover glass subsequently mounted on a glass slide. This adaptor strip is supplied with each instrument.

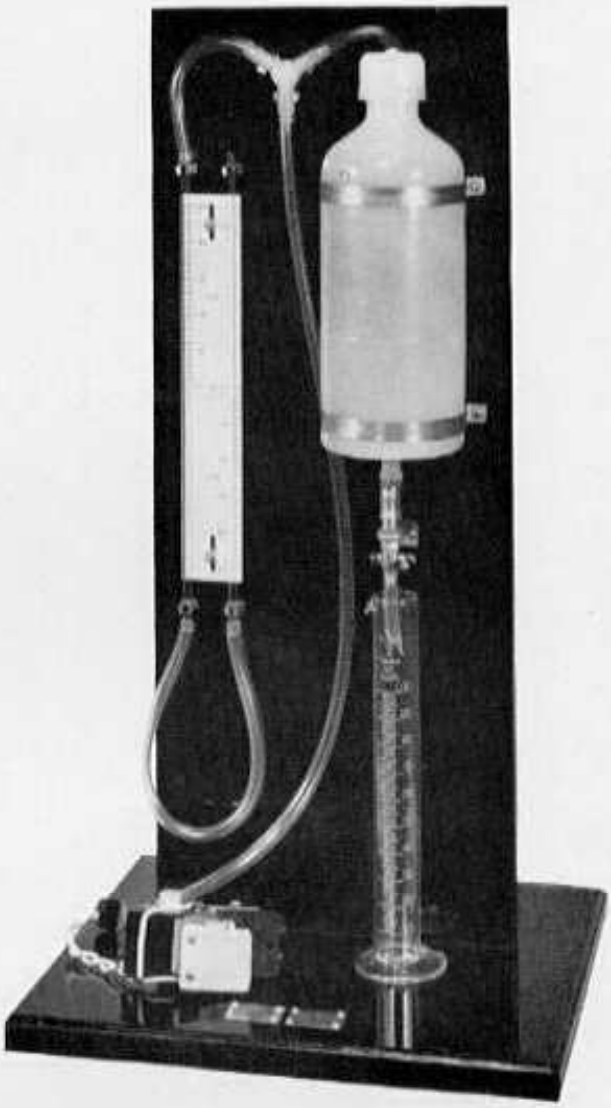


Fig. 2 Leak tester for sampling head

MAINTENANCE

The battery must be recharged after about 8 hours use and standard maintenance procedures adopted. If the sampling head has not been used for some weeks the heating wire becomes contaminated and must be 'burnt-off' by passing the usual heating current until no deposit is found on a clean glass. At intervals the head leakage and the aspiration rate of the pump should be checked. Simple test equipment for this purpose is available. (See Figs. 2 and 3.)

GENERAL SPECIFICATION

Sampling Efficiency

See fig. 1

Aspiration Rate

2 ml/min from motor driven piston pump, preset to ± 2·5%

Current Consumption

Sampling head	0·8 amp
Motor	40 mA
	both from a 7 aH battery

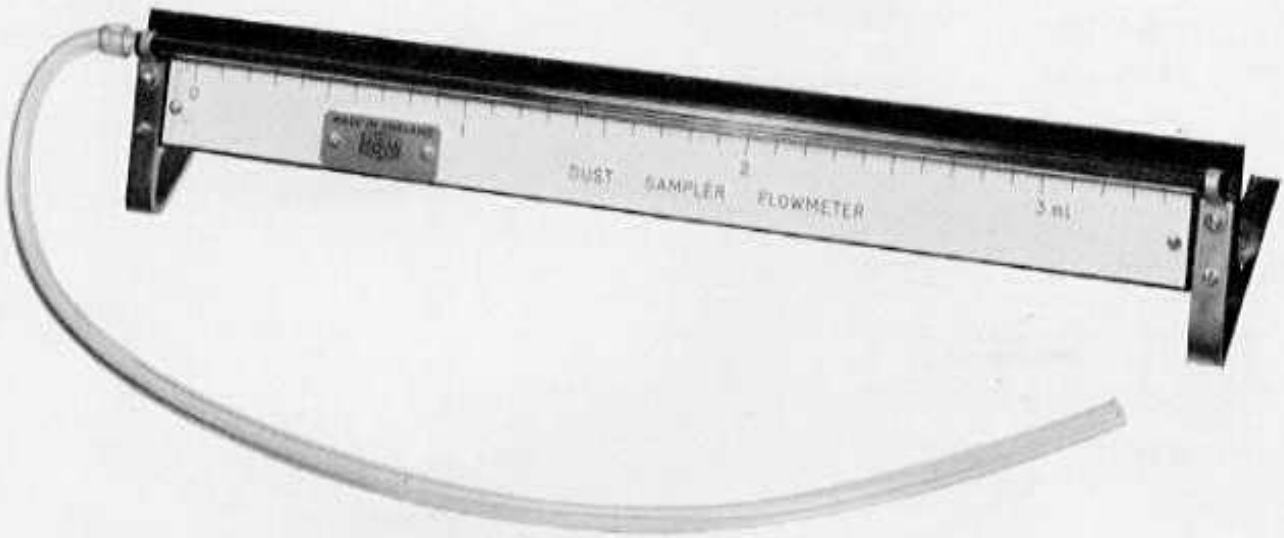


Fig. 3 Flowmeter to test aspiration rate

Weight

9½ lb 4·3 kg

Dimensions

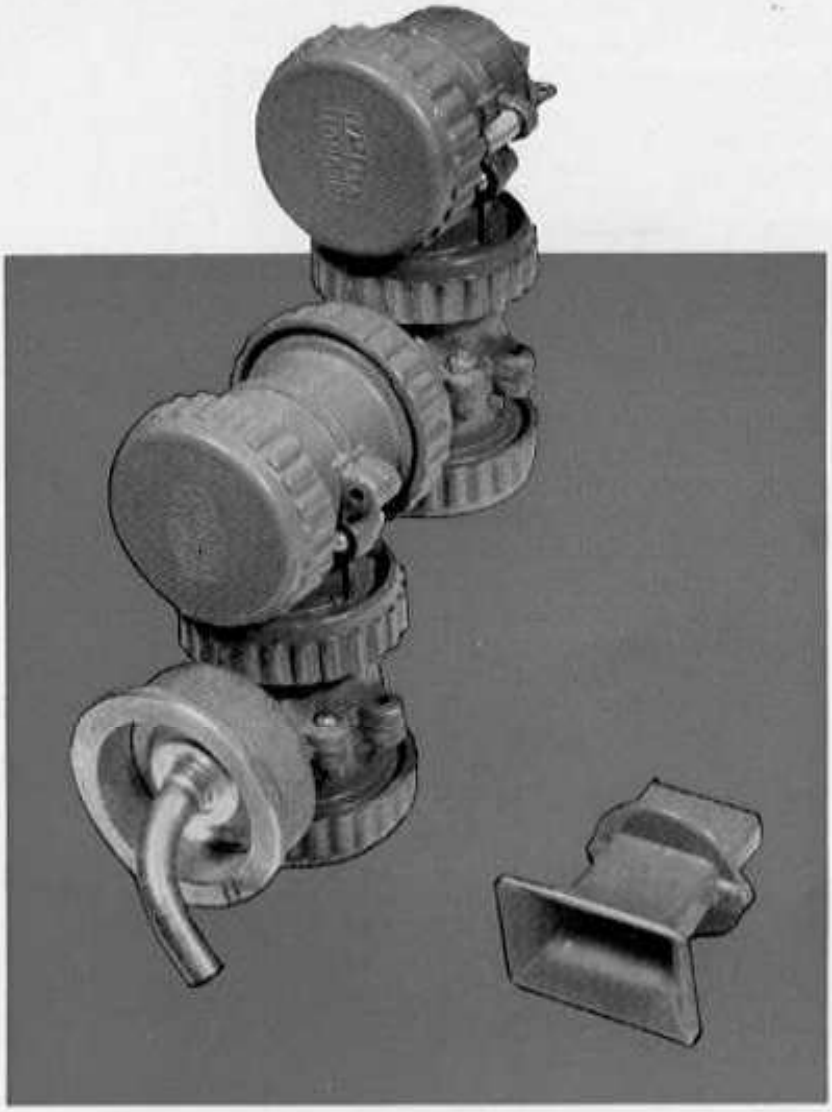
7½ × 5¾ × 6½ in 19 × 14·5 × 16 cm

CATALOGUE REFERENCES

T13000 Long Period Dust Sampler, Type 112A
T13004 Canvas carrying case
T12656 Box of 100 microscope slides, 3 × 1 in (75 × 25 mm)
T13524 Box of 100 cover glasses, 2 × ⅞ in (51 × 22 mm)
T13012 Box of 100 paper spacers, 2 × ⅞ in (51 × 22 mm)
T12660 Book container to store 100 microscope slides
T12696 NCB 4-dot graticule for use with Ramsden eyepiece (Fig. 4 p. 7)
T12700 NCB 4-dot graticule for use with Huyghenian eyepiece (Fig. 4 p. 7)
T12704 Stage micrometer scale (1 mm into 100 divisions)
T13016 Leak tester for sampling head (Fig. 2)
T13018 Flow meter to test aspiration rate (Fig. 3)

A push button operated counter to assist the counting and size analysing of the particles is described on page 36.

Cascade Impactor



The Cascade Impactor samples liquid or solid particles from 0·5 to 50 μ diameter without in any way altering them. This is of particular value when sampling a liquid droplet cloud, since even large drops are not shattered. A very wide range of materials can be sampled with suitable techniques. Low as well as high concentrations can be sampled, whilst evaluation is made easier by the separation during sampling into four size fractions on separate glass discs.

