570
Portable Oxygen Analyser
Instruction Manual

Ref No. 00570/001B/6
Order as Part No : 00570 001B

GENERAL SAFETY INFORMATION

Servomex Oxygen Analysers are sophisticated devices intended for use by qualified personnel only. It is necessary that this manual be read and understood by those who will install, use and maintain this equipment.

Important

Model B - Versions of the 570A analyser are certified by BASEEFA for use in certain hazardous areas, subject to the conditions laid down in the certificates at the rear of this manual. Certification can be recognised by the BASEEFA crown on the back panel of the analyser.

578A - Power supply units are for use with Model B analysers only, and are not suitable for use in hazardous areas.

WARNING
ANY MODIFICATION TO THE ANALYSER WILL INVALIDATE BASEEFA APPROVAL

DESCRIPTION OF SAFETY TERMS IN THIS MANUAL

DANGER -	Used when there is a possibility of serious personal injury or death.
WARNING -	Used when there is a possibility of personal injury.
CAUTION -	Used when there is a possibility of damage to the equipment.
NOTE -	Used to alert the user to pertinent facts and conditions.

NOTES

The 570A portable paramagnetic oxygen analyser complies with the European Community “Electromagnetic Compatibility Directive” 89/336/EEC by the application of the following standards:

EN50081-1:	Emissions:	Light Industrial Environment
EN50082-1:	Immunity:	Light Industrial Environment

The 570A is certified for use in hazardous areas and is excluded from the scope of the European Community “Low Voltage Directive” 73/23/EEC.

The 570A is CE marked for the European Community “Electromagnetic Compatibility Directive” 89/336/EEC only. It complies with the transitional arrangements of the European Community “ATEX Directive” 94/9/EC.

Oxygen USP Verification Measurements

Analysers used for Oxygen USP verification, must be set up in accordance with Section 2.2.2(c) and calibrated and used in accordance with the relevant part of Section 3.3

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Section 1: Description

1.1 General

This manual describes the Servomex 570A portable Oxygen Analyser, used for determining the oxygen content of a gas sample in the range 0 to 100% O_2.

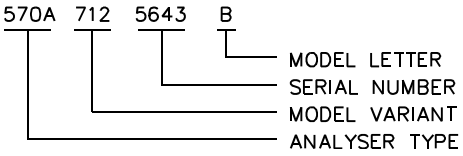
It is fully portable, being powered by rechargeable batteries. An optional power supply / recharging unit is available. The 570A has a digital liquid crystal display to indicate the oxygen reading. The 570 A analyser is BASEEFA approved, certificate number EX812155X, code EEX ib IIC T4. This approval also covers CENELEC standards EN50 014 and EN 50020.

The analyser is supplied with a standard accessories kit comprising:

1 x Hand Aspirator
1 x Drying Tube
1 x 5mm Allen Key
1 x 3/32 " Allen key
1 x Filter Elements
1 x 2.5mm Jack Plug

1.1.1 Analyser Variants

A serial number label on the base of the analyser identifies the model number and its variants.



The model variant number is as follows for Model B analysers:

Rechargeable	712
Rechargeable + Internal Pump	713

1.2 Principles Of Operation

1.2.1 Analyser

The analyser measures the paramagnetic susceptibility of the sample gas by means of a proven magneto-dynamic type measuring cell.

The paramagnetic susceptibility of oxygen is significantly greater than that of other common gases. Simply, this means that oxygen molecules are attracted much more strongly by a magnetic field than are molecules of other gases, most of which are slightly diamagnetic (repelled by a magnetic field). Magneto-dynamic oxygen analysers are based upon Faraday's method of determining the magnetic force developed by a strong non-uniform field on a diamagnetic test body suspended in the sample gas. The test body of all measuring cells in Servomex oxygen analysers consists of two nitrogen filled quartz spheres arranged in the form of a dumb-bell as shown by figure 1.1 A single turn of fine platinum wire (the feedback coil) is secured in place around the dumb-bell. A rugged, taut band platinum ribbon suspension attached to the midpoint of the dumb-bell positions the dumb-bell in the strong non-uniform magnetic field between the specially shaped pole pieces of the permanent magnetic structure - see Figure 1.2.

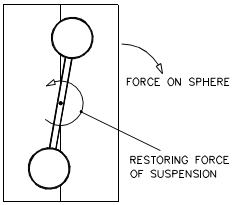


Figure 1.1 Dumb-bell System

The angular rotation of the dumb-bell is sensed by a light beam projected onto a mirror attached to the dumb-bell from which it is reflected onto a pair of photocells. See figure 1.3. The difference in the outputs from these photocells is fed to an amplifier whose output is zero when both photocells are illuminated equally.

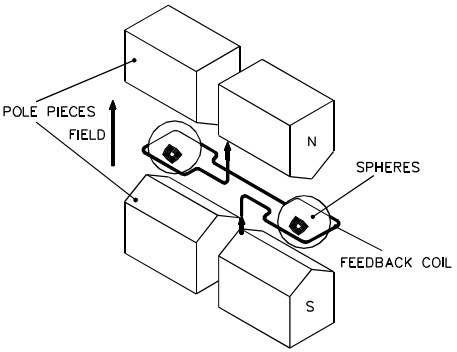


Figure 1.2 Servomex Oxygen Cell

When a sample gas containing oxygen surrounds the dumb-bell, the oxygen molecules are attracted to the strongest part of the magnetic field, thus changing the forces acting on the dumb-bell, causing a displacement of the light beam across the photocells, which in turn results in a difference signal being sensed by the amplifier. The corresponding output of the amplifier is a current, proportional to the oxygen content of the sample, which is fed to the feedback coil of the measuring cell. This produces a magnetic field, which opposes the forces causing the dumb-bell to rotate. Thus the dumb-bell is retained in its original position.

Since this current is proportional to the oxygen content of the gas sample, it is used to develop the output signals available from the analyser. This current feedback force balance design is resistant to mechanical shock and has outstanding accuracy and linearity.

The paramagnetic susceptibility of oxygen varies inversely as the square of the absolute temperature, therefore, a temperature sensitive element in contact with the magnet / measuring cell assembly is included in the feedback current circuit to provide compensation for changes in analyser temperature. While this compensation is adequate to maintain the instrument accuracy over normal short fluctuations at ambient temperature, larger changes will require span adjustment.

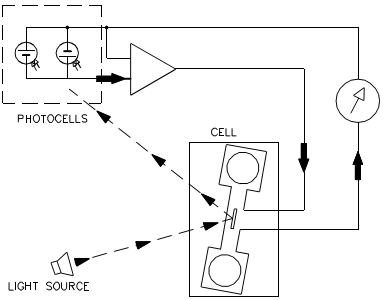


Figure 1.3 Servomex Analyser Configuration

1.2.2 Sampling System

The sampling system of this analyser includes a combination filter / automatic flow control device (AFCD), which is designed to introduce the sample into the measuring cell within the proper range of flow rates (80 to 150cc / min of air) and to prevent the entrance of particles into the measuring cell.

The sample gas enters the AFCD through one of the upper two ports. If the sample pressure is between 0 and 1/3 psig (0 to 2.3 kPa) all of the sample gas flows to the measuring cell via the upper port. The spring loaded ball valve begins to open at sample inlet pressures above 1/3psig (2.3kPa) thus by-passing the excess sample flow to vent.

Selection of the inlet / outlet ports is based on the relative importance of the speed of response, ability to accommodate accidental introduction of condensate and whether or not the internal sample pump is fitted. (See section 2.3)

1.3 Specifications

1.3.1 Mechanical

Dimensions:	Width	150mm (6in)
	Height	190mm (7.5in)
	Length	305mm (12in)
	Weight	6.5kg (14lb)

Inlet and outlet connection 6.5mm (0.25") OD tube. Push on

1.3.2 Environment

Operating temperature range 0 to 50°C (32 to 122°F) (BASEEFA Approval to 40°C)

1.3.3 Electrical Requirements

Powered by a rechargeable NiCad pack which is re-charged by the power supply. Rechargeable battery capacity between charges is 25hr approx. Or 12hr if a pump is fitted.

The analyser will run continuously when the power supply is connected.

WARNING

NEVER USE THE 578A POWER SUPPLY IN A HAZARDOUS AREA

The 578A is BASEEFA approved for connection to model B analysers. BASEEFA certification of the analyser will be invalidated if the analyser is connected to any power supply other than the 578A.

Range

From 00.0% O_2 to 100.0% O_2.

Readout / Output

The readout is a 3½ digit 0.7 inch high liquid crystal display with a resolution of 0.1% O_2

An output of 0-1 volt for 0-100% is available through a 2.5mm jack socket.
Output impedance 1k ohm.

Accuracy is ±0.1% oxygen.

Operating Controls

Push button switches.

On / Off

Battery check, momentary action.

Combined screwdriver or finger adjust on front panel for span.

Screwdriver adjust on left hand side of case for zero.

1.3.4 Sample Requirements

Particle Size

Less than 0.6 micron

Dew Point

10°C (18°F) below minimum expected ambient temperature.

Inlet Pressure

Min 1/3psig (2.3kPa). Max. 10psig (70kPa). Inlet pressure change from 1/3psig to 10psig will cause a reading change of less than 0.1% O_2.

When the internal pump is fitted, the minimum inlet pressure is 25mm Hg suction and the maximum is 2psig (14kPa).

Flow Control

An automatic flow control device controls the cell flow to between 80 and 150cc/ min, with an inlet pressure of 1/3 psig (2.3 kPa) to 10 psig (70 kPa)

The bypass flow will vary between 1 ½ litres / minute and 6 litres / minute approx for inlet pressure between 1/3 psig (2.3kPa) to 10 psig (70kPa)

Inlet on front panel.

Cell outlet and bypass outlet on back panel.

A replaceable fibreglass type tubular filter is fitted on the back panel.

Response Time

The overall response time is less than 7.5 seconds with an inlet pressure of 10psig (70kPa)

Materials in contact with sample

-Stainless steel 303 and 316
-Glass
-Platinum
-Epoxy Resin
-P.T.F.E
-Viton
-Polypropylene

Additionally when an internal pump is fitted:

-Carbon
-Resin

1.3.5 Certification

The model B instrument has been approved by BASEEFA for use in Zone 1 and 2 hazardous areas, where the ambient temperature is less than 40°C, and in hydrogen atmospheres. The certification also approves the analyser for use on a mixed hydrogen and oxygen gas sample. (Certification number EX812155X Code EEX ib IIC T4). See certificates at the rear of this manual for further information.

1.3.6 Accuracy

There are various effects that will influence the measuring activity of the analyser as follows.

Effect of battery charge

The reading will change by less than 0.05% O_2 when the battery changes from full charge to end point (8.1 to 6.6V).

Temperature Coefficient

Effect at 0% O_2, less than ±0.02% O_2/°C

Effect on span: Less than ±0.2% full scale /°C

Pressure Effect

The oxygen reading will vary in direct proportion to barometric pressure.

