micromeritics®

SediGraph® III 5120

Service Manual

March 2010

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1. GENERAL INFORMATION

This service manual contains information and instructions for providing instrument service on the Micromeritics SediGraph III 5120 and is intended for use by Micromeritics' factory-trained and supported service personnel.

Organization of the manual

The service manual is organized as follows:

Chapter 1 **GENERAL INFORMATION**

Provides general information about the service manual and its contents.

Chapter 2 **FUNCTIONAL DESCRIPTION**

Provides a functional description of analyzer components.

Chapter 3 **ANALYSIS SEQUENCE**

Provides a description of the analysis sequence.

Chapter 4 **PREINSTALLATION**

Provides Preinstallation requirements and checklist.

Chapter 5 **INSTALLATION**

Provides Installation Instructions.

Chapter 6 **OPERATOR TRAINING**

Provides a checklist for training operators on the use of the SediGraph analyzer.

Chapter 7 **MAINTENANCE DOCUMENTS**

Provides scheduled maintenance documents.

Chapter 8 **CALIBRATION PROCEDURE**

Provides a copy of the Factory Calibration Procedure.

Chapter 9 **MECHANICAL AND ELECTRICAL DRAWINGS**

Contains mechanical and electrical drawings.

Chapter 10 **SERVICE PARTS**

Contains a list of service replacement parts.

Chapter 11 **SOFTWARE**

Provides access to the SediGraph III 5120 demo software.

Chapter 12 **OPERATOR'S MANUAL**

Provides links to current versions of the operator manuals.

Chapter 13 **SERVICE TRAINING**

Provides a syllabus for training service personnel.

Using This Manual

This manual is most efficiently used from the Micromeritics web site. However, it can be downloaded to a portable media device, such as a CD or a USB stick.

Conventions

This manual uses the symbols shown below to identify notes of importance, warnings, and cautions:

Notes contain important information pertinent to the subject matter.

Warnings contain information that help you prevent actions that may cause personal injury.

Cautions contain information that help you prevent actions that may damage the analyzer.

2. FUNCTIONAL DESCRIPTION

The Functional Description describes the systems and components that comprise the SediGraph III 5120 System. It includes graphics showing the location of major systems, modules, and components, as well as functional descriptions.

Equipment Description

The SediGraph III 5120 analyzes particle sizes utilizing gravity induced sedimentation. With this method, particle sizes are determined by knowing the falling rates of particles in liquid with known density, temperature and viscosity properties.

The SediGraph III 5120 uses operator input for these parameters to perform an analysis and produce reports:

- Sample density
- Liquid viscosity and density
- Starting and ending diameter
- Type of analysis: High speed, Standard or High Resolution
- Choice of stopping at a certain mass percentage
- Report options

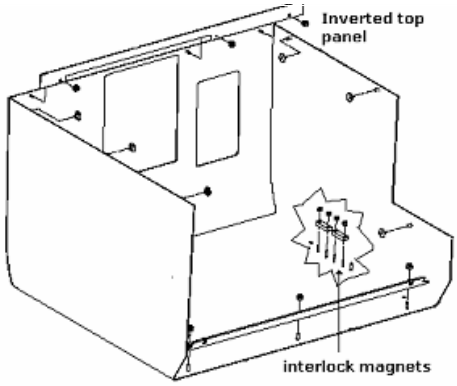
See section Chapter 3, The Analysis Sequence, for more detailed information.

The SediGraph III 5120 system consists of the cabinetry, Fluid Control module, Analysis module, X-ray generation, X-ray detection, data collection, and a computer for data reduction and reporting.