APPLICATIONS

This is one of the few samplers capable of dealing with liquid droplet clouds, both volatile and non-volatile. It is therefore widely used to

establish the efficacy of sprays for spreading insecticides in fields, or the carry of fine mists of atomized liquids. Smokes and other delicate structures such as pollens and spores can also be sampled. Its fairly high sampling rate also enables it to be run for long periods in low concentrations in order to achieve a statistically significant number of particles. For open air use a free swinging suspension with a wind vane enables the orifice to be aligned automatically up wind. When poisonous materials are sampled, washing and sterilization can be easily carried out.

PRINCIPLE OF OPERATION

Impaction, implying low particle velocity, rather than impinging, which implies a high velocity, is one of the secrets of success of this instrument. The low speed allows large particles and in particular delicate ones, liquid or solid, to be deposited with high efficiency. This would normally mean that no small particles would be collected, but as the name of the instrument implies, there is a cascade of impacting jets constructed to give an increasing air velocity, and thus efficiency of collecting the varying sizes. With the four jets two aims are achieved: the collection of all particles down to 0·5 μ and a size separation to assist the evaluation. The construction of the first jet is such that the flow patterns give isokinetic sampling when facing a wind of between 1·8–5·4 metres/sec (4–12 mph). For still air an adaptor is fitted over the first jet. For certain work a filter paper can be fitted after the last jet. Collection is onto glass discs of 25 mm diameter.

CONSTRUCTION

Each of the four stages containing a jet has a spring loaded disc locator held in place by a removable threaded cap. The instrument can be taken apart so that any of the four stages can be used independently. After the fourth stage a filter may be inserted to collect particles too fine even for the fourth jet.
The stages are zinc alloy die castings, precision machined to provide a very high degree of reproducibility from instrument to instrument.

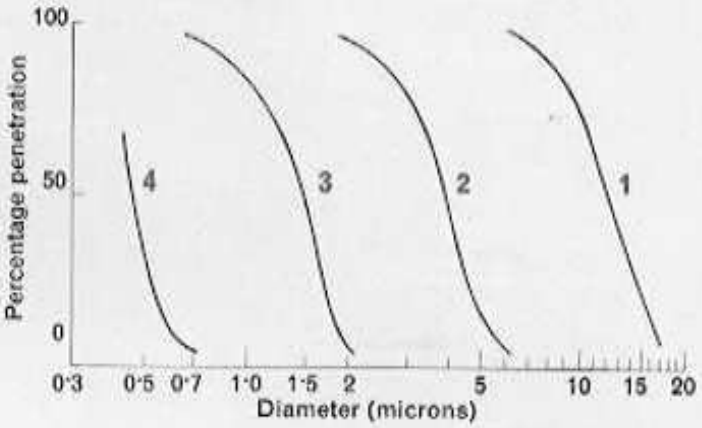


Fig. 1 Penetration, for spheres density 1·0, at flowrate of 17·5 litres/min

1. First disc
2. Second disc
3. Third disc
4. Fourth disc

OPERATION

The glass collecting discs are coated with a medium suitable for the material to be collected. For solid particles a non-drying sticky film is generally used. For liquid particles, powders, dyes, etc., other media have been devised; details are given in the instruction manual sent with each instrument.
The coated discs are loaded into each of the four stages, a filter paper if required into the fifth stage, and a source of suction connected to the outlet pipe. After running for a given time the discs are unloaded and mounted on to glass slides for subsequent evaluation.

EVALUATION

Basically, this involves counting the particles in strips across the deposit with the aid of a high power microscope. Since each disc contains a fairly narrow size fraction, the numbers can often be given in a range of sizes from a count on each disc. But for more accurate size analysis the Porton graticule is used in the microscope eyepiece. This graticule differs somewhat from the usual types and has been specially devised for use with the Cascade Impactor.

MAINTENANCE

The rubber sealing rings in each cap and between each stage must be examined and replaced when they are no longer providing a good seal. Leaks, particularly around the third and fourth stages, will reduce the efficiency.

GENERAL SPECIFICATION

Sampling Efficiency

Fig. 1 shows the cut off for each stage

Aspiration Rate

17½ litres/min

Weight without Vane, in Case

2 lb 0·9 kg

Dimensions

4½ × 5½ × 2 in 11½ × 14 × 5 cm

CATALOGUE REFERENCES

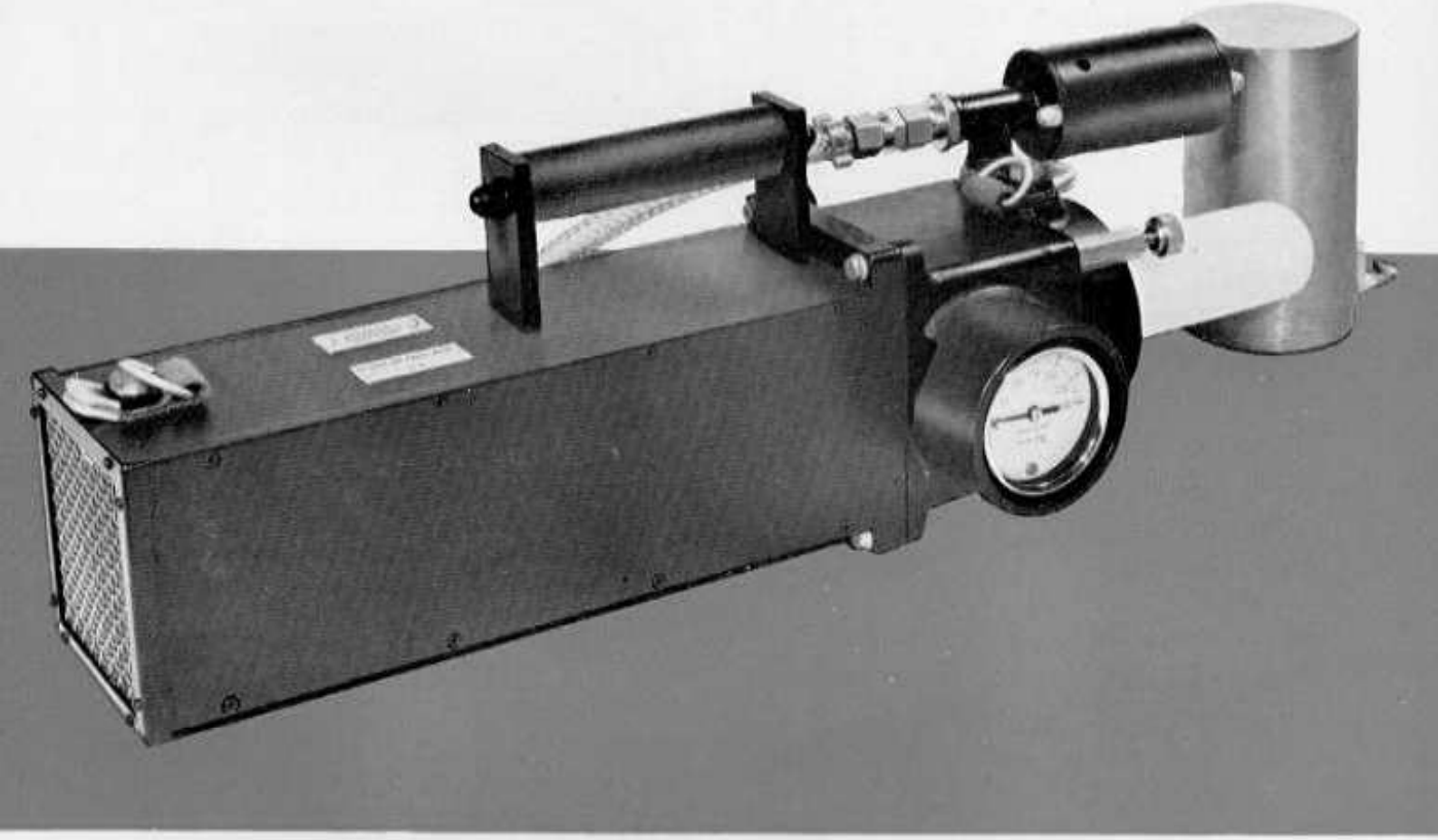
T13200/1	Cascade Impactor, without vane, in canvas case
T13202	Vane, in canvas case
T13206	Box of 50 glass sampling discs 1 in (25 mm) diameter
T13248	Box to carry exposed sampling discs
T12656	Box of 100 microscope slides, 3 × 1 in (75 × 25 mm)
T1266	Book container to take 100 microscope slides
T13209	Box of 100 filter discs for fifth stage
T13210	Box of 50 cover glasses 1 in (25 mm) diameter
T13211	Box of 50 cardboard rings 1 in (25 mm) diameter
T12672	Tube of liquid glue
T13212	Porton eyepiece graticule
T12704	Stage micrometer scale (1 mm into 100 divisions)
T13216/1	Still-air adaptor
T13220	10 Counting forms
T13224	Air ejector, for use off compressed air line
T13240	Flowmeter. To measure aspiration rate of an adjustable suction source such as an air ejector or pump
T13228	Critical orifice. To provide constant aspiration rate irrespective of pump fluctuation, but requires a pump with minimum output of 20 litres/min at 120 mmHg
T13244	Valve for short sampling periods
T10876	Rubber tube, per foot (30 cm)

Pumps suitable for use with the Cascade Impactor, are described on page 35.

A push button operated counter to assist the counting and size analysing of the particles is described on page 36.

The instrument was devised by K. R. May of the Microbiological Research Establishment, Porton.

Hexhlet



Knowledge of the size distribution and concentration of a dust cloud is not always sufficient. It is often important to know the chemical composition of the particles breathed by workers. Samples taken from the floor of a factory or mine are not reliable. Instead a large sample of the respirable fraction of airborne dust must be collected over a long period of time, say 8 hours. The Hexhlet, with its aspiration rate of 50 litres/min and its elutriator to exclude particles larger than 7 μ, is specially designed for this work. The sample is collected in a 'Soxhlet' thimble filter and may then be weighed or subjected to chemical analysis to determine, for instance, the silica content.