Repeatability

Better than 0.1% O_2.

Linearity

Better than 0.1% O_2.

Effect of tilt (from Calibration attitude)

Degrees of Tilt	0	10	45	90
±O_2 Error (Max)	0	0.2	0.45	0.9
±O_2 Error (Typical)	0	0.1	0.3	0.6

For best accuracy, the analyser should be calibrated at the angle of tilt at which it is to be read.

Effect of External Magnetic Materials

When magnetic materials are placed directly on the analyser case, the reading will alter by less than 0.1% O_2.

1.4 Optional Extras (Refer also to Section 8 of this manual)

(i) Internal Sampling Pump

The back panel can be fitted with an electrical pump which will enable sample gas to be drawn in automatically from ambient or slightly negative pressure atmospheres. Model B analysers fitted with the internal pump are BASEEFA certified.

(ii) Mains Power Supply

The power supply can be used to recharge the rechargeable battery.

(iii) Flue Gas Sampling System

This system permits the monitoring of the oxygen content of a flue gas sample either on a sot check basis or for carrying out boiler performance surveys.

WARNING

Analysers modified to take the flue gas sampling system are not BASEEFA certified, even if the system is not connected.

NOTES

Section 2: Initial Set-Up

2.1 Rechargeable Battery Pack

Check the state of charge by pressing the On /Off switch to On. Press the battery check button (>6.5). The reading should be greater than 6.5.

If the indication is less than 6.5 then the batteries need to be recharged. The Servomex Power Supply plugs into the jack socket on the back of the analyser, to charge the batteries and power the analyser at the same time.

WARNING

NEVER USE THE 578A POWER SUPPLY IN A HAZARDOUS AREA.

2.2 Support Facilities

The following utilities, gases, test equipment and tools must be available on site in order to maintain proper operation of the analyser.

2.2.1 Electricity Supply

If a 578A Power supply is used, a source of electric power, installed in accordance with local codes of practice, capable of supplying a nominal voltage of 100, 117 or 234V AC, 48 to 62 Hz, must be available at locations where the analyser is to be used or serviced. Regulation of this supply must be within ±15% of the nominal voltage if specified accuracy is to be maintained.

2.2.2 Calibration Gases

The following calibration gases must be available:-

(a) Oxygen-free Nitrogen - Zero Gas

The minimum purity of this nitrogen must be 99.9%

WARNING
NITROGEN IS AN ASPHYXIANT AND MUST NOT BE USED IN CONFINED SPACES WITHOUT ADEQUATE VENTILATION.

(b) Instrument Quality Air

Instrument quality air meeting the requirements of ISA Standard S-7.3

- Dew Point Temperature 10 deg C (18 deg F) below the lowest expected ambient temperature.

- Particle size - maximum; less than 3 micron.

- Oil Vapour; below 1ppm.

WARNING

NEVER USE THE ANALYSER TO MEASURE A GAS WITH A HIGH OXYGEN CONTENT FOLLOWING USE ON AIR WITH AN OIL VAPOUR CONTENT. THE OIL VAPOUR WILL CONTAMINATE THE TUBING AND MAY RESULT IN A FIRE ON CONTACT WITH HIGH OXYGEN LEVELS.

If instrument quality air is not available, dry bottled air or ambient air with hand aspirator and drying tube may be used.

CAUTION

All gas cylinders used in conjunction with 570A Analysers must be fitted with a tank or cylinder mounted regulator whose delivery pressure can be limited to 10 psig (70 kPa) and an appropriate output pressure gauge. This will prevent serious over-pressuring of the analyser and resulting damage to the measuring cell.

c) Certified Oxygen Cylinder

A certified cylinder of high purity oxygen 99.2% minimum, for analyser span when verifying high purity oxygen. The cylinder must be fitted with either a pressure regulator with gauge or an adjustable litre flow regulator. use of high purity oxygen negates the requirement for instrument air in (b).

2.2.3 Test Equipment /Tools

The following test equipment and tools should be available to personnel responsible for maintenance and calibration of the analyser

(a) Test Equipment

A volt, ohm, milliamp meter of impedance of at least 1,000 ohms per volt.
A manometer to measure 12 inches (300 mm) water gauge.

(b) Spanners

- Removing an installing a measuring cell requires the following open ended spanners:-

British Designation	Width across the Flats	U.S Equivalent
3/16 Nom.	0.445in	7/16

(c) Removing the case halves requires a 5mm hexagon key (supplied)

Opening the cover to the 0 to 1 volt signal output requires a 3/32 " hexagon key (supplied).

Removing the span potentiometer knob requires a 1.5mm hexagon key.

(d) Bubble flowmeter to adjust automatic flow control device.

(e) A 4 ½ digit voltmeter to adjust the analogue to digital converter.

(f) Silica gel for refilling drying tubes.

WARNING
USE ONLY THE BATTERY PACK SUPPLIED BY SERVOMEX. FITTING OF ALTERNATIVE BATTERIES INVALIDATES BASEEFA CERTIFICATION.

2.3 Connections to Automatic Flow Control Device (AFCD)

The selection of the sample / measuring cell connections to the automatic flow control device (AFCD) should be based on the relative importance of speed of response, ability to accommodate accidental introduction of condensate, and presence of internal sampling pump. Figure 2.2, shows the internal construction of the AFCD and also the fixed restrictions, A & B, used along with the spring loaded relief valve to control the flow to the measuring cell. The characteristics of the fixed restrictions for identifications purposes are as follows:- (Ref: Fig 2.2)

Function	**Bore mm (in)**	**Height of Hex Base mm (in)**
A. Inlet	0.33 (0.013)	Short 3.1 (0.125)
B. To measuring Cell	0.63 (0.025)	Tall 6.2 (0.25)

The results obtained with the various configuration are given in Table 2.1.

Table 2.1
Effect of Various Input Configurations

Configuration	A (inlet)	B (to cell)	Flow rate (total l/min)	Time90% Response	Effect of condensate
1 Direct	M	T	6	11 sec	Minimal
2 Direct	T	M	6	5 sec	Soak Filter, some to cell
3 Pump	T	M	0.6	15 sec	Fill pump and soak Filter

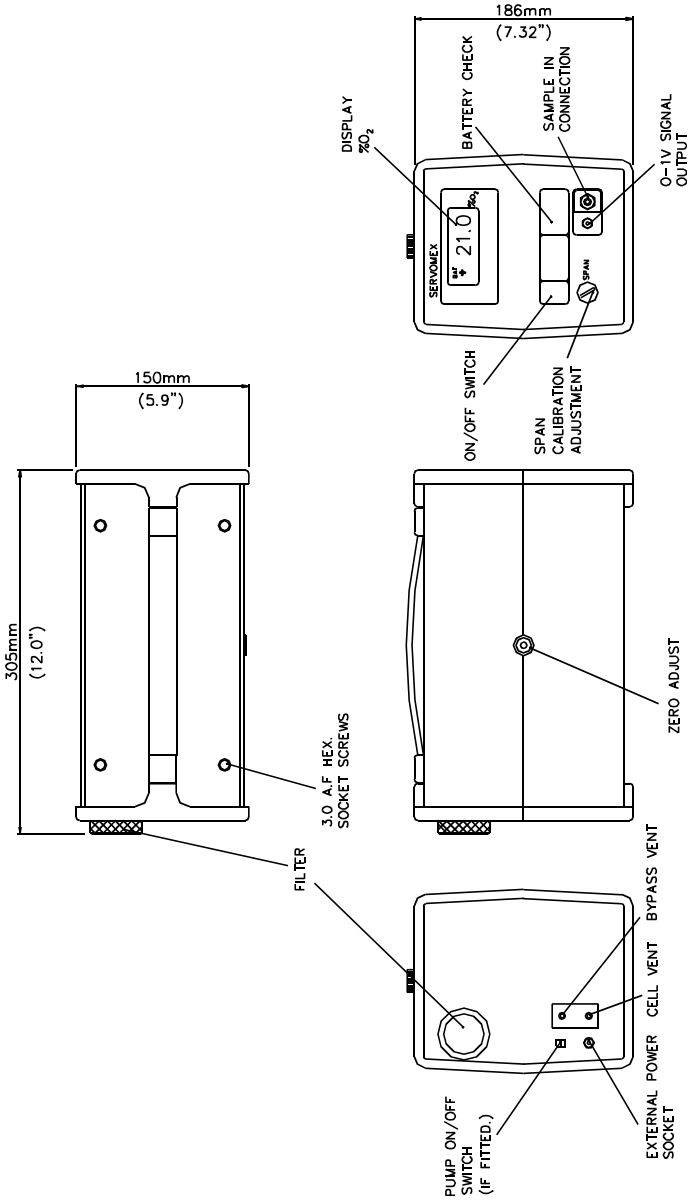


Figure 2.1 570A Principal Dimensions and Controls

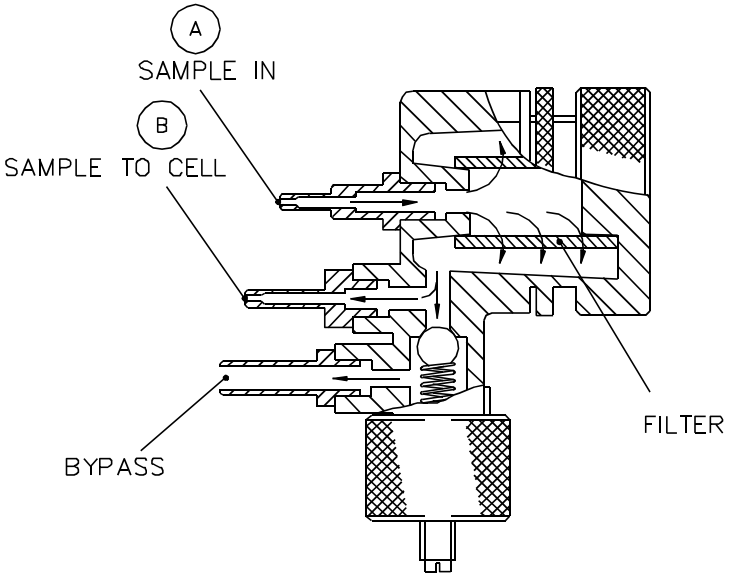


Figure 2.2
Automatic Flow Control Device (AFCD) Section
(Shown with restrictors arranged for internal pump)

NOTES

Section 3: Operating and Calibration Instructions

3.1 Operational Precautions

The following paragraphs describe in detail the effects of certain operational factors which must be observed in order to achieve the accuracy of which the analyser is capable and to minimise possible damage by accidental operation outside of its design specifications.

3.1.1. Ambient Temperature

The 570A Oxygen Analyser should be stabilised and calibrated at the ambient temperature at which it is to be used.

3.1.2. Vibration

The analyser is relatively insensitive to vibration, however, best results will be obtained when it is situated away from heavy vibrations.

3.1.3. Classification of Areas Of Use

Refer to general Safety Information at the beginning of this manual.