Cabinetry

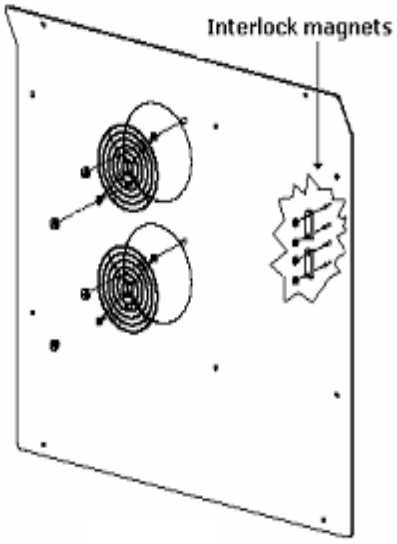
The cabinetry used for the SediGraph III 5120 provides the mounting structure for the fluid module, Analysis module, power supplies, card cage, air flow control, flood control, cabinet interlocks and all interconnecting cables for these assemblies. These assemblies can be further broken down into the following components.

Top Panel



The top panel is removable. There are two magnetic interlocks located under the panel on the side rail.These interlocks require the use of an interlock defeat tool (PN 512/25850/00) to allow generation of X-rays when the top panel is off. The Analysis module and the control and display panel (key-switch, X-ray status lamps and Pump kill) are accessible through the top panel.

Rear Panel

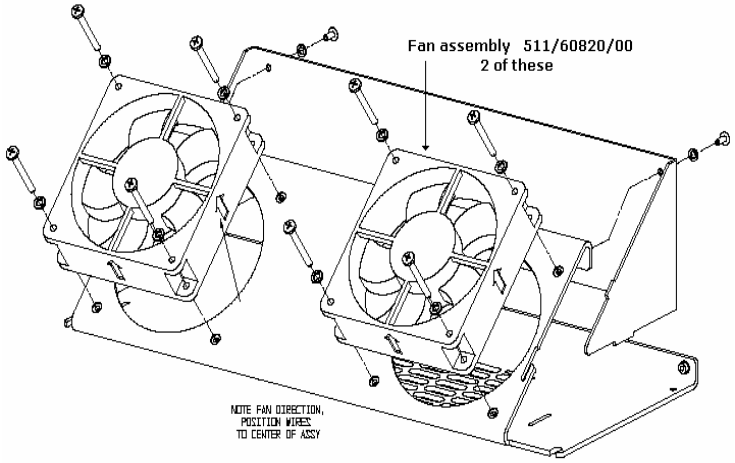


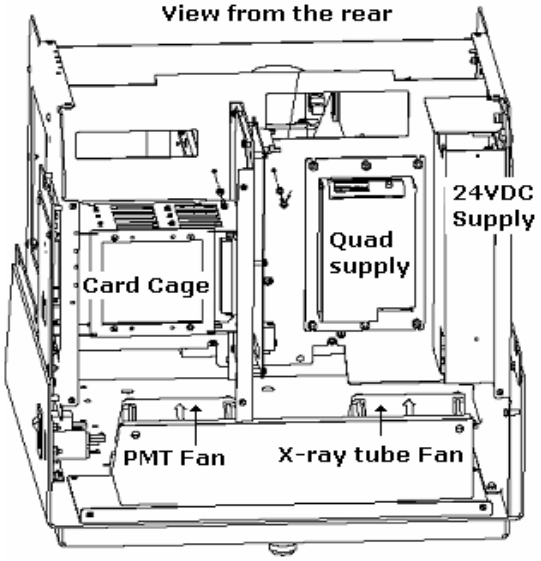
The rear panel is a removable panel which allows access to the 24VDC and the Quad switching power supplies used in the instrument. There are cut-outs in this panel to allow air flow out of the instrument.

Cooling air is drawn into the instrument from two fan assemblies on the bottom, passed over the internal components, and vented to the outside through the rear panel. The X-ray tube cooling fan has an aluminum deflector which forces air across the tube for extra cooling capability. There are sensors to alert the operator if a fan has lost 30% of its power.

Fluid Module Cover

A cover houses the fluid module and the mixing chamber, and helps with noise abatement.