APPLICATIONS

The instrument can be used in mines, factories and foundries during preliminary work on establishing the parameters of dust clouds. It can be used to supplement size and concentration type samplers, or it can be used on its own to establish the control of dust suppression methods in use.

In this latter role it is widely used in foundries where it is run daily in the varying locations where the dust is most actively produced or where the greatest number of operatives work. Since it can be operated from a compressed air line, its use in coal mines is rendered easy and safe.

PRINCIPLE OF OPERATION

The dust laden air is normally drawn into the instrument by passing compressed air through a built-in air ejector. Alternatively a suction pump may be used if more convenient. The flow rate is controlled by a critical flow orifice in conjunction with a vacuum gauge. The non-respirable fraction of the dust cloud is removed by a horizontal elutriator, while the respirable fraction is collected in a Soxhlet thimble filter for subsequent recovery in a variety of ways.

When the dust concentration is low it is often more accurate to collect the sample on a filter disc, either paper or glass fibre. An adaptor to take a 4·25 cm diameter filter is screwed in place of the soxhlet.

If it is desired to collect the complete airborne sample, the elutriator may be detached from the Soxhlet portion and the latter used alone.

CONSTRUCTION

The instrument comprises two main components, the elutriator and the sampler, both made almost entirely of aluminium alloy.

The elutriator is a rectangular open ended box containing a large number of thin aluminium plates slotted into the side walls. The length, breadth and height of each duct thus formed is so calculated that with a flow rate of 50 litres per minute particles above 7 μ will fall to a duct floor before reaching the end. The large number of independent ducts is provided so that the build-up of particles is shared and the elutriating properties of the whole unit is unaltered.

The sampler body is a rectangular casting to one end of which the elutriator is bolted. Built into the other end is a critical flow orifice which discharges into a Soxhlet thimble surrounded by a removable tubular cover which forms the evacuation chamber. A compressed air ejector fitted to the top of the casting induces a partial vacuum inside this chamber and causes the dust laden air to be drawn through the elutriator and the critical orifice into the thimble, where the dust remains until a sufficient quantity has been collected. The compressed air ejector is provided with a silencer and a filter to prevent dirt blocking the ejector nozzle. On one side of the casting a pressure gauge, calibrated in millimetres of mercury, indicates whether the required flow is being maintained. If it is more convenient to use a vacuum pump instead of a compressed air supply the air ejector may be removed and a nozzle put in its place.

OPERATION

A Soxhlet thimble is fitted and its cover put on. The instrument is suspended horizontally at the desired location and connected to a compressed air line or vacuum pump. The time is noted, the suction is adjusted to show the correct reading on the vacuum gauge and sampling is commenced. At intervals during running the vacuum gauge is examined and if necessary the compressed air or vacuum pump adjusted. The critical orifice will maintain the correct flow rate at any gauge reading above 100 mmHg. After 8 hours or other suitable time the instrument is disconnected and taken to a clean location for unloading.

SAMPLE RECOVERY

The dust can be recovered from the thimble by several ways, the one used depending on the information required:

(a) The dust can be washed out by acetone and recovered by centrifuging and then weighing.

(b) After a 'pre-clogging' treatment with an inert dust the sample may be recovered by vibrating the thimble free of dust and weighing.

(c) By using acid hardened thimbles with a low, constant ash content, the thimble may be incinerated and the dust, less the thimble ash, weighed.

EVALUATION

Since silica is the fraction of the dust which is harmful and has to be evaluated, X-ray diffraction or chemical methods are usually used.

MAINTENANCE

No maintenance is required, apart from seeing that no mechanical damage has occurred which could affect the functioning of the gauge; for example, the fit of the thimble cover forming the evacuation chamber.

GENERAL SPECIFICATION

Sampling Efficiency

See Fig. 1

Aspiration Rate

50 litres per minute from air ejector using 23 psi (2·1 kg/cm²)
Rate is pre-set at ± 1%

Weight

11¼ lb 5 kg

Dimensions

20 × 6½ × 6½ in 51 × 16·5 × 16·5 cm

CATALOGUE REFERENCES

T13100/1	Hexhlet, with one soxhlet thimble and vacuum pump connector
T13104/1	As above, but without elutriator
T13106	Adaptor to take 4·25 cm diameter filter
T13108	Box of 25 seamless Soxhlet thimbles, single thickness, 41 mm diameter × 123 mm long

Pumps, suitable for use with the Hexhlet, are described on page 34

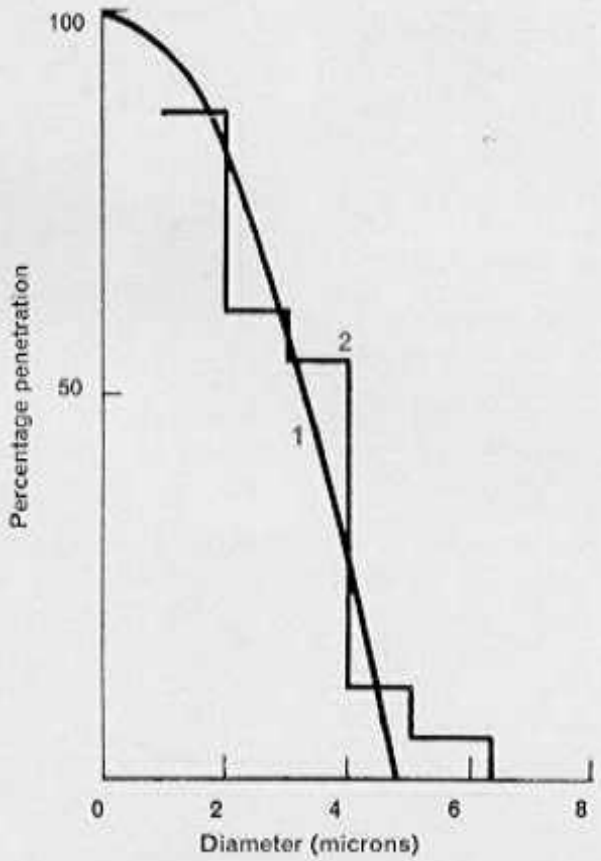


Fig. 1 Horizontal elutriator performance
1. Theoretical, for spheres density 2.25
2. Experimental, for spheres density 2.25

This instrument was the result of work done by Dr. B. M. Wright then of the Pneumoconiosis Research Unit of the Medical Research Council, Cardiff

Personal Air Sampler

In locations where persons are exposed to the risk of inhalation of hazardous substances the assessment of the hazard and its control are best carried out continuously. If the source of contamination is fixed and the position of working is also fixed and the surroundings are consistently ventilated, a static sampler will give the required information. If, however, these conditions are not met, then this method can give large errors. This instrument has therefore been designed to accompany the worker wherever he may go and yet not impede his work.

APPLICATIONS

For the continuous sampling of radio-active particles in the breathing zones of workers employed in atomic energy establishments, or for similar use by workers in research laboratories or in industries where radio-active materials are used. This type of sampling is carried out for the accurate assessment of the long term concentration to which the wearer is exposed. It is also a valuable means of establishing the levels of control systems, so that it is not necessary to use such large safety factors in the design. Radio-active iodine and other radio-active vapours can be sampled by collecting onto carbon-loaded glass fibre discs or on a carbon pack. The standard head will sample all toxic dusts and fumes and by using a different head vapours and gases such as benzene or carbon tetrachloride may be sampled on the same basis. Vapours and gases can be absorbed by bubbling through one of the recognized absorbing liquids or passed through an adsorbent bed such as silica gel.

PRINCIPLE OF OPERATION

The contaminated air is drawn by a diaphragm pump through a glass-fibre filter disc or other collecting material held in the sampling head.
The instrument aspirates a sufficiently large volume of air to ensure that a statistically large enough sample may be obtained from the most toxic substances in existence. The volume sampled is also adequate to permit micro-chemical analysis for toxic substances at a small fraction of their allowable concentrations. The battery capacity allows for a ten hour continuous run on one charge.

CONSTRUCTION

The sampling head comprises a small aluminium alloy cylinder open at one end and closed at the other. The filter disc of 25 mm diameter is inserted into the open end and held in position by a plastic cap, in the centre of which is the sampling orifice. After passing through the filter disc the air is drawn up through an inverted U-tube, one limb of which is an internally tapered transparent tube containing a ball to indicate the flow rate. The other limb, of aluminium alloy, passes down through the cylinder to form a nozzle. Plastic tube is used to connect this nozzle to the pump unit. A safety pin for attaching the head to a coat lapel is clipped to this second limb.
The standard head measures approximately $1\frac{1}{2} \times 1 \times 3$ in ($4 \times 2{\cdot}5 \times 7{\cdot}5$ cm) and weighs only 2 oz (57 g).
The pump unit comprises two simple flap valves and a thin flexible diaphragm driven by an adjustable eccentric from a small governed motor operated by five nickel cadmium sealed rechargeable batteries. A worm fixed to the motor spindle between the motor and the eccentric engages a worm wheel on a non-resetting counter which indicates the number of hours run. These parts are suspended from a laminated plastic strip and the whole unit is housed in a metal case covered in white plastic. A window cut through one side of the case exposes the counter reading. The upper surface of the laminated plastic strip forms the top of the unit and carries the socket and switch plug used to start the motor and the extension nozzle from the pump for connecting the plastic tube.

OPERATION

At the beginning of the sampling period, a clean filter disc is loaded into the sampling head, the counter reading noted and the pump started by inserting the switch plug. The head is attached to the coat lapel, or other sampling position, with the pump unit in a convenient pocket. At the end of each day the pump is stopped, the counter read, and the batteries put on charge. If running for one week, the filter disc is left in position until the end of the sampling period.