Also:-

WARNINGS

1) DO NOT REMOVE THE BATTERIES IN A HAZARDOUS AREA.

2) DO NOT CLEAN THE PLASTIC CASE IN A HAZARDOUS AREA BY RUBBING IT. THIS MAY GENERATE STATIC ELECTRICITY.

WARNING

TO PERMIT THE 0-1V OUTPUT CONNECTOR OF INSTRUMENTS MARKED WITH THE BASEEFA NUMBER EX812155X/5 TO BE CONNECTED TO OTHER INTRINSICALLY SAFE APPARATUS. IN THIS CASE THE WARNING "MAXIMUM INPUT 1V" DOES NOT APPLY AND THE PARAMETERS BELOW TAKE PRECEDENCE.

THE PARAMETERS FOR THE CONNECTOR ARE :

Uo (Umax out) = 10.2V, Io (Imax out) = 12mA, Po (Wmax out) = 30mW,
Ci (Ceq) = 0, Li (Leq) = 0,

Ui (Umax in) = 10.2V, Co (Cext) $\leq$ 2µF, Lo (Lext) $\leq$ 200mH,
Lo/Ro (L/R) $\leq$ 1000µH/Ohm, FOR ALL GROUPS.

DO NOT USE THE 0-1V OUTPUT OF INSTRUMENTS MARKED WITH THE BASEEFA NUMBER EX812155X ONLY IN A HAZARDOUS AREA

3.1.4. Sample Temperature

Dry samples with temperatures at the inlet of the analyser below 80°C (176°F) will not damage the analyser.

The sample temperature should be within ± 5°C (9°F) of the ambient temperature for maximum accuracy. See section 3.1.5. for discussion of the effects of dew-point temperatures of “wet” samples.

3.1.5 Sample Dew Point Temperature

The dew point temperature (the temperature at which condensate forms on cooling of the sample) of all gases introduced into the analyser must be at least 10°C (18°F) below the minimum expected ambient temperature if the detrimental effects of condensate formation in the analyser are to be avoided. These detrimental effects include:

(A) Saturating and blocking the inlet filter especially when dusty samples are involved.

(B) Condensation in the measuring cell window and mirror surfaces thus reducing the analyser accuracy and ultimately rendering it inoperative**.**

(C) Condensation on the dumb-bell upsetting the static balance of the measuring cell thus causing a change in the zero position.

(D) Condensate containing chemicals such a strong mineral acids, organic solvents, etc, detrimental to materials of construction of the pipes and measuring cell will ultimately destroy it.

A second problem associated with moderately high dew-point temperature is the dilution effect. Bottled nitrogen, oxygen and air normally have dew-point temperatures below -45°C (49°F) corresponding to about 0-0.06% water vapour. A sample whose dew-point temperature is 10°C (50°F) however, will contain about 1-2% water vapour. Thus the apparent concentration of oxygen would be low by approximately 1-2% of reading.

3.1.6. Sample Inlet Pressure

Standard Version

Inlet pressure must be withing the range of 1/3 psig (2.3 to 70kPa).

Inlet pressures of less than 1/3 psig (2.3kPa) may not be adequate to permit the sample flow rate required for the speed of the response desired.

Internal Sampling Pump Version

Inlet pressures must be within the range 25mm Hg (suction) to 2 psig (14kPa)

CAUTION

Do not restrict the vent pipes from the analyser.

3.1.7. Particulates in Sample

An internal 0.6 micron filter of limited capacity is included in the analyser in order to prevent occasional particles of dirt damaging the measuring cell. An external filter of capacity and particle size rating appropriate to the intended use must be used if significant quantities of particulates are anticipated.

3.1.8. Vent Pressure

The sample pressure at the lower analyser vent connection is the same as that in the measuring cell. The analyser determines the actual partial pressure of oxygen present in the sample gas. Pressure variations occurring in the measuring cell since the last calibration cause a proportional change in the oxygen reading . Thus any tubing, etc, attached to either vent connection should be sized so as to cause minimum pressure drop at the flow rates being used.

3.1.9. Sample Flow Rate

The automatic flow regulator of the analyser is designed to control the gas flow rate through the measuring cell to between 80 and 150cc /min for the specified inlet pressure.

3.1.10. Effects of Other Gases

The 570A Oxygen Analyser measures the volume of paramagnetic susceptibility of the sample gas flowing through the measuring cell on a scale defined by pure nitrogen as zero, and pure oxygen as 100% at the pressure and temperature at which the last calibration occurred.

Each gas present in a mixture of gases contributes to the paramagnetic susceptibility of the mixture in direct proportion to its volume fraction in the mixture, multiplied by its relative paramagnetic susceptibility based on the oxygen / nitrogen scale mentioned above.

Inspection of the paramagnetic susceptibilities of other commonly encountered gases and calculating their effects (see Servomex publication 7986-0073, for details) shows clearly that most gases have no significant effect on the determination of oxygen beyond their dilution effect.

This will not be the case, however, if significant and changing quantities of NO and NO_2 are, present in the samples to be analysed. Certain hydrocarbons such as ethane through heptane have a similar effect when oxygen levels are below about 2% O_2.

If low oxygen concentrations are being analysed, greater accuracy may be achieved by setting the analyser zero for the background gas being analysed.

3.2 Operation

3.2.1 Check the Batteries

Switch on the analyser by pressing the On /Off switch. Check the battery voltage by pressing the battery check button >6.5. The indication should be at least 6.5V If it is not , refer to Section 2 - Initial set up, paragraph 2.1. The analyser is now ready to be calibrated.

3.3 Calibration

Zero

Introduce the zero gas (normally high purity nitrogen) at a pressure between 1/3 and 10 psig (2.3 to 70 kPa). Use a screwdriver to turn the Zero adjust screw on the side of the analyser to obtain an indication of 0.00 on the display or Meter. However if the zero gas is not nitrogen, an equivalent zero may be obtained by turning the Zero adjust screw to obtain an alternative indication, determined by the paramagnetic susceptibility of the particular zero gas chosen. For details refer to the Servomex application note 7986-0073, The effects of Variations in Gas compositions on Servomex Oxygen Analysers.

Span

Introduce the span gas (normally clean, dry air) at a pressure between 1/3 and 10psig (2.3 to 70 kPa). Adjust the span control to obtain the corresponding indication (21.0% for clean dry air). The analyser is now calibrated and ready to use.

Taking an Oxygen Reading

After Calibration, the analyser is ready for use by connecting the gas sample at a pressure of 1/3 to 10 psig (2.3 to 70 kPa) to the gas inlet. The % O_2 is displayed on the front panel indicator. The hand aspirator may be used to provide the specified inlet pressure.

CAUTION

The drying tube (supplied with the analyser) should always be fitted ahead of the analyser inlet. This will help prevent entrance of particles and condensate into the analyser in addition to its normal function of removing water vapour from the sample gas.

The normal drying agent (Silica Gel) supplied with the analyser may absorb some of the background / carrier gases and may, therefore lead to inaccurate oxygen readings. Select and alternative drying agent or consult Servomex if these inaccuracies are unacceptable.

Calibration for Oxygen USP Verification

In accordance with Title 21, section 211.194(c) of the Code of Federal Regulations, all calibration standards must be accompanied by their manufacturer's Certificate of Analysis (COA). the analyser zero gas must be 99.9% (minimum) nitrogen and the analyser span gas must be 99.2% (minimum) oxygen. A drying tube is not required since the zero, span, and sample gases are all clean, dry cylinder gases. The sample filter may be checked monthly. There are no requirements to have instrument quality air on hand. Due to the potential effect of tilt upon the analyser accuracy, the analyser must not be moved between the time of calibration and its use to verify Oxygen USP. Physical relocation of the analyser, even within the same room, necessitates recalibration before medical gases can be verified.

3.4. Recorder Output

Access to the recorder output is achieved by releasing the cover over the jack socket with a 3/32" Allen key. The cover is spring loaded and turning the Allen key will release the locking pin.

The output is 0.1 Volt for 0-100% O_2 through a 2.5mm jack socket.

To reduce loading, the impedance of the load (digital voltmeter, recorder etc) should be greater than 100k ohms.

The accuracy should then be better than ±0.2% full scale deflection.

WARNING - IGNITION SOURCE

DO NOT USE THE RECORDER OUTPUT IN A HAZARDOUS AREA WITHOUT REFERENCE TO SECTION 3.1.3 OF THIS MANUAL

3.5. Altitude Compensation

If the analyser is to operate at high altitudes (above 2000ft) or the sample output does not vent to atmospheric pressure, difficulty may be experienced adjusting the span to obtain the required indication.

If this is the case then it will be necessary to select a new value of the coarse span resistor which is R20 on the 500A PCB. The value should be selected within the range 200Ω to 2.5kΩ, and the replacement resistor should be a metal oxide one of at least 1/4W. USE OF WRONG TYPE OF RESISTOR INVALIDATES BASEEFA CERTIFICATION.

To preset the coarse span resistor for altitudes other than the calibration one, proceed as follows:-

a) Determine the present barometric pressure (correct to sea level).

b) Determine the change in elevation from present location to the required altitude.

c) Select the curve on the graph, Figure 3.1, (corresponding it to the present barometric pressure corrected to sea level).

d) Determine the intersection of the relative altitude and barometric pressure line and note the % O_2 reading for clean, dry air corresponding to this intersection.

e) With the span pot set mid way, change R20 for the indicator to read the predetermined value (% O_2)

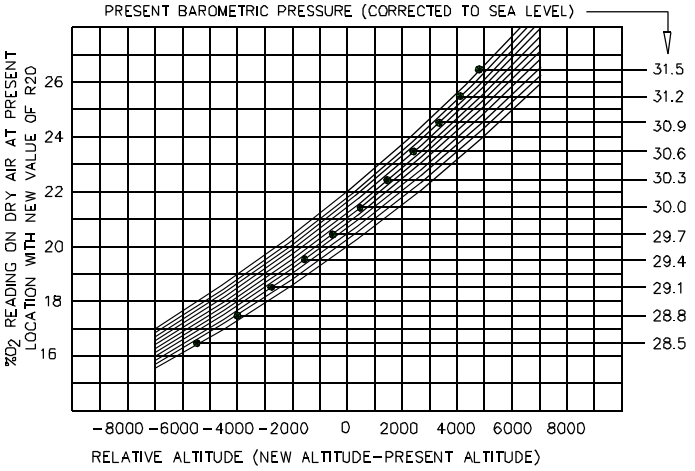


Figure 3.1 Graph for adjusting Span AOT Resistor

Section 4: Routine Maintenance

WARNING

DO NOT CARRY OUT MAINTENANCE IN A HAZARDOUS AREA

4.1 General

The following instructions should be carried out as at the frequency indicated in order to keep the analyser in top operating condition. The frequency of calibration required will depend on the operating requirements for accuracy and upon the environmental conditions. The following is a guide which may be modified in the light of operating experience in particular circumstances.