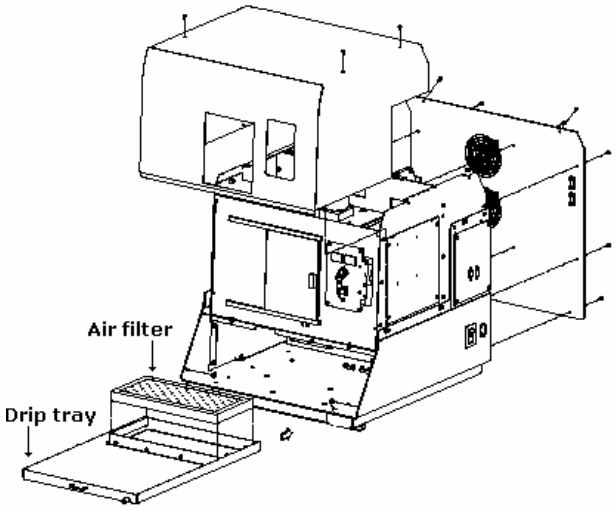




Drip Tray and Filter Assembly

A drip tray assembly (PN 512/25890/00) is located directly beneath the Fluid Control module. The tray has a handle, which allows an operator to pull the tray assembly out of the instrument. The tray is used for collection and removal of sample spills. There is a port in the front of the tray to which overflow tubing is connected.

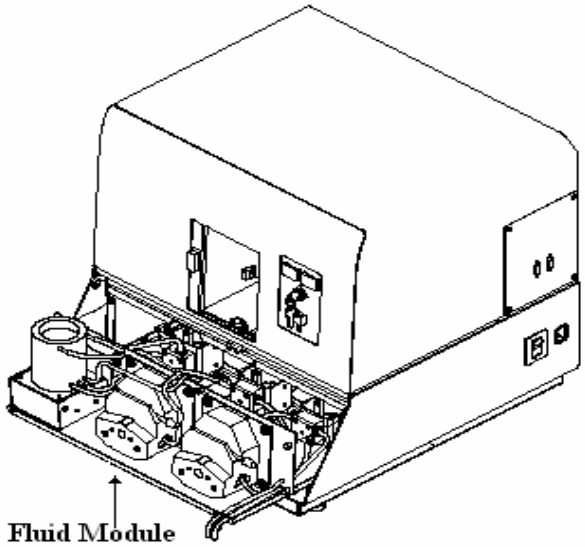
The tray contains a filter assembly (PN 512/27600/xx), which filters the incoming air used to cool the instrument. There are three filters available depending on air pressure.



Cabinetry Serviceable items

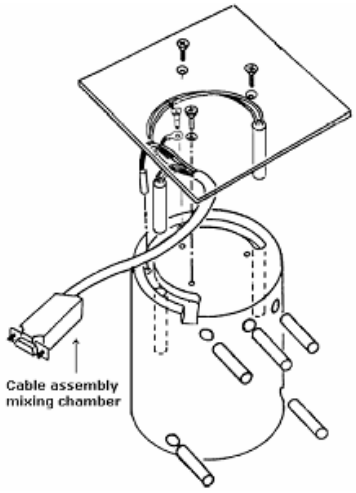
- 511/60820/00 Assembly 24 volt fan (two of these)
- 512/27600/01 Filter, Air 10 PPI
  or
- 512/27600/02 Filter, Air 25 PPI
  or
- 512/27600/01 Filter, Air 45 PPI
- 003/51170/02 Magnetic switch

Fluid module



The purpose of the fluid module (PN 512/34006/00) is to control the flow of fluid into and out of the instrument for rinsing and cleaning, and to load and circulate sample material. It is located in the lower part of the instrument behind the fluid module cover and consists of the following components.

Mixing Chamber



The mixing chamber is located under the fluid module cover, on the left side of the instrument. The chamber allows circulation of fluid through the pumps, valves and up to the sample cell assembly. The chamber also houses an RTD and a heater cartridge for temperature control.