EVALUATION

The method of evaluation will depend on the nature of the contaminant being assessed. For radio-active substances, the filter disc may be assayed in any standard radio-active counting equipment. Provided that the counting efficiency of the equipment is known, the air concentration can readily be determined.
Further evaluation of the sample may be made by alpha, beta or gamma spectrometry, or by radio-chemical assay. Samples may be rendered transparent for microscopical examination.
Non-active toxic substances may be evaluated by any of the standard methods.

MAINTENANCE

No attention is needed so long as the flow meter is reading the appropriate rate with a clean filter. If the flow rate drops, make sure that there are no blockages in the head or connecting tube. The valves or diaphragm are the most likely cause of trouble but should run for long periods with no attention. The most likely cause

of failure occurs if the unit has been run with the inlet blocked.

The batteries are sealed and need no attention other than recharging.

GENERAL SPECIFICATION

Aspiration Rate

2 litres/min

Running Time on One Charge

10 hours

Re-charging Time

Overnight or weekend

Current Consumption

80 mA approximately

Weights

Sampling head	2 oz	57 g
Pump	1 lb 6 oz	625 g
Charger	12 oz	340 g

Dimensions

Sampling head	$1\frac{1}{2} \times 1 \times 3$ in	$4 \times 2{\cdot}5 \times 7{\cdot}5$ cm
Pump	$4\frac{1}{2} \times 3\frac{1}{4} \times 1\frac{1}{2}$ in	$11{\cdot}5 \times 8{\cdot}3 \times 4$ cm
Charger	$5 \times 3 \times 2$ in	$12{\cdot}5 \times 7{\cdot}5 \times 5$ cm

CATALOGUE REFERENCES

T13030 Personal Air Sampler with head for 25 mm diameter filter disc
T13034 Battery charger
T13038 Lead with plug and socket for running instrument off mains through charger
T13060 Box of 100 25 mm diameter glass fibre filter discs

Plutonium Dust Sampler

This instrument is designed for fast sampling of toxic airborne contaminants such as plutonium dust, whilst ignoring natural radon and thoron decay products which might mask the presence of the toxic contaminants.
90% of natural radon decay product activity is associated with particles of less than 0·35 μ diameter. Toxic contaminants which have been let loose in the air because of mechanical disruption from the solid or liquid state, are however, mainly greater than 1 μ diameter.
The Plutonium Dust Sampler collects only particles over 1 μ diameter at a sampling rate of up to 1000 litres per minute, and can therefore provide a radioactive dust sample substantially free from radon or thoron decay products.
Since the high rate of air flow is obtained with relatively small power, the device is reasonably portable, and in an emergency is quickly set up in the required area.

APPLICATIONS

(1) For the rapid detection of airborne plutonium or long-lived alpha-emitters of high toxicity, particularly after accidental spillage in industrial and laboratory processes.
(2) For sampling beta- or gamma-active particulates, other than daughters of gaseous fusion products, using a modified counting technique.
(3) For sampling large volumes of relatively dust-free air for non-radioactive particles, for subsequent chemical or microscopic analysis and examination.
(4) For sampling such airborne contaminants as beryllium dust, pathogenic organisms and allergy inducing airborne proteins, where a high sampling rate is valuable.

PRINCIPLE OF OPERATION

The air is drawn through an annulus formed by the near meeting of a cone surrounding a central tube. The particles are collected on a metal tray coated with a sticky layer such as petroleum jelly positioned 3 mm from the annulus. Suction is provided by high volume low pressure means, such as a vacuum cleaner. The sample is evaluated under a scintillation counter for radio active dusts, or by other techniques for different

dusts. A glass disc can be substituted for the metal tray for microscope examination.

CONSTRUCTION

The main body of the sampler is of aluminium alloy of cylindrical section about 2½ in. diameter and 3¾ in. long (6·5 × 9·5 cm). A cone formed inside the main body converges to a short cylindrical portion terminating in a lip to carry the sampling tray. A metal tube about 8 in. (20 cm) long is centred in the cone with its inner end brought to a knife edge and adjusted to be 3 mm from the sampling tray. This small distance gives a high air velocity, about 60 metres/sec, which causes the particles to adhere to the sticky coating. The outer end of the central tube is connected to the source of suction.

OPERATION

The sampling tray is lightly coated with either petroleum jelly or silicone grease and positioned over the orifice. The air to be sampled is drawn through for about two to five minutes, the tray removed and the particles counted with an alpha sensitive scintillation counter. If bacteria, spores, dust, etc., are being collected on glass discs, then the appropriate technique for evaluating are used. These are basically similar to those used with other samplers.

MAINTENANCE

Apart from repair of accidental damage no maintenance is needed.

GENERAL SPECIFICATION

Sampling Efficiency

90% for airborne plutonium dust, but only 10% for radon decay products. This is much higher than comparable filter samplers, whose efficiency varies with time and with the type of paper used.

Aspiration Rate

1000 litres per minute

Weight

Approximately 1 lb 450 g

Dimensions

2½ in dia × 3¾ in long 6·5 × 9·5 cm

CATALOGUE REFERENCE

T13120 Plutonium Dust Sampler.

Pumps, suitable for use with the Plutonium Dust Sampler, are described on page 35.

This instrument was devised by G. W. C. Tait of Atomic Energy of Canada Ltd. The instrument is patented and we have a sole licence to manufacture it.

Airborne Bacteria Sampler

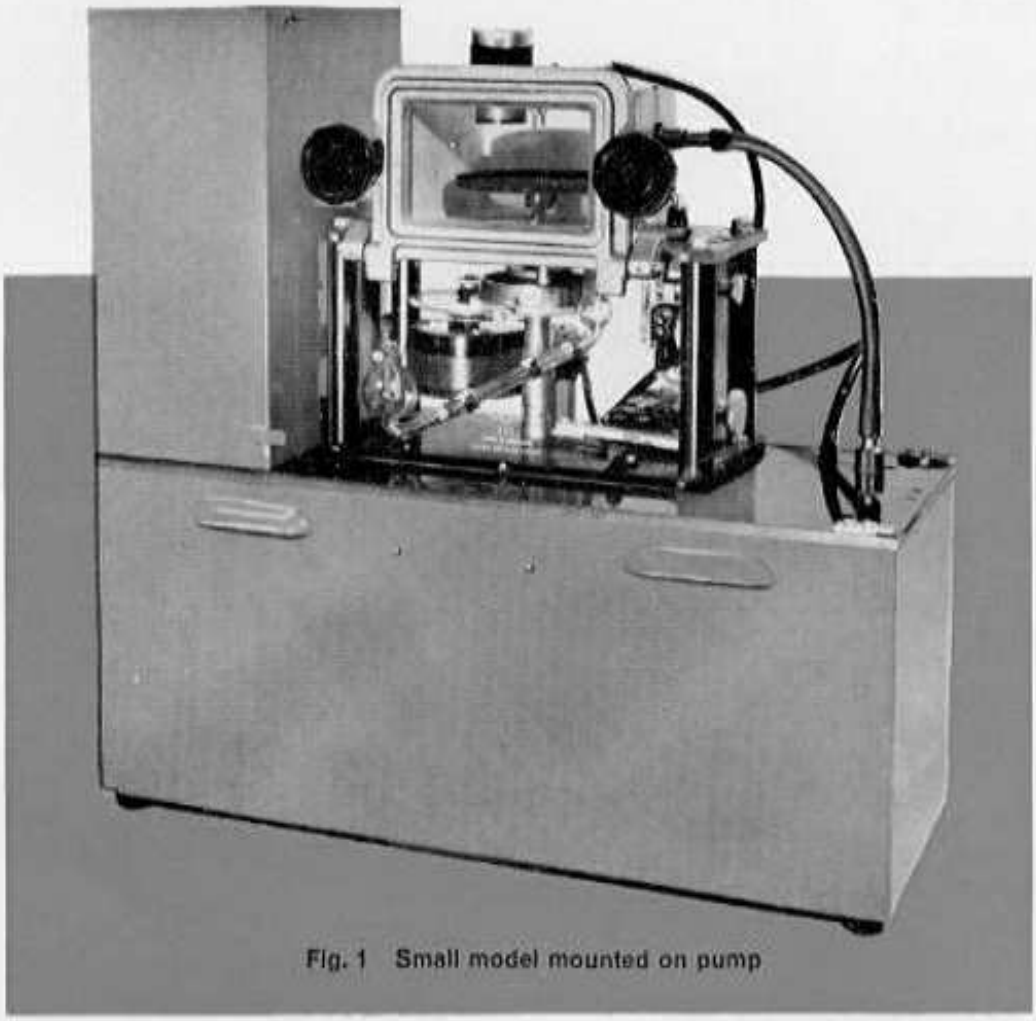


Fig. 1 Small model mounted on pump

Airborne bacteria of many different types can be present in closed areas inhabited by people. Many of these bacteria are harmless but others can cause the spread of disease or infection. To obtain a sample by exposing a culture plate to the general atmosphere is unsatisfactory for a number of reasons. No reasonable assumption can be made about the concentration, since it is not known from what volume of air the organisms were collected. The terminal velocity of the smaller dust particles on which bacteria may collect is so low that any reasonable amount of ventilation will prevent their settling on an open plate.