Daily : Adjust the span. Paragraph 3.3 refers.
Check condition of dryer tube. If colour of indicator granules has changed from amber to clear, replace dryer material (silica gel). Keep ends of dryer tube capped when not in use.

Weekly: Adjust the zero, then the span, paragraph 3.3 refers.

If the available adjustment on the Zero Adjust screw is insufficient to obtain the zero indication, then the alignment of the zero assembly in the 500A has to be adjusted. Refer to section 5, Testing and Fault Diagnosis., paragraph 5.2.6.

The filter should be checked once a week if the analyser is in continuous use.

CAUTION

The analyser must not be operated without the filter element in place since dust and other particulates will permanently damage the measuring cell.

The filter element is removed by unscrewing the large filter knob on the back of the analyser.
Discard the old filter element if dirty or wet and fit a new filter element of the type specified in the parts list, Section 7.

4.2 Recharging the Rechargeable Batteries

WARNING

THE POWER SUPPLY MUST NOT BE USED IN A HAZARDOUS AREA.

To recharge the rechargeable batteries connect the jack plug of the power supply into the socket on the back panel of the analyser and connect the power supply to the local electricity supply.

If the batteries are charged with the instrument off, then they will be fully charged in about 18 hours. If they are being charged while the instrument is operating, the charging time will be increased.

Rechargeable batteries will last longer if they are allowed to discharge completely before recharging.

The batteries can be charged indefinitely without damage at ambient temperatures above 10°C. Below 10°C the batteries should only be charged for 18 hours. The instrument will function with battery voltages down to 6.5 volts, however, when the battery voltage reaches 7.0 volts, most of its capacity has been used, and for continuous operation it is advisable to recharge as detailed above.

Section 5: Testing and Fault Diagnosis

5.1 General

WARNING

1) DO NOT CARRY OUT ANY REPAIRS IN A HAZARDOUS AREA.

2) A FULLY CHARGED RECHARGEABLE BATTERY COULD IGNITE OR EXPLODE IF ITS TWO TERMINALS ARE SHORTED TOGETHER.

Repairs should only be carried out by a skilled person.

If the rechargeable batteries are run down beyond their end point voltage, the battery check switch will not function. If this is suspected, connect the power supply to the instrument for 15 minutes before carrying out any further testing.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short circuiting of fuses must be avoided.

CAUTION

Replacement parts should only be as specified by Servomex in the parts list.

The use of inferior components may degrade the performance of the analyser and invalidate the BASEEFA approval.

In the event that the result of any test exceeds the specified tolerance it is recommended that the action described in FAULT DIAGNOSIS is followed. After the repair activity is complete, the test procedure should be resumed from the beginning.

The fault diagnosis is intended to provide a resolution down to the level of the sub-assemblies listed in the Recommended Spares List.

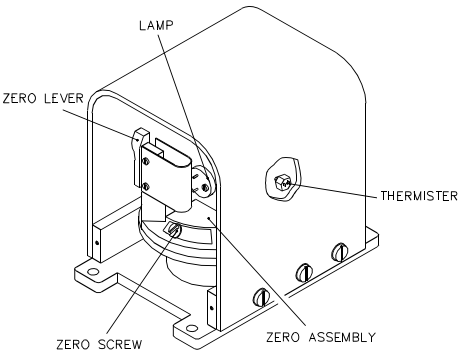


Figure 5.1 Internal View of the 500A Transducer

5.2 Test Procedure for a Complete 570A Analyser

TEST NO	TEST PROCEDURE	VALUE	TOL	FAULT DIAGNOSIS
5.2.1.	LEAK TEST Connect the sample vents on the back panel to a 300mm (12 in) water manometer by means of rubber tubing and a “T” piece. Connect a piece of rubber tubing to the sample inlet on the front of the analyser and pressurise it so that the manometer indication is not less than 300mm (12 in) water gauge (W.G). Seal it off and note the pressure. Wait two minutes and then check the pressure again. The pressure drop should be less than:	2mm W.G		Switch the analyser off. Remove the cover. With the analyser pressurised to about 300mm (12 in) W.G. apply soap solution to all the joints. A leak will manifest itself by blowing a soap bubble. If necessary, remove the covers of the 500A by loosening the two bright screws at the bottom of each cover. Search for leaks around the connectors and on the edges of the cell window. Clean the cell window after this test.
5.2.2	FLOW CONTROL TEST Connect nitrogen or air at a pressure of 2.3 to 70 kPa (1/3 to 10 psig) to the sample inlet connection. Connect a bubble flowmeter to the lower vent pipe on the back panel in order to measure the flow rate through the 500A. At a sample pressure of 70kPa (10 psig) the measured flow rate should be: At a sample pressure of 2.3 kPa (1/3 psig) the measured flow rate should be greater than:	145 to 150ml / min 80ml /min		1. Inspect the Filter 2. Remove each length of tube the inspect the bore. Clear any swarf or blockage away. Also check the measuring cell for contamination with foreign matter. Reassemble the tubes. 3. Service the AFCD as described in Section 6 ‘Repair’, Paragraph 6.7.

TEST NO	TEST PROCEDURE	VALUE	TOL	FAULT DIAGNOSIS
5.2.3.	POWER SUPPLY TEST The analyser power supply is derived from the back panel. Measure the voltage across the terminals 2 and 1 on the screwed terminal on circuit board 00570/924 The voltage should be :	6.5V Min 12V Max		1. Check the battery voltage. Recharge rechargeable cells if necessary. 2. If the battery voltage is adequate refer to section 6 'Repair' Paragraph 6.6. and check the fuses, etc. out of the power supply board.
5.2.4	500A TEST Check terminals 5,6 and 8 are linked. Measure the voltage of terminal 7 with respect to terminals 5, 6 and 8 on the 500A. (Terminal 7 -VE). This should be : Check that terminals 9 and 10 on the 500A are linked together. Measure the voltage of terminals 9 and 10 with respect to terminals 5, 6 and 8 on the 500A. (Terminals 9 and 10 +VE). This should be:	2.89V Min 5.57V Max 3.48V Min. 6.66V Max.		If the power supplies to the 500A are not within the specified tolerance, carry out continuity checks between the 500A and the power supply on the back panel. Check the continuity of the fuse (or fuses on early rechargeable versions). See repair, paragraph 6.2. If the 500A fails to give a satisfactory output, check the lamp, the photocells and the measuring cell within the 500A. a) **Measuring Cell** Withdraw cell (see Paragraph 6.9), and examine the dumb-bells through the windows. The inside should be free from contamination and the mirror should be clean. The dumb-bells should be at an angle to the plane of the window.

TEST NO	TEST PROCEDURE	VALUE	TOL	FAULT DIAGNOSIS
5.2.5	CIRCUIT BOARD ASSEMBLY POWER SUPPLY If the results of tests 5.2.3 and 5.2.4. show that the powers supplied to the 500A is correct, check as follows that the circuit board assembly correctly displays the output signal from the 500A on the meter. Connect air at a pressure of 2.3 to 70 kPa (1/3 and 10 psig) to the sample inlet. Measure the voltage of terminal 1 with respect to terminal 6 on the 500A.	0.21V	±0.005 V	The resistance of the coil should be between 36Ω and 65Ω. b) **Lamp Circuit** i) Measure the current into pin 9 on the connector. This should be between 43 and 55 mA at 20 °C. Measure the voltage across the lamp. This should be about 1.2V. If both of these are correct, it is probable that the lamp circuit is functioning properly. ii) If the lamp current is not as (I) above, continue checks as follows:- Voltage across R1 (i.e. current through TR1) should be between 1 volt and 0.65 Volts and the voltage across R7 should be between 150 mV and 200 mV. The voltage across R6 will be about 700 mV. To set the lamp current connect a milliammeter in series with LED 1. The current should be between 40 and 50 mA. R3 is adjusted (AOT) to set this current ad a change should only be necessary if D1 or TR2 are changed.

TEST NO	TEST PROCEDURE	VALUE	TOL	FAULT DIAGNOSIS
5.2.6	SET THE ZERO With oxygen free nitrogen at 2.3 to 70 kPa (1/3 to 10 psig) connected to the Sample Inlet connection, adjust the “Zero Adjust “ screw on the side of the analyser so that the meter indicates: Disconnect the nitrogen supply	Zero	±0.2% O_2	Check the alignment of the zero assembly as follows:- Connect nitrogen at less than 10 psig (70 kPa)to the Sample Inlet. Refer to figure 5.1 and loosen the Zero Screw, then press down the Zero Lever. Move the Zero Assembly to obtain an approximate zero indication on the display. Tighten the Zero Screw. Move the Zero Lever to its upright position. Obtain a precise zero reading by adjusting the “Zero Adjust” Screw on the side of the Analyser.
5.2.7	SET THE SPAN Connect Oxygen of known concentration to the Sample Inlet at a pressure of between 2.3 to 70 kPa (1/3 and 10 psig). Adjust the span potentiometer to obtain an indication of the known concentration.	$\%O_2$	±00.0% O_2	1) Check that the measuring cell coil is not open circuit. The resistance should be 36Ω to 65Ω. 2) Since the analyser measures the partial pressure of oxygen, the indication is influenced by changes in barometric pressure. If the analyser is operated at high altitude or otherwise at an unusual barometric pressure, it may be necessary to select a new value for one of the resistors in order to span the analyser.

TEST NO	TEST PROCEDURE	VALUE	TOL	FAULT DIAGNOSIS
				The resistor to be changed is R20 on circuit board 00500921 in the 500A Basic Oxygen Analyser. The selected value must be between 200 and 2.5k ohms. The resistor must be metal oxide or metal film type. If the analyser still cannot be spanned, a new transducer may be required. Contact Servomex.
5.2.8	CHECK LINEARITY Disconnect the oxygen supply and connect a supply of air at a pressure of between 2.3 to 70 kPa (1/3 to 10 psig) to the Sample Inlet. Allow one minute to obtain the optimum response. The indication should be :	21%	±0.5% O_2	
5.2.9	LOOP GAIN TEST Allow the meter indication to stabilise and record it. Switch the Power Off and unsolder the link from the 500A terminal labelled “Gain Check”. Ensure that this free wire does not come into contact with any bare metal. Switch the electricity Power On and observe the new meter indication. The difference between the two indications should be less than :	1.5% O_2		Refer to figure 5.1 and remove the zero screw and two washers, then withdraw the zero assembly. If the window of the cell is dirty, clean it and try the test again. Inspect the measuring cell through the window and if it is contaminated with foreign matter fit a replacement. See Section 6 ‘Repair’ Paragraph 6.9. Inspect the lamp and the