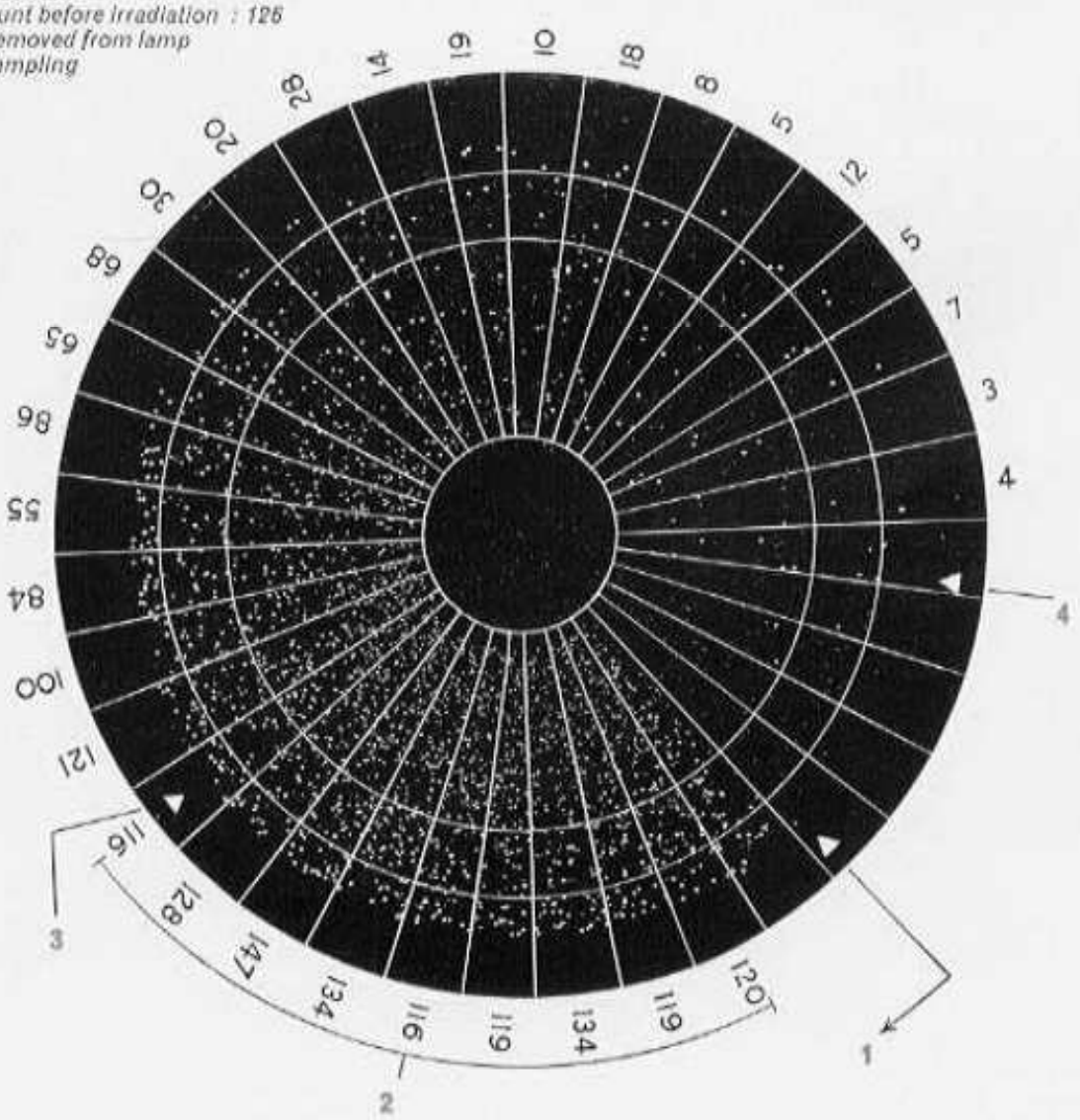
The only satisfactory sampling method is to draw through a known volume of air and collect as high a percentage of organisms as possible. For the widest use some timing device is also of great value.

APPLICATIONS

To study and assist control of the number of bacteria present in the atmosphere. This may be required for a number of reasons:
(1) To combat the spread of airborne disease which can occur when a large number of people is brought together in a confined space such as a canteen, underground train or school.
(2) To assess the efficacy of airborne bactericides.
(3) To study cross infections which can occur in hospitals, both in wards and operating theatres.
(4) To assess the highly sterile conditions required during the manufacture of antibiotics.
(5) To sample bacteria deposited on fabrics.

As an example of (2) above Fig. 2 shows a typical record obtained during the test of an ultra violet lamp (125 watts) in a room of 3,500 cu ft (100 cu metres). The air of this room was circulated by fans and a broth culture of streptococcus salivarius sprayed into it. Ten seconds after sampling began, the lamp was uncovered. The ruled screen is divided into 10-degree sectors, each marking out the area on the plate which passed under the slit during one second.

Fig. 2 Typical record from a plate
1. Start of rotation
2. Mean count before irradiation : 126
3. Screen removed from lamp
4. End of sampling



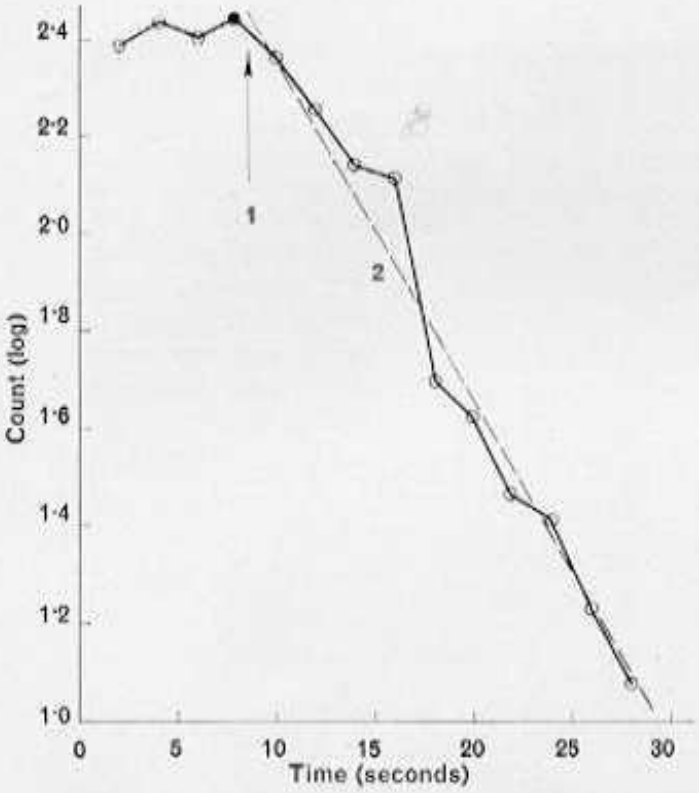


Fig. 3 Graph of counts against time
1. Screen removed from lamp
2. Killing rate

The number of colonies subsequently counted in each sector is recorded round the edge.

Fig. 3 shows the graph obtained by plotting the logarithms of the above counts against time. To reduce the variation found with small numbers, each point plotted is the sum of the two adjacent sectors. The killing rate is equivalent to ventilation at the very high rate of 640 air changes per hour. The killing rate is high, since most salivary organisms when finely sprayed are much less resistant than dry dust-borne species.

The sampling of bacteria deposited on fabrics can be done by joining to the inlet of the sampler a length of rubber tube terminating in a slit, with which specific objects, such as clothes or blankets, may be examined. Thus coat lapels form a useful searching point for haemolytic streptococci during a tonsilitis epidemic.

PRINCIPLE OF OPERATION

Air is drawn at a known rate through a horizontal slit onto a rotating plate containing agar or other nutrient solution. After a suitable sampling time, the plate is removed and incubated for 24 hours. The original bacteria are then visible to the naked eye for counting. Knowledge of the sampling rate and time of exposure permits calculation of the number of bacteria present per unit volume of air. Also by knowing the rotation speed of the plate the times at which bacteria were present above the sampling intake can be identified.

Two models are available, the one to be used depending on the work in hand. The small model (Fig. 1) covers a concentration from 1 to 3,000 organisms per 84 litres (3 cu ft). This enables air in canteens and other places of average conditions to be sampled. The large model (Fig. 4) covers concentrations down to 1 organism per 2·8 cubic metres (100 cu ft) and is therefore more suitable for sampling the relatively clean air found in operating theatres, pharmaceutical laboratories or during the manufacture of antibiotics.

The rotation speed of the sampling plate can be varied to suit the concentration and a marker may be employed to indicate any special event during sampling.

Since the aspiration rate is important for the subsequent evaluation, it is controlled by reference to a built-in manometer. Also since the efficiency of collection is dependent on the slit to collecting surface distance being small and reproducible, a built-in distance indicator is provided.

CONSTRUCTION

The turntable on which the culture plate rests is enclosed in an airtight metal box with a glass observation door. The slit is positioned in the top of the box to be radial to the plate. An external lever raises and lowers the plate to bring it to the correct distance from the slit. A synchronous motor rotates the turntable through a train of gears. A sloping mercury manometer is provided with a zero mark and a second mark for achieving the correct aspiration rate.

A special switch starts the turntable motor and the pump motor simultaneously. This may then be set for continuous rotation or to stop the motors after one revolution.
The turntable and manometer portions form one unit (the movement) to which can be quickly attached the sampling box for either the small or large model. When used as a small model the movement is fitted to a rectangular baseplate, at one end of which is a metal compartment to house spare culture plates. This baseplate forms the dividing plate over a suction pump, making a self contained portable instrument (Fig. 1).
If it is desired to use the sampler separate from the pump this can be done but would be the subject of a special quotation.
When used as a large model (Fig. 4) the baseplate is nearly square, but cannot have its pump mounted integrally with it. If a dual purpose or interchangeable model is required the movement together with the large sampling box is mounted on the square baseplate and the small sampling box is secured under the main cover.