TEST NO	TEST PROCEDURE	VALUE	TOL	FAULT DIAGNOSIS
	Switch the Power Off and resolder the link to the Gain Check Terminal. Switch the Power On.			photocells and if either one is damaged it will be necessary to renew the zero assembly as described in Section 6 'Repair' Paragraph 6.10. Inspect the printed circuit board 00500921 within the 500A for damage.
5.2.10	ANALOGUE TO DIGITAL CONVERTOR TEST Connect a 4.5 digit volt-meter to the front panel by means of the 2.5mm signal output socket. Select the 2 Volt range. Switch on the analyser. Introduce pure oxygen, at a pressure between 1/3 and 10 psig (2.3 to 70 kPa), to the Sample Inlet. Adjust the span control to set the indication on the digital voltmeter to: Adjust RV1 on front panel circuit board assembly so that the analyser display alternates between 99.9 and 100.0. The analogue to digital converter is now adjusted.	0.9995	± 0.0001	

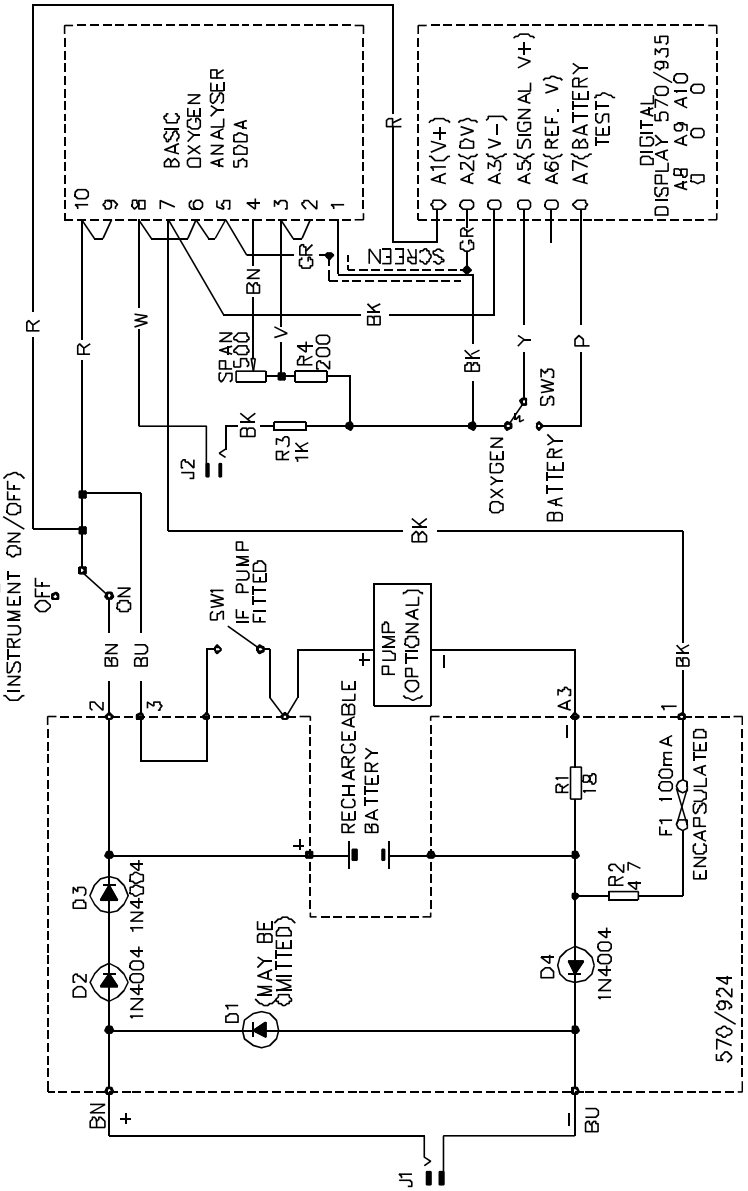


Figure 5.2
Interconnection Diagram 570A Model B

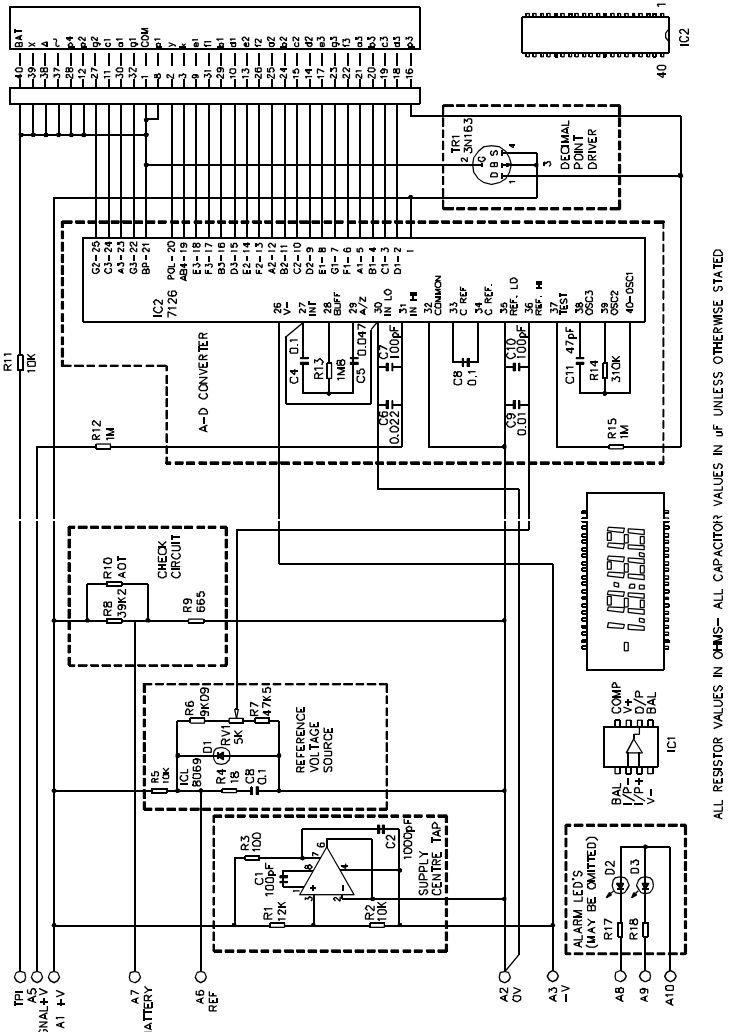


Figure 5.3A 570A Digital Display Circuit Diagram (Sheet 1)

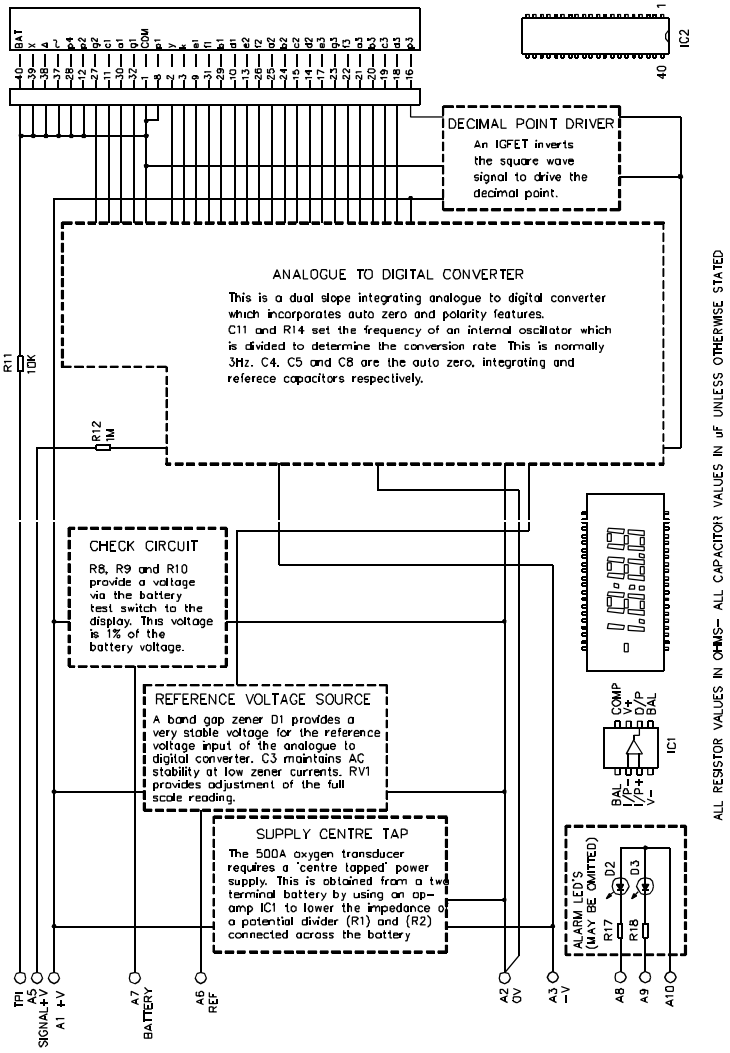


Figure 5.3B 570A Digital Display Circuit Diagram (Sheet 2)

Section 6: Repair

WARNING

DO NOT CARRY OUT ANY REPAIRS IN A HAZARDOUS AREA

6.1 General

Detailed repair techniques are not described here. Good workshop practice should be observed.

If a replacement part is fitted, it should be of the type specified in section 7 - Parts List.

When a new component is fitted, the repaired circuit board should be varnished before fitting in the analyser.

Note: On model B instruments poor quality repairs or use of inferior components will invalidate BASEEFA certification. If in doubt return the unit to Servomex for repair.

6.2 Replacement of a Fuse

WARNING

THE FUSE ON MODEL B ANALYSERS IS FITTED FOR INTRINSIC SAFETY.

THE SHORTENING OF FUSE LINKS OR THE USE OF MENDED FUSES WILL INVALIDATE THE BASEEFA CERTIFICATION.

It is very unusual for an internal fuse to fail, and this is nearly always due to another faults somewhere in the analyser resulting in excessive current demand. Therefore before the failed fuse is renewed, tests must be carried out in order to find the cause.

Unscrew four socket cap screws with a 5mm hexagon key.

Lift off the top case half.

Lift out the rear panel to gain access to the power supply board.

Test the fuse or fuses with a resistance meter. If an open circuit fuse is found, ascertain the cause before fitting a replacement.

Replacement fuses must be of the type specified in Section 7 - Parts List.
The Model B analyser is fitted with an encapsulated 100mA fuse (F1) obtainable only from Servomex. The shorting of fuse links, or the use of mended fuses is prohibited.

Fit the rear panel into the slot in the rear of the case bottom.

Fit the case top, taking care not to trap wires or sample tube between the case halves.

Fasten the four socket cap screws with a 5mm hexagon key.

6.3 Replacement of a Filter

Unscrew the large filter knob and retainer.

Withdraw the filter element and discard it.

The replacement must be of the type specified in Section 7 - Parts List.

Put the new filter element in place, then the filter retainer.

Screw the filter knob finger tight.

If the filter must be changed too frequently, or if it is wet, this indicates an excessively dirty sample gas. An extra filter is required in the gas sample line in such an instance. Refer to section 3 - Operating instructions, Paragraphs 3.1.5. and 3.1.7.

6.4 Replacement of the 570A Circuit Board Assembly (570/935).

Unscrew four socket cap screws, and lift off the top case half.

Lift out the front panel assembly from the bottom case half.