OPERATION

Loaded culture plates covered with lids to protect them are taken with the instrument to the sampling site. A plate without its lid is centred on the rubber disc of the turntable in the sampling box. The door is closed and the turntable raised until the neon light of the distance indicator glows. With a pump connected and adjusted to the correct flow rate, and a suitable speed selected, the starting switch is operated,

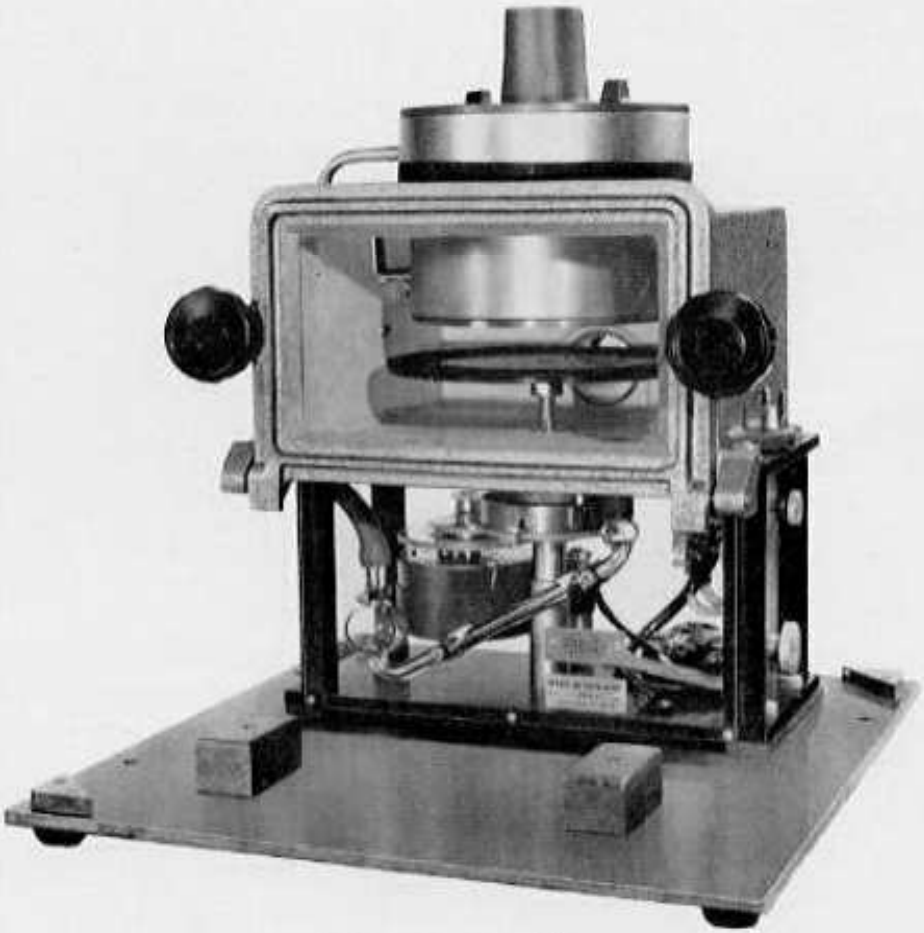


Fig. 4 Large model

the marker depressed and the instrument left to run for the selected time. At the end of the run the procedure is reversed and the plate put away with its cover. Incubation in anerobic conditions for 24 hours at 37°C will now cause the bacteria to be visible. Counting is done either directly through a ruled screen or by making an enlargement on bromide paper through a ruled screen.

MAINTENANCE

At intervals a few drops of oil on the turntable spindle and raising lever are all that is necessary. The instrument should be kept clean and a watch kept on the mercury in the manometer. The sampling box is not made for steam sterilization, but if it is essential to exclude any contaminant, a 40% formaldehyde solution left inside in a dish overnight will be found satisfactory.

GENERAL SPECIFICATION

Sampling Efficiency

98%

Flow Rate

Small model 28 litres per minute ± 5%
Large model 700 litres per minute ± 5%

Slits

Small model 1 slit, 0·3 mm wide × 28 mm long
Large model 4 slits, each 1 mm wide × 44·5 mm long
Distance from plate 2 mm

Turntable Speeds

1 revolution in ½, 2 or 5 minutes

Plate Sizes

Small model approximately 4 in. diameter (10 cm)
Large model approximately 6 in. diameter (15 cm)

Weights

Small model	41 lb	18·60 kg
Large model	29 lb	13·15 kg
Interchangeable model	33 lb	14·97 kg

Dimensions

Small model
18½ × 18 × 7 in 47 × 46 × 18 cm
Large model
12 × 12 × 13½ in 30·5 × 30·5 × 34 cm
Interchangeable model
12 × 12 × 13½ in 30·5 × 30·5 × 34 cm

CATALOGUE REFERENCES

Bacteria Sampler, Small Model

mounted on pump, with metal cover and carrying strap

T13642 For use off 220v, 50 cycles AC
T13644/1 For use off 230/250v, 50 cycles AC
T13648/1 For use off 110v, 60 cycles AC

Bacteria Sampler, Large Model

with metal cover and carrying strap, but without pump

T13668 For use off 200/250v, 50 cycles AC
T13672 For use off 100/120v, 60 cycles AC

Bacteria Sampler, Interchangeable Model,

with metal cover and carrying strap, but without pump

T13700 For use off 200/250v, 50 cycles AC
T13704 For use off 100/120v, 60 cycles AC

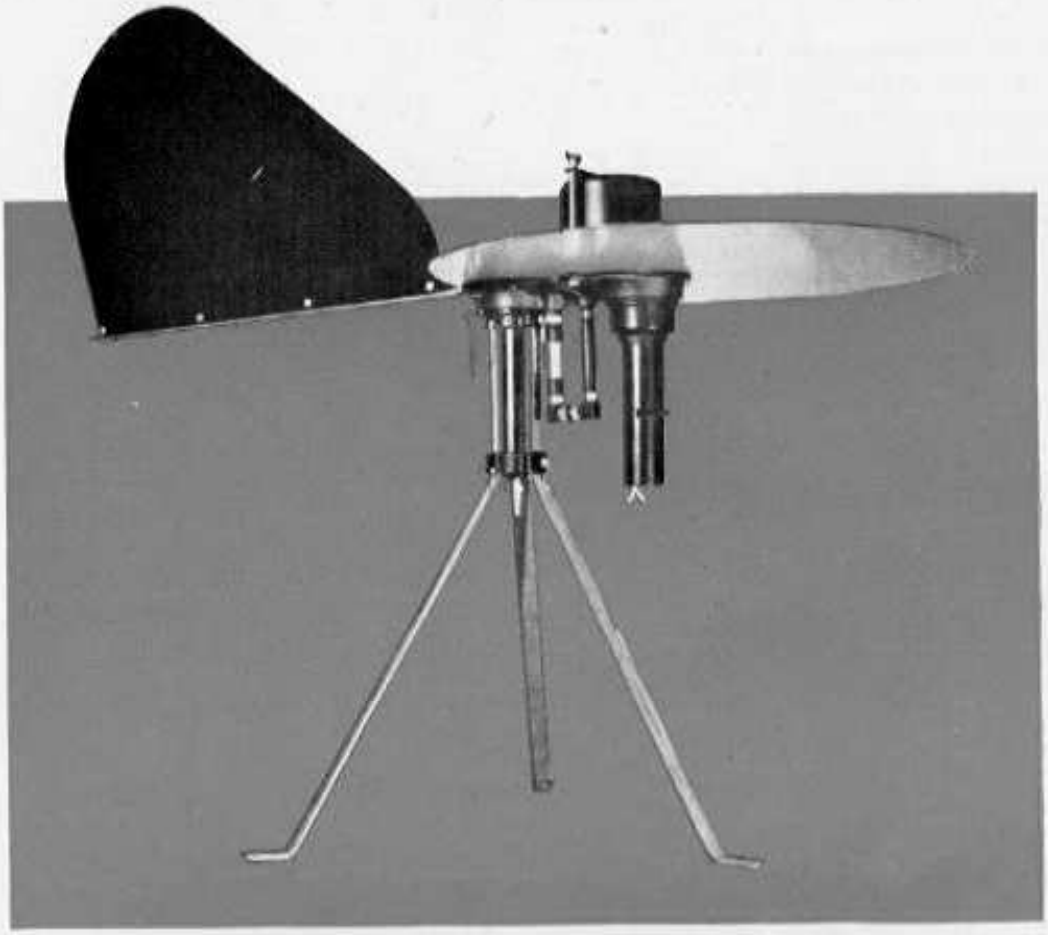
T13724 By-pass to enable pumps T13692 or T13688 (p. 35) to be used with interchangeable model when small chamber is in position

T13728 Slit for sampling from textiles

Pumps suitable for use with the Bacteria Sampler are described on page 34

This instrument was originally developed by Drs. Bourdillon, Lidwell and Thomas of the Medical Research Council, Hampstead

Hirst Spore Trap



Continuous sampling of airborne spores in the open in all weathers is necessary in several fields of research. Many plant diseases, such as rust and mildew, are spread by airborne spores, while other spores and pollen grains cause respiratory allergies.

Apart from biological factors, weather conditions probably have the most influence on the number and types of spores in the air, and the use of the Hirst Spore Trap enables samples obtained over a period to be related to meteorological or other data.

It has been shown that the simple exposure of a horizontal slide or a vertical cylinder is most unsatisfactory. The volume of air from which the spores are collected is not known, and the efficiency of collection is extremely low, varying from 5% to 0·05% for a slide, or from 50% down to 0·5% in the case of a vertical cylinder exposed to wind speed variations of 0 to 10 metres/sec. The only satisfactory method is to draw through a known volume of air and collect from it as high and as constant a percentage of spores as possible. To relate the catch to time also provides valuable information for research.