Remove the printed circuit board from the front panel by undoing four screws, four washers, and four spacers.

Lift off the circuit board.

Reassemble in reverse order to disassembly.

6.5 Replacement of Components on the Front Panel

Unscrew four socket head cap screws, and lift off the top case half.
Lift the front panel assembly out of its locating socket to gain access.

Signal Output Socket J.2.

Use the 3/32" Hexagon key to release the safety cover over the jack socket.
Unscrew one nut to release the jack socket.
Transfer the soldered wire connections to a new jack socket and fasten in the front panel.

Ensure that the socket cover and its fastenings; locking screw, spring, and pin are functioning properly to secure the socket cover. **This is particularly important if the analyser is to be used in areas designated Hazardous.**

Span Control

Before changing the Span Potentiometer, check that the difficulty is not due to the need for altitude compensation. Refer to section 3, Paragraph 3.5. With the front panel assembly removed, turn the span control to gain access to two concealed grub screws on the shaft. Use a 1/32" hexagon key to loosen each of these then remove the span knob from the potentiometer shaft.

Unscrew the lacing nut, remove the potentiometer.

Transfer the soldered wire connections to a new potentiometer.

Put the crinkle washer on the boss of the potentiometer, then place the potentiometer shaft in the hole in the front panel, and fasten it with the nut.

Put the span knob on the potentiometer shaft and tighten the two grub screws with a 3/32" hexagon key.

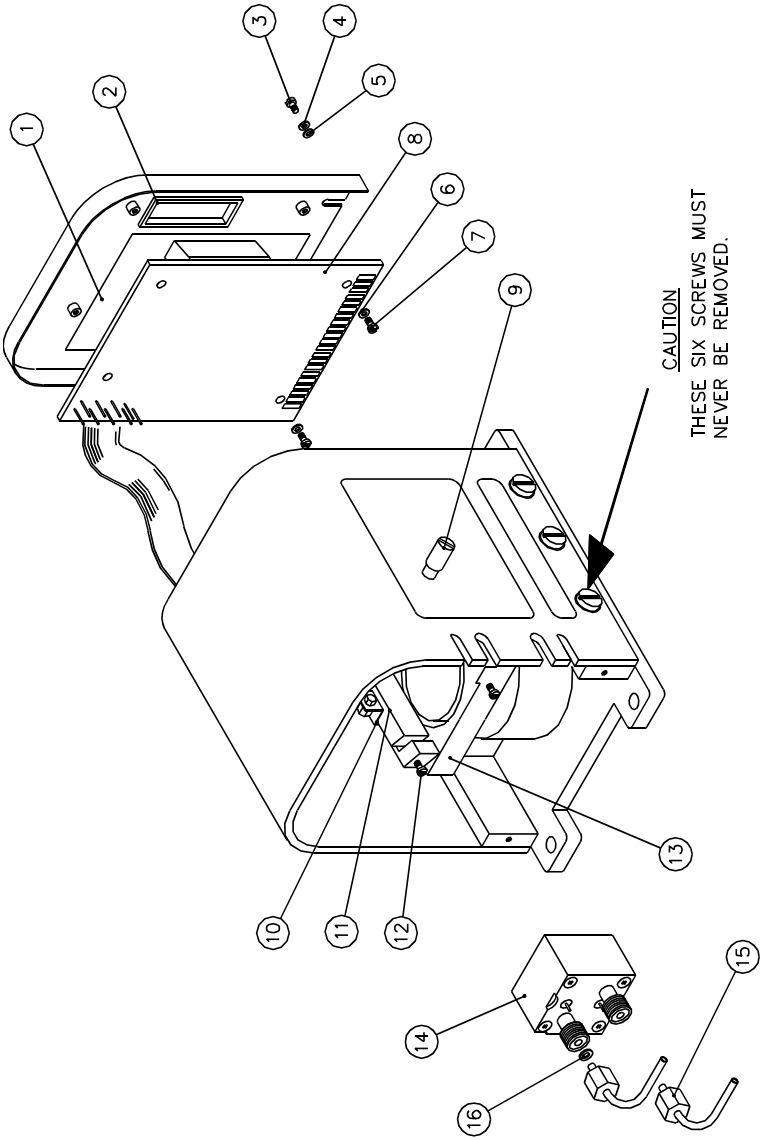


Figure 6.1 Exploded View of the 500A Transducer

6.6 Replacement of Rechargeable Batteries

The rechargeable batteries should only be recharged with the Power Supply, 578A for Model B instruments.

The rechargeable batteries should give many years of service, but if they are thought to be faulty, fully charge the batteries, and check the time taken for the battery voltage to fall to 6.5 Volts when powering the instrument. If this is less than 50% of the specified time the batteries may need replacing..

If renewal of the batteries is inevitable the analyser must be stripped down.

Unscrew four socket head cap screws, and lift off the top case half.

Lift the back panel assembly out of its locating slot in the bottom case half.

Unsolder the two battery leads from the power supply board.

Unscrew two nuts, two plain washers, and two shakeproof washers.

Remove the battery cover, and the rechargeable battery.

Place the new battery on the pads in the back panel, and lay the two wires towards the power supply board.

Fit the battery cover, and secure it with the washers and nuts removed earlier.

Reconnect the new battery wires onto the circuit board.

Undo the retaining screw, and release the battery clip.
Remove the battery by lifting it upwards.

Place the new battery pack in position with its flat side against the back panel.

Resolder the wires onto the circuit board and reassemble as described below.

Fit the back panel assembly into the slot in the lower case half.

Fit the top case half, taking care to ensure that no wires or tubes are trapped between webs of the two case halves.

Fasten four cap head socket screws with a 5mm hexagon key.

6.7 Repair of the Automatic Flow Control Device

The automatic flow control device compensates for fluctuations in sample gas pressure. It maintains a sample flow rate through the 500A of between 80 and 150 ml/min, for a sample inlet pressure between 2.3 and 70 kPa (1/3 to 10 psig). The device is preset by the manufacturer, and must not be readjusted except in accordance with the following instructions.
An incorrectly adjusted device may either reduce the flow through the 500A to such an extent as to cause an unacceptably long response time, or alternatively it may allow too high a flow rate through the 500A and so permanently damage the measuring cell.

If difficulty is encountered with the sample flow rate, first inspect the filter, Paragraph 6.3 refers. If this is in order, remove the tubing to each of the three connectors in turn, and inspect each connector to make sure it is not choked by debris.

Unscrew each connector in turn and inspect the orifice. Inspect each “O” ring for damage. Renew any that are suspect.

Take care to ensure that the connectors are replaced correctly in their respective positions in the flow control device. The outlet and inlet connectors look similar, but, on close scrutiny with the naked eye, the outlet connector bore will be seen to be smaller than the inlet connector bore.

If the foregoing procedure has not revealed the cause of the difficulty then the problem probably lies within the automatic flow control device. The complete device should be renewed unless adequate test equipment is available to adjust the device as follows.

NOTE

Positions of the outlet and inlet connectors (Short and Tall hex nut, respectively) may be reversed. See Figure 6.2 and Table 2.1.

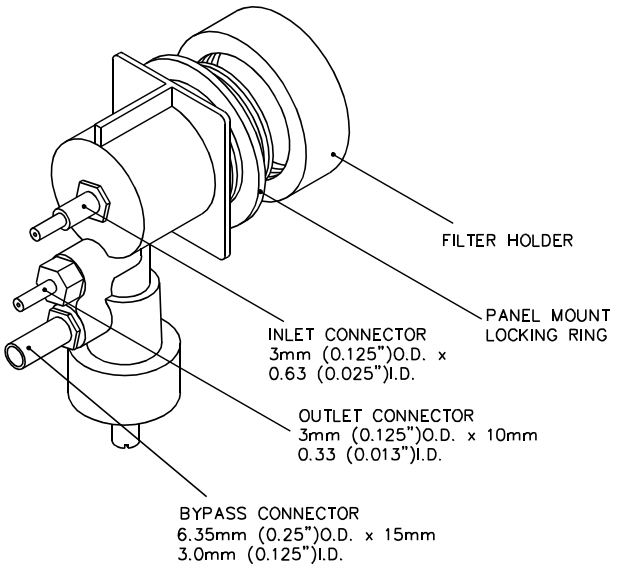


Figure 6.2 Automatic Flow Control Device (AFCD)

6.8 Adjustment of the Automatic Flow Control Device

The following equipment is needed:

A bubble flowmeter to measure 0 to 150ml /min. A conventional “variable area” type flowmeter is unsuitable because it has a significant pressure drop across it at the flow rates used. If such a flowmeter were to be used, the error in the flow rate that would result when it is removed from the analyser vent could be sufficient to cause the analyser to give inaccurate indications.

A bubble type flowmeter is specified because there is a negligible pressure drop across at the specified flow rates, so that when it is removed after the adjustment is complete, the flow rate through the analyser cell will not be increased.

An air supply with a variable gas regulator and pressure gauge, range 2.3 to 70 kPa (1/3 to 10 psig).

Unscrew the filter knob

Unscrew the locking nut.

The automatic flow control device may now be withdrawn from the back panel and hand held to give access to the adjusting screw.

Screw the filter knob back in place.

Ensure that all the flexible sample tube connections between the device and the rest of the analyser are still fitted in place.

Connect the air supply at 10 psig (70 kPa) to the sample inlet on the front panel.

Hold the automatic flow control device vertically, and with the adjusting screw pointing downwards, turn the adjusting screw to obtain a flow of 145-150 ml/min.

Adjust the pressure regulator to reduce the sample inlet pressure to 2.3 kPa (1/3 psig)

The flow should be greater than 80 ml/min.

When it is correctly adjusted, varnish the adjusting screw to lock it.

Remove the filter knob, and place the automatic flow control device in the orifice in the back panel.

Fasten it with the locking nut

Put the filter knob back on.

Ensure that all the sample tube connections are in place, then put the top case half in position.

Be careful not to trap wires or tubing between the casing halves.

Fasten four socket cap screws with a 5mm hexagon key.

6.9 Replacement of the Measuring Cell

NOTE: There is a very strong magnetic field inside this equipment, so wrist watches should be taken off and kept well away.

The measuring cell 325 replaces cells with Model Nos. 116, 286, 311 and 316.

Refer to figure 6.1.

Unscrew four socket cap screws with a hexagon key.

Lift off the top case half.

Lift out the front panel assembly and the rear panel assembly to gain access to the interior of the analyser.

Remove the tubing connections to the 500A at the “In” and “Out”.

Remove the two covers by sliding them up and out.

Remove screw, spring washer and washer.

Withdraw the zero assembly and place it to one side to gain access to the interior of the 500A.

Remove two screws and washers to free the sample connections.

Loosen screw. About six turns clockwise should be sufficient.

Unsolder the two wires, red and orange, from the pin connections on the back of the cell.

Push firmly on the cell to overcome the pull of the magnet, and the cell will slide out with the sample tubes connected.

CAUTION

Do not pull the cell out by the sample tubes. This would cause serious damage (See Figure 6.3).

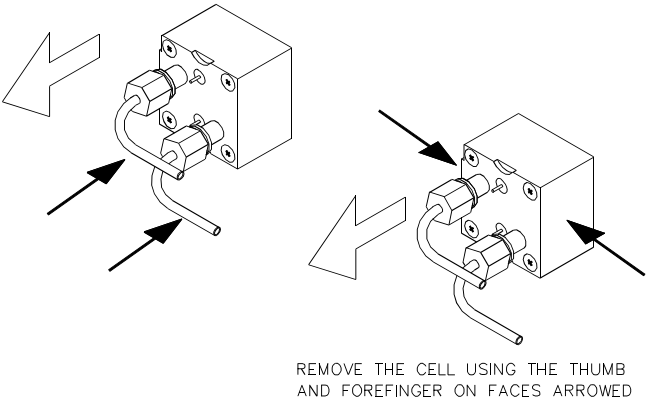


Figure 6.3 Removing the Measuring Cell

Undo the two sample tube connectors to the cell using two spanners to avoid turning the cell connections.

Discard the two 'O' ring seals and obtain a new or serviceable measuring cell.

Before fitting the replacement cell it is advisable to leak test it to a pressure of 300mm (12 in) W.G. Connect a manometer to one cell connection, and a length of rubber tubing to the other, and pressurise it to 300mm (12 in) then seal it. There should be no discernible drop in pressure after two minutes.

Also, the electrical resistance of the cell across the two connection pins should be between 36 ohms and 65 ohms.

Fit the connecting tubes to the replacement measuring cell, using two of the 'O' ring seals supplied with the cell. The orientation must be such that when looking through the cell window from the direction of the lamp, the right hand dumb-bell is forward. Tighten the connections not more than three flats beyond finger tight.

Insert the cell and attached tubing into the 500A, and locate it between the magnet pole pieces. There is a mark etched into the mounting casting to indicate the proper position of the back of the cell.

Secure the cell in position by the tightening screw, but be careful not to over tighten it as damage could occur.

Position the "Sample", "In", and "Out" tube so that the adjacent screw holes line up and fit the screws, and washers.

Connect the analyser tubing to the 500A “Sample”, “In” and “Out” connections.

Solder the wires to the measuring cell. It is important not to overheat the terminals as this could induce a leak. Use a chilled heat sink on each terminal. The red wire goes on the terminal pin adjacent to the yellow spot, and the orange wire goes on the terminal pin adjacent to the black spot.

Put the zero assembly in position, and insert, but do not tighten, screw, spring washer and washer.

Reconnect the fanning strip to the terminal connector and take care that no electrical short to the chassis occurs.

WARNING

The orientation of the fanning strip with respect to the connector in the 500A must be observed or serious damage will result in 500A. See Fig 6.4

The fanning strip must be inserted with connecting lead wires up towards the top of the 500A.

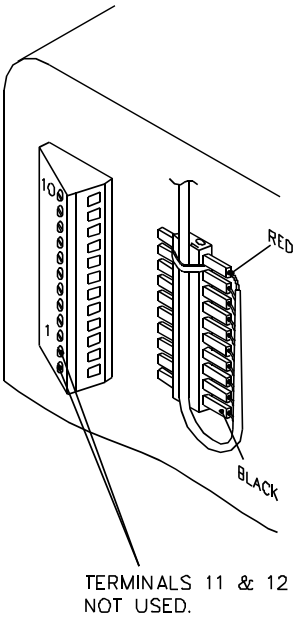


Figure 6.4 Orientation of 500A Transducer Fanning Strip

Put the front panel assembly and the rear panel assembly back in their locating slots in the case bottom half.

Adjust the position of the zero assembly.

Switch the Power On.

Connect Nitrogen at between 2.3 and 70 kPa (1/3 and 10 psig) to the inlet connection.

Refer to Figure 5.1. and press down the zero lever.

Move the zero assembly to obtain an approximate zero reading on the display.

Tighten the zero screw, and check the reading again.

Move the zero lever up and obtain a precise zero by adjusting the “Zero Adjust “ screw.

The zero is now set.

Due to manufacturing tolerances each measuring cell has a different sensitivity.
To compensate for this, a resistor is incorporated in the 500A printed circuit board and its value can be selected as follows.

Introduce a gas of a known oxygen content (air) into the analyser. The span control is a ten turn potentiometer. Turn it to mid adjustment, that is, five turns from one end stop, and if necessary select a new value for R20, between 200 ohms and 2, 500 ohms, to obtain an indication corresponding to the known oxygen content of the sample, (21% for clean dry air). Carry out the full test procedure as described in Section 5.

When the tests are completed satisfactorily, refit covers and tighten screws. Fit the top case half and secure it with four socket cap screws, and tighten each with a hexagon key.

6.10 Replacement of the Zero Assembly

Refer to figure 6.1.

Unscrew four socket cap screws with a hexagon key.

Lift off the top case half.

Lift out the front panel assembly to gain access to the interior of the analyser.

With the 500A still installed in the analyser, loosen, but do not remove the four screws. About three turns anti-clockwise should be sufficient.

Remove the cover by sliding it up and out.

Remove screw, spring washer, and washer. Withdraw the zero assembly.

A defective lamp assembly, or photocell, may be renewed separately.
Replacement of either of these components necessitates removal of two screws to release the spring support for the photo cells. The photo cell assembly is a delicate component and must be handled gently to avoid damage.

Alternatively the entire zero assembly may be renewed.

Refer to Figure 6.4 and solder the grey and white wires to the photocell terminals, and solder the blue and the violet wires to the lamp terminals.

Mount the zero assembly on the 500A and fit, but do not tighten, screw, spring washer and washer.
Adjust the position of the zero assembly as follows.

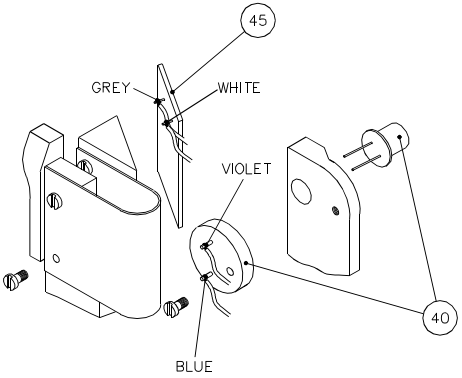


Figure 6.5 Zero Assembly Connections

Switch the Power On, Connect nitrogen at 70 kPa (10 psig) to the Sample Inlet. Refer to figure 5.1 and press down the zero lever. Move the zero assembly to obtain an approximate zero indication on the meter.

Tighten the zero screw and check the zero reading again.

Return the zero lever up and obtain a precise zero indication by adjusting the “Zero Adjust” screw.

Carry out the full test procedure as described in section 5.

When the tests are satisfactorily completed, refit cover and tighten screws.

Put the front panel assembly back in the locating slot in the case bottom half.

Fit the top case half. Secure with four socket head screws, and tighten each with a hexagon key.

6.11 Replacement of the 500A Printed Circuit Board (500/921)

Unscrew four socket cap screws with a hexagon key. Lift off the top case half.

Lift out the front panel assembly, to gain access to the interior of the analyser.

Loosen the ten screws in the electrical connector on the 500A and remove the fanning strip from the electrical connector.

With the 500A still installed in the analyser, loosen, but do not remove the two screws securing the cover which has the connector. About three turns anti-clockwise should be sufficient.

Remove the cover assembly by sliding it up and out.

Remove the four screws and washers to free the printed circuit.

It is recommended that the board is cleaned with an isopropanol based cleaning agent.. Inspect the board carefully by looking for defects such as broken or dry solder joints, breaks in the conductor track and damaged or overheated components.
If the complete printed circuit board is to be replaced, unsolder the wire connections and obtain a new or serviceable replacement board.

Transfer the soldered wire connections to the replacement printed circuit board. Replace the “U” section extrusion around the slot in the cover.

Carefully locate the circuit board so that the connector protrudes through the slot.

Refit screws securing p.c.b.

Refit the cover assembly in position and tighten two screws.

Connect the fanning strip to connector and tighten up the terminal screws.

The fanning strip must be inserted with connecting lead wires up towards the top of the 500A. Refer to Fig 6.4.

Carry out the entire test procedure detailed in section 5 and on satisfactory completion of these tests, fit the front panel assembly back in the locating slot in the case bottom half. Fir the top case half and secure it with four socket cap screws, and tighten each with a hexagon key.

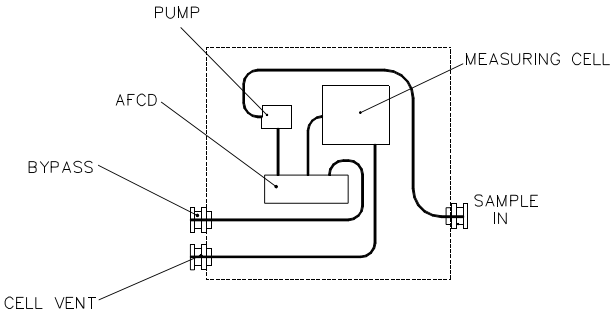


Figure 6.6 Sample Flow Diagram

NOTE : See Figure 6.2 and Table 2.1 for alternate connections of pump and automatic flow controller.

Section 7: Parts List

7.1 Introduction

Parts list for small volume sampling and flue gas sampling kits are given in section 8.
The parts lists are in tabular form.
The headings are

ITEM NUMBER	Identifies the Item on the exploded view. Item Numbers not illustrated are marked by an asterisk.
DESCRIPTION	The items are presented in the order in which they break down into subassemblies. Items indented to the right of an item are component parts of that preceding item.
ORDER NUMBER	This is the number to quote ordering when replacements, if available. If the order number is not shown, the part is no longer available.
QUANTITY	This is the quantity to make one only of the next higher assembly, and it is not necessarily the full quantity in the equipment.

Table 7.1
Available Spares List for Model B Analyser

Description	Order Number
Grommet Zero Adjust	00570449
PCB Digital Display	00570935
Catchpot Assembly (For 214 /706)	S0214905
Battery PCB, Recharge	S0570924
Rear Panel Assembly, Rechargeable	S0570961
Front Panel Assembly	S0570962
Fuse Kit	S0570984
Instruction Manual, 570 Model B	00570001B
Knob (Span 570A)	00570445
Automatic Flow Control Device	00570915
Pump Kit (Intrinsically Safe)	00570932
Spare Case Kit	00570981
Spare Filter Kit	00570982
Ancillaries Kit	00570990
Kit, R. Panel and Brey Pump, Recharge	00570992
Anhydrous Calcium Sulphate	1734-2524
Pump I.S 6V 570 / 731	2387-2628
Drier Assembly (For 214/706)	S0214904
Front Panel Assembly, 570A	00570460
LCD 3+1/2 Digit	2553-8513
Potentiometer 10 Turn 500R	2726-2803
Oxygen Transducer	00500000
Measuring Cell	00325000
Photocells	00500912
Power Supply Unit 117V with USA style moulded plug	00578701
Power Supply Unit 230V with UK style moulded plug	00578000
Power Supply Unit 230V with European style moulded plug	00578704
Power Supply Unit 100V	00578703
2.5mm Jack Socket	2534-1104
2.5mm Jack Plug	2535-9510

Section 8: OPTIONAL EXTRAS

8.1 578A Power Supply

See also Section 1.3.3.