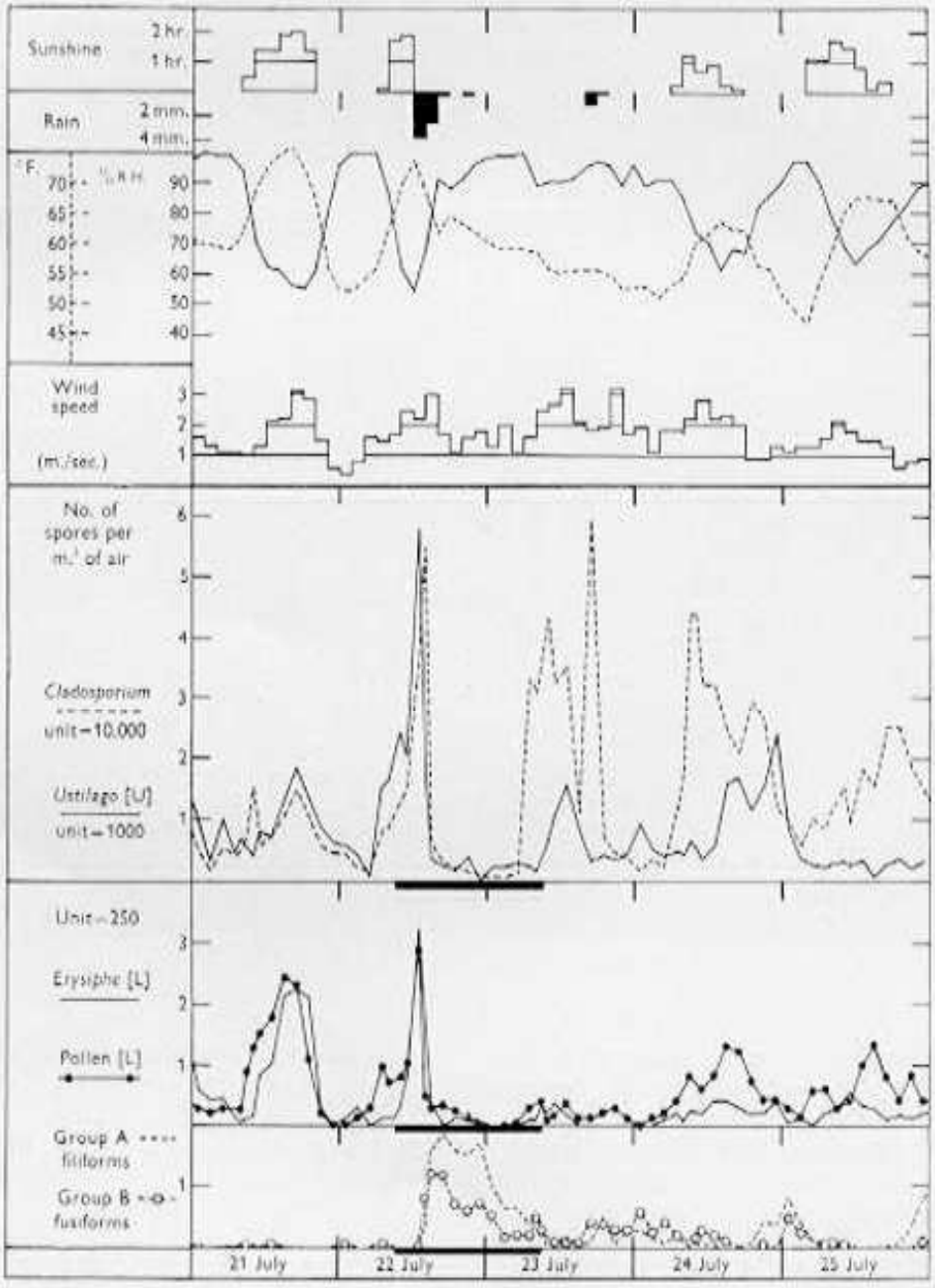


Fig. 1 Variation of spore count with weather

APPLICATIONS

Agricultural: The relationship between plant diseases, spores and meteorological conditions is a complex one studied by agricultural research organizations throughout the world. Surveys extend into many fields involving mycology, plant pathology, etc., as well as meteorology.

Medical: An ever growing work is concerned with respiratory allergies, and its allied field of asthma. Here, much has to be learnt about the many different pollens and spores which are the causative agents.

As an examole of the information this trap can provide, Fig. 1 shows the changes in concentration of spores in the air, related to weather, particularly rainfall. The explanation of this figure is briefly as follows:

In the upper portion the relevant meteorological data are plotted at 2-hourly intervals. The lower three panels show the concentrations of six spore groups at 2-hourly intervals.

A 7-day spell of warm dry weather ended in a thunderstorm at 13.30 on 22nd July. Up to noon on 22nd July a typical dry air spora develops with Cladosporium, Ustilago, Erysiphe and pollens but with few hyaline spores of other groups. The dry air spore types normally become more abundant towards the middle of the day, but here the process is probably accelerated by the rising temperature, wind speed and increasing turbulence accompanying the thunderstorm. At 14.00 the concentration of Ustilago, Erysiphe and pollens had fallen to one-third, one-half and one-sixth respectively of that existing just before the rain. Cladosporium on the other hand increased from 36,000 to 55,000 per cubic metre. A similar striking increase is seen on 23rd July at 17.00 when rain was not accompanied by a change in wind direction or velocity. By 17.00 on 22nd July a spora characteristic of damp air had developed, it lasted throughout the night until it was replaced next morning by a return of spore types characteristic of dry air. Similar but less marked changes occurred after the rain on 23rd July and the high humidity and possible dew on the nights of 24th and 25th July. A selection of typical photomicrographs is shown in Fig. 2 of various portions of the slide exposed from 09.00 on 22nd July to 09.00 on 23rd July. No. 1 is a photograph of the whole slide; the heavy deposit on the left is the period just before the rain at 13.30. A photomicrograph at 13.00 (No. 2) shows the typical dry air spora and smoke particles. The effects of the rain begin to become apparent in the next photograph at 14.00 (No. 3) and are very pronounced by 17.00 (No. 4) when few of the spore types present before the rain are to be found. During the night the spores are predominantly hyaline. At present few of those shown in No. 5 (at 23.00) can be identified, some are, however, produced by 'Mirror Yeasts' of the genus Sporobolomyces, these minute hyaline basidiospores become much more common later as shown in No. 6 at 01.00 on 23rd July. The final photograph of the series (No.7), all × 400, shows the return of Cladosporium in very large numbers soon after dawn and the disappearance of the hyaline spores.

PRINCIPLE OF OPERATION

Air drawn through a horizontal slit impacts the spores onto a microscope slide with a sticky surface. A built-in flow meter shows the volume of air being drawn through, whilst the slide is moved past the slit at a constant rate for 24 hours. Thus, the number of spores and pollen may be counted and related to meteorological and other data at any particular time. The sampling part of the instrument can rotate freely about a vertical axis and is kept facing into the wind by a large vane. A rain shield extends over the slit so that in most conditions the sampler may be operated continuously irrespective of the weather. Legs of different lengths are available to bring the slit at varying heights above the ground.

CONSTRUCTION

The main parts of the trap comprise the cylinder in which the slit is formed, the top main casting carrying the clock, and the vertical rotating axis incorporating the seal. The cylinder is a vertical

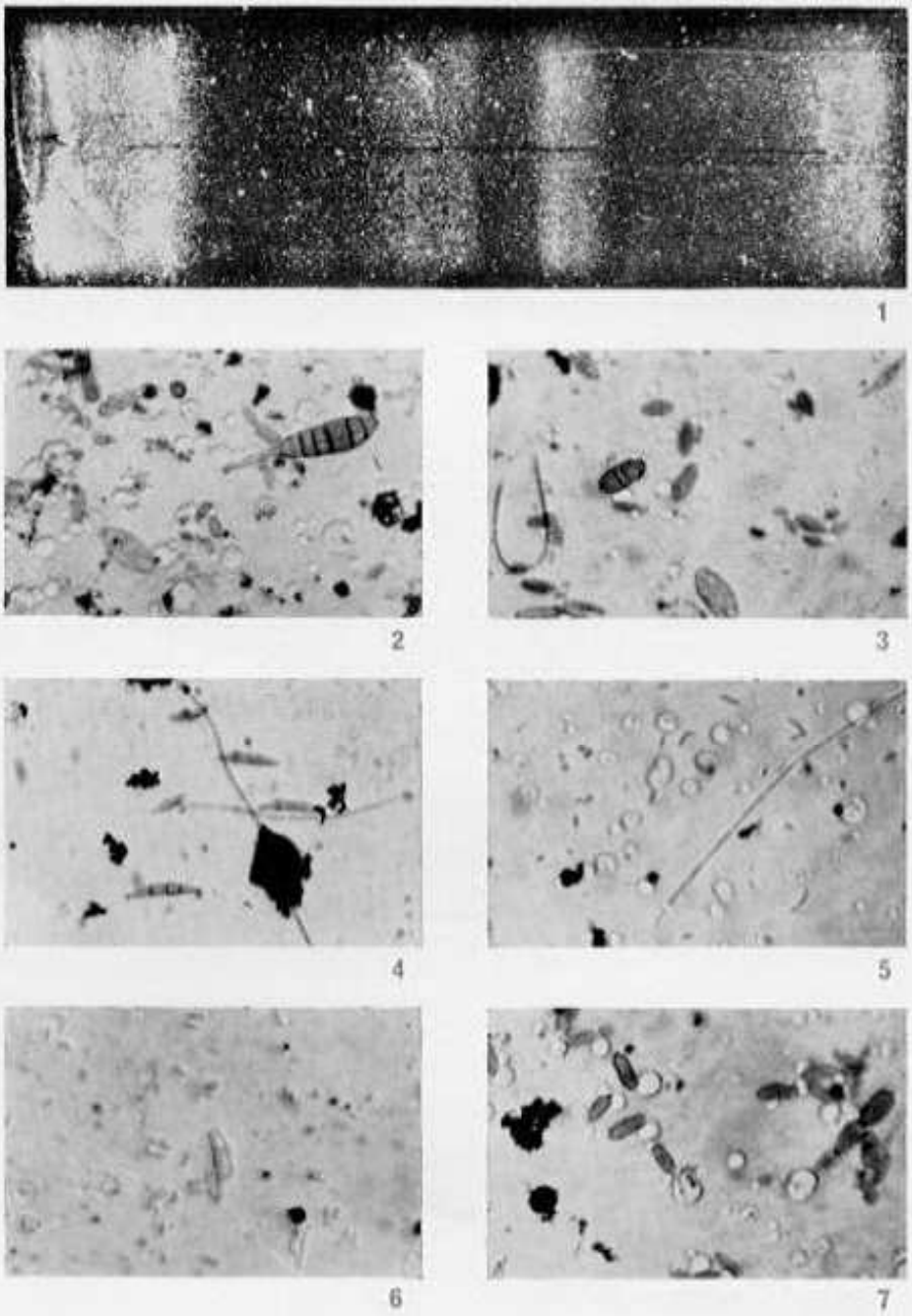


Fig. 2 Photomicrographs of slide for 22nd/23rd July

metal tube, towards the lower end of which is formed the slit, 14 mm wide by 2 mm high, through which air is drawn. The glass slide is carried in a metal holder accurately located in the tube so that the collecting surface is always 0·6 mm from the slit. The holder is drawn upwards past the slit by a fine thread wound round a small drum on the clock spindle. A friction-drive on the drum allows for easy resetting of the holder. The clock rotates once in 24 hours but only needs winding once a week.