The 578A is BASEEFA approved for connection to Model B instruments.

There are four variants of the power supply. 117VAC fitted with a US style moulded plug, 230VAC fitted with a UK style moulded plug, 230VAC fitted with a European style moulded plug, and 100VAC without a mains plug.

The power output is sufficient to continuously power the analyser and recharge the batteries, unless a pump is fitted.

The 578 is suitable for use with 230, 117 or 100V, ±15%, 48 to 62 Hz, AC mains supplies. Before use check that the supplied is connected for the correct mains supply, by reference to the identification label on the power supply. If necessary the voltage tapping may be adjusted by altering the position of a soldered link on the PCB inside the power supply. It is important that the correct value fuse is then fitted in accordance with table 8.1.

Specification

Size : 120 X 75 X 65mm
Input: 100,117 or 230V a.c. ±15%, 48-62 Hz, 20VA.
Output: 200mA ±10% constant current at 17V d.c. min.

Checking the Voltage Selector

Ensure that the Power Supply is not connected to any voltage source.

Undo the two screws on the outer case and remove the case half.

Remove the four screws holding the metal chassis to the remaining case half and remove the chassis from the case.

The soldered link is clearly visible on the PCB. A soldering iron is needed to change its setting.

Checking The Output
The output of the Power Supply can be checked by connecting the Power Supply to the main electrical supply and measuring the output current between the centre and outer connection of the 3.5mm jack plug.

This should be 200mA d.c. ±10%.

CAUTION
Do not leave the output shorted for more than one minute.

Component damage may occur if the output is left shorted.

Mains Input Fuse

A mains input fuse is incorporated on the PCB to protect the transformer. Should the fuse (F1) blow, it should be replaced in accordance with the following table.

TABLE 8.1
POWER SUPPLY FUSE VALUE

Type of Power Supply	Voltage	Type of Fuse Fitted
578A	100/117	125mA Anti -surge
578A	230	63mA Anti-surge

The fuse is accessed by separating the case halves.

8.2 Internal Sampling Pump

The pump is fitted along with a switch on the back panel of the instrument. The switch allows the pump to be turned on and off, but the pump will not operated unless the instrument is switched on. For installation details, see Fig 8.3

When the pump is used, the time between batter recharging is reduced from 25 hours to 12 hours approximately.

When the pump is fitted, the maximum sample pressure must be restricted to 13.8 kPa. (2 psig).

Specifications

Dimensions : The pump is totally enclosed within analyser casing, therefore it does not increase the overall dimensions.

Weight:	0.25 kg (0-55 lb)
Maximum Inlet pressure :	13.8 kPa (2psig)
Pump Type:	Rotary Vane
Minimum inlet pressure (Suction)	25mm Hg
Minimum Outlet flow from pump	350 ml/min
Typical Cell flow *	50 ml/min

* Adjustable on the Automatic Flow Control Device.

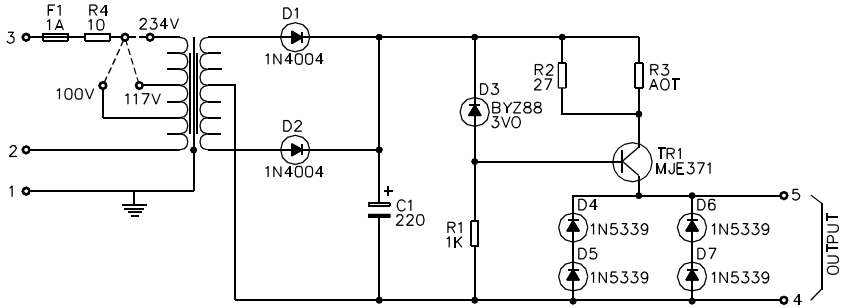


Figure 8.1
578 Power Supply Circuit Diagram

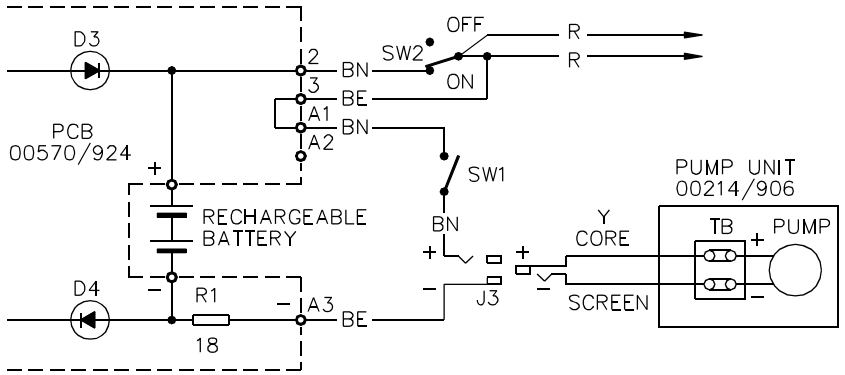


Figure 8.2
Flue Gas System Circuit Diagram

8.3 Portable Flue Gas Sampling System (214/706)

8.3.1 Introduction

The system permits the monitoring of the oxygen content of a flue gas sample either on a spot check basis, when close control of boiler efficiency is not required, or for carrying out boiler performance surveys. The system is designed to be fitted to Servomex 570A oxygen analysers which have the rechargeable battery option.

WARNING

Analysers modified to take the flue gas sampling system are not BASEEFA certified, even if the system is not connected.

8.3.2 Description

The kit consists of a separator with a removable drain plug, a filter, a pump and a drying tube charged with anhydrous calcium sulphate. These components are mounted on a panel which is attached to the analyser on the right hand side when viewed from the front. The pump is controlled by a switch on the back of the analyser.

8.3.3 Specification

Response Time:	Typically 45-50 seconds to 90% of the final reading.
Sample Temperature:	Within 10°C of ambient temperature for maximum instrument life and efficiency.
Battery Life:	In excess of 8 hours when commencing operation from fully charged batteries
Drying Agent:	Non-indicating anhydrous calcium sulphate.
Safety:	The system is suitable for use in non-hazardous areas only. Note: The use of this kit invalidates any Intrinsically Safe Certification offered with the analyser.

8.3.4 Operating Instructions

After performing a calibration as described in Section 3.3 the instrument is ready for use.

Proceed as follows:-

(i) Connect the viton tube from the top of the drying tube to the sample inlet on the front of the analyser.

(ii) Insert the jack plug into the upper of the two sockets on the back of the analyser.

(iii) Insert a probe into the flue (see Note 1).

(iv) Connect a tube between the probe and the inlet to the flue gas sampling system - located at the top of the catchpot towards the rear of the system.
(v) Switch on the analyser and the pump.
(vi) After a short time, depending on the D.V. lag of the sample line, the analyser will display the oxygen content of the sample gas.

Remove the jack plug from the socket on the rear panel when not in use to avoid accidental damage.

Note 1: The location of the sample point in the flue is very important. It must be positioned so that the sample it measures is representative of the boiler combustion products. Normally the best results are obtained with the sample intake as close to the centre of the duct as possible. A sampling point too close to the flue wall may not provide a representative sample because of the stratification of the flue gas or leaks in the duct.

If the flue gas sample is very dirty it is advisable to use the catchpot as a bubbler by filling it with water to a point just above the bottom of the inlet dip-leg.

8.3.5 Maintenance

The only routine maintenance required is:
(i) Draining the catchpot when necessary.
(ii) Replacing or regenerating the drying agent **weekly**.
(iii) Cleaning or replacing the filter.

Note: The drying agent can be regenerated by heating to 200-200°C in an oven for 24 hours. It will withstand in excess of 100 regenerations.

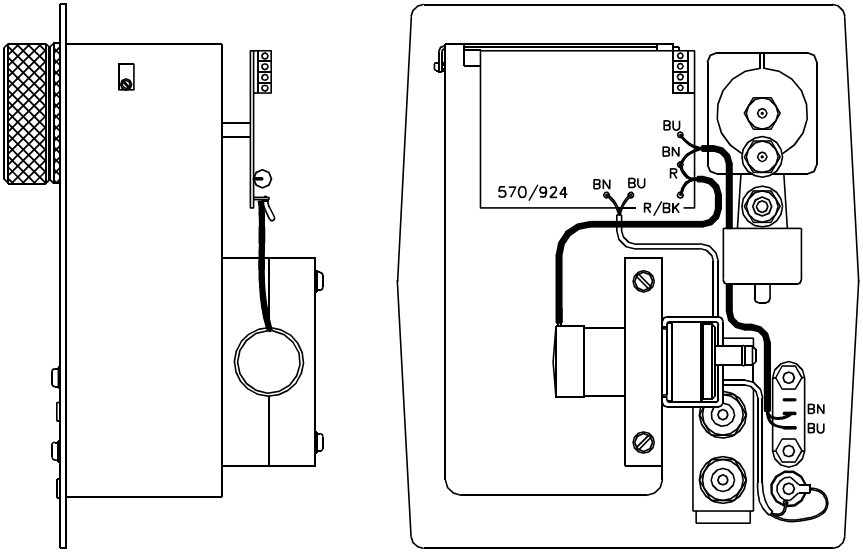


Figure 8.3
Installation Details, Internal Pump

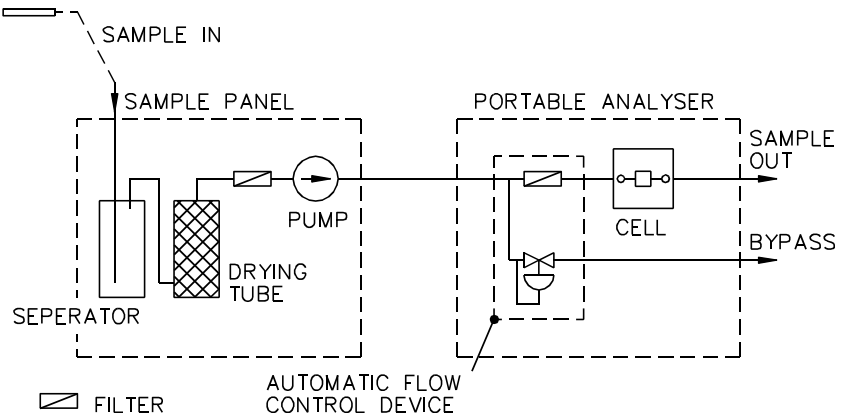


Figure 8.4
Flue Gas System Schematic

Section 9: Appendix 1

BASEEFA Certificates

The following pages are copies of BASEEFA certificates covering the 570A Oxygen analyser, and the 578A Power Supply.

Note: Since these certificates were issued the company changed its name to Servomex Group Ltd.