OPERATION

Every 24 hours a glass slide, freshly coated with a sticky solution such as petroleum jelly, is inserted into the holder after it has been reset to the bottom of its travel. A suitable suction pump is connected and the motor turned on. If necessary the flow rate is adjusted to the setting indicated by the flow meter. The instrument is then left unattended for 24 hours when the exposed slide is taken out and the sample protected by a cover glass.

EVALUATION

It is not within the scope of this catalogue to describe the evaluation technique. Basically it is a question of counting the numbers of selected spores and pollens in each 2 hour period. These can be plotted against meteorological or other data, according to the work in hand. To assist the counting work an electromagnetic push button counter is available and described on page 36.

MAINTENANCE

Very little is needed. The holder and the rods on which it slides must be kept clean to ensure ease of movement. The moving parts must be dried if excessive rain enters the orifice. The ball bearings of the rotating centre need grease annually, while the clock may need attention every two years.

GENERAL SPECIFICATION

Efficiency
Between 70% and 90%, according to spore type and wind speed

Flow Rate
10 litres/minute

Slit Size
14 × 2 mm

Distance of Slit from Slide
0·6 mm

Speed of Slide
2 mm/hour

Weight
30½ lb 13·8 kg

Dimensions
4 ft 6 in × 2 ft × 3 ft 9 in. high 137 × 61 × 114 cm

CATALOGUE REFERENCES

T13500 Hirst Spore Trap with legs for 0·5 m height
T13504 Set of legs for 2 m height
T13520 Material for preparation and mounting of slides
T12656 Box of 100 microscope slides, 3 × 1 in (7·5 × 2·5 cm)
T13524 Box of 100 cover glasses, 2 × $\frac{7}{8}$ in (51 × 22 mm)
T13012 Box of 100 paper spacers, 2 × $\frac{7}{8}$ in (51 × 22 mm)
T12660 Book container to take 100 microscope slides

Pumps suitable for use with the Hirst Spore Trap, are described on page 34.

We wish to acknowledge the help we have received from J. M. Hirst of the Plant Pathology Department, Rothamsted Experimental Station, Harpenden, who was responsible for the development of this instrument.

Pumps

As will have been noted, many of the samplers described in this catalogue need an external source of suction. On this and the following pages we give details of the pump required for each instrument. Although these pumps are available from us we give sufficient information to enable customers to decide whether their own pumps will be suitable.
When considering pumps, the question of lubrication is most important. Any pump whose vanes or piston are lubricated will emit an oil mist which can be drawn in by the sampler and spoil the sample. Oil-less or diaphragm pumps overcome this problem and all the following are of one or other of these types.

HEXHLET

Pressure difference 215 mmHg
Volume 210 litres/min
Approximate power consumption ¼ HP
Weight 50 lb 22·5 kg
Dimensions 18 × 6 × 6 in 46 × 15 × 15 cm
Catalogue References
T13110 Pump for use off 220v, 50 cycle AC
T13112 Pump for use off 230/250v, 50 cycle AC
T13114 Pump for use off 110/120v, 60 cycle AC
This pump is not enclosed in a box. The apparent high power requirement is due to the needs of the critical orifice and to the necessity of maintaining the flow at the end of the shift when the Soxhlet has become partially clogged.

HIRST SPORE TRAP

Electric Pumps
Pressure difference 15 cm water gauge
Volume 10 litres/min
Approximate power consumption 40 watts
Weight 16 lb 7·2 kg
Dimensions 18 × 7 × 8 in 46 × 18 × 20·5 cm
Catalogue References
T13629 Pump for use off 220v, 50 cycle AC
T13630 Pump for use off 230/250v, 50 cycle AC
T13625 Pump for use off 110v, 60 cycle AC
This pump is enclosed in a metal box. It is reasonably quiet and suitable for continuous operation. The same pump is also offered for the Cascade Impactor and the small model Bacteria Sampler.

Petrol-Motor Driven Pump
To use the instrument in the field we offer a pump driven by a 4-stroke petrol engine. This is suitable for continuous operation, bearing in mind the usual maintenance requirements of an internal combustion engine. The petrol tank capacity is enough for a 24-hour run. The engine is fitted with a governor but to ensure a constant suction rate it is supplied with a critical orifice.
Cubic capacity of engine 412 cc
Approximate petrol consumption ¾ litre/hr
Weight 242 lb 109 kg
Dimensions 30 × 21 × 24 in 76 × 53 × 61 cm
Catalogue Reference
T13516 Petrol-motor driven pump

BACTERIA SAMPLER, SMALL MODEL

Pressure difference 22 mmHg
Volume 28 litres/min
Approximate power consumption 40 watts
Weight 16 lb 7·2 kg
Dimensions 18 × 7 × 8 in 46 × 18 × 20·5 cm
Catalogue References
T13629 Pump for use off 220v, 50 cycle AC
T13630 Pump for use off 230/250v, 50 cycle AC
T13625 Pump for use off 110v, 60 cycle AC
This pump is enclosed in a metal box. It is reasonably quiet and suitable for continuous operation. The same pump is also offered for the Cascade Impactor and the Hirst Spore Trap.

BACTERIA SAMPLER, LARGE MODEL

Pressure difference 30 mmHg
Volume 700 litres/min
Approximate power consumption ½ HP
Weight 11 lb 4·95 kg
Dimensions 7 × 7 × 7 in 18 × 18 × 18 cm

Catalogue References
T13692 Pump for use off 200/250v, 50 cycle AC
T13688 Pump for use off 110/120v, 60 cycle AC
This is a vacuum cleaner type pump and is not intended for continuous use. Although enclosed in a box it is noisy.

CASCADE IMPACTOR

Pump for Use with Flowmeter
Pressure difference 100 cm water gauge
Volume 17½ litres/min
Approximate power consumption 40 watts
Weight 16 lb 7·2 kg
Dimensions 18 × 7 × 8 in 46 × 18 × 20·5 cm
Catalogue References
T13629 Pump for use off 220v, 50 cycle AC
T13630 Pump for use off 230/250v, 50 cycle AC
T13625 Pump for use off 110v, 60 cycle AC
This pump is enclosed in a metal box. It is reasonably quiet and suitable for continuous operation. The same pump is also offered for the Hirst Spore Trap and the small model Bacteria Sampler.

Pump for Use with Critical Orifice
Pressure difference 120 mmHg
Volume 20 litres/min
Approximate power consumption ½ HP
Weight 50 lb 22·5 kg
Dimensions 18 × 6 × 6 in 46 × 15 × 15 cm
Catalogue References
T13110 Pump for use off 220v, 50 cycle AC
T13112 Pump for use off 230/250v, 50 cycle AC
T13114 Pump for use off 110v, 60 cycle AC
This pump is not enclosed in a box. The apparent high power requirement is due to the needs of the critical orifice.

PLUTONIUM DUST SAMPLER

Approximate pressure difference 50 mmHg
Volume 1000 litres/min
Approximate power consumption ¾ HP
Weight 15 lb 6·8 kg
Dimensions 12 × 6 × 8 in 30·5 × 15 × 20·5 cm
Catalogue References
T13124 Pump for use off 200/250v, 50 cycle AC
T13128 Pump for use off 110/120v, 60 cycle AC
This is a vacuum cleaner type pump and is not intended for continuous use. It is noisy.

Push Button Counter

The most tedious part of dust sampling is the subsequent evaluation of the sample under a microscope. This is particularly true when size analysing dust or counting different types of spores and pollens. This counter is designed to assist and speed up this work.

APPLICATION

As each particle or spore is sized or identified it has to be recorded. If this is done on paper the break in concentration slows the work and tends to make it less accurate. This may be overcome by having a second person to write down what the observer calls out, but in terms of man-hours this is an expensive method.

With this counter a series of six easily operated push buttons is placed within reach of one hand while observing the microscope. Each button is connected to a four-figure resetting electromagnetic counter, which advances one at each depression of the button. By adopting a convention as to which button in the various rows is being used for a size or a

type, the whole bank may be operated without having to look at it.

PRINCIPLE OF OPERATION

The push buttons are arranged in banks so that they are more easily memorized. On depressing a button the counter advances one and can only be made to operate again by releasing the button and depressing it once more. A totalising counter gives the total of the individual counters.

When this catalogue was being printed the Push Button Counter was being redesigned. Although the illustration is no longer correct the above description is accurate and the unit is still housed in a metal cabinet of similar appearance and to the dimensions and weight given below.

GENERAL SPECIFICATION

Weight approximately 8 lb	3·6 kg
Dimensions 13 × 9 × 6 in	33 × 23 × 15 cm

Catalogue References

T12710 Push Button Counter for use off 220/250v, 50 cycle AC

T12714 Push Button Counter for use off 110v, 60 cycle AC

Catalogue designed by John Burls

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