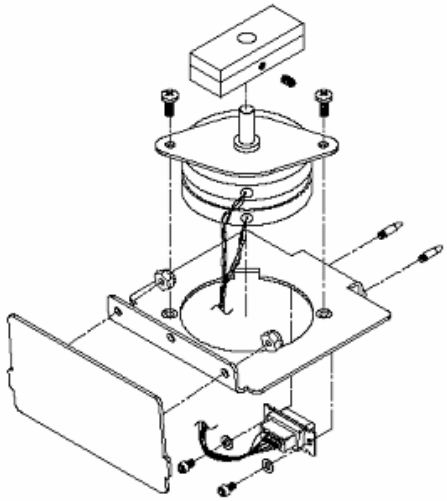
There are four chambers available.

- 511/25870/00 (standard chamber) is an aluminum large bore chamber.
- 511/25870/02 is a stainless steel large bore chamber used when high pH levels or caustic materials are present.
- 511/25875/00 is an aluminum small bore chamber.
- 511/25875/02 is a stainless steel small bore chamber used when high pH levels or caustic materials are present.

A cable assembly (PN 510/60817/00) is embedded in the wall of each type of mixing chamber. This cable has two heater cartridges and an RTD. The cable is the only serviceable part of the mixing chamber.

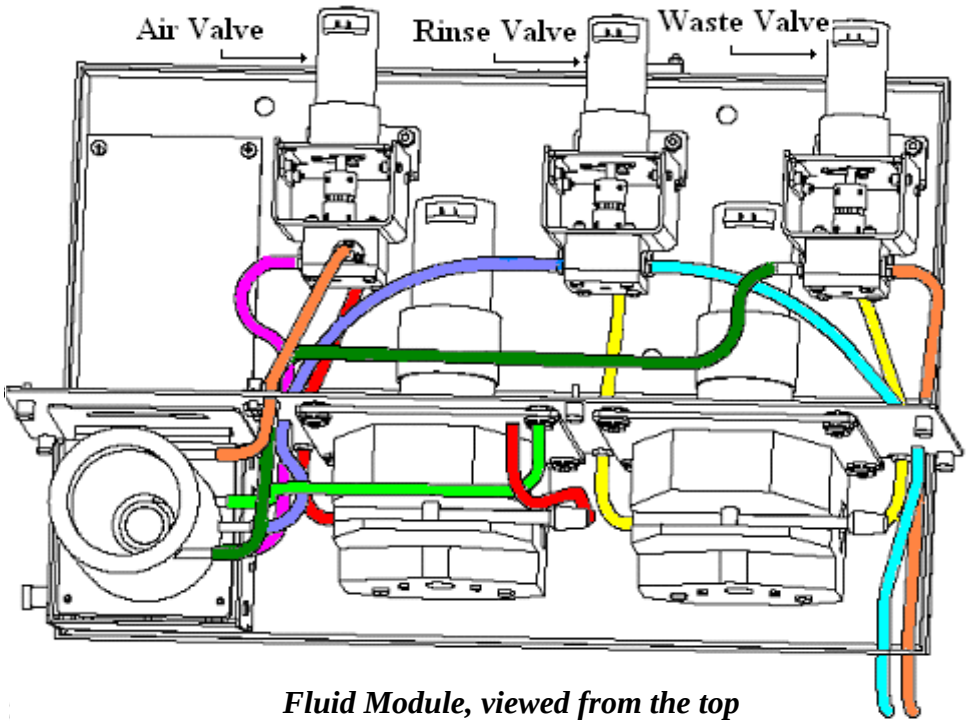
There are future plans to offer an optional module which will act like the older predecessor to the 5100. A module with one pump is planned in the future (like a 5000 manually-operated instrument). The 5120 will see this due to two bits being used in the cable to decode which type of chamber is present.

Magnetic Stirrer Assembly



A magnetic stirrer assembly (PN 512/34005/00) is located directly beneath the mixing chamber. It includes a stepper motor with a magnet attached to the output shaft. This assembly stirs the fluid to keep particles from settling during an analysis.

There is an interconnect PCB (PN 512/17709/011) located directly behind the stirrer assembly that allows connection of the mixer chamber, magnetic stirrer, all valves, and pump motors at the back side of the magnetic stirrer mechanism. These signals pass through this PCB with no manipulation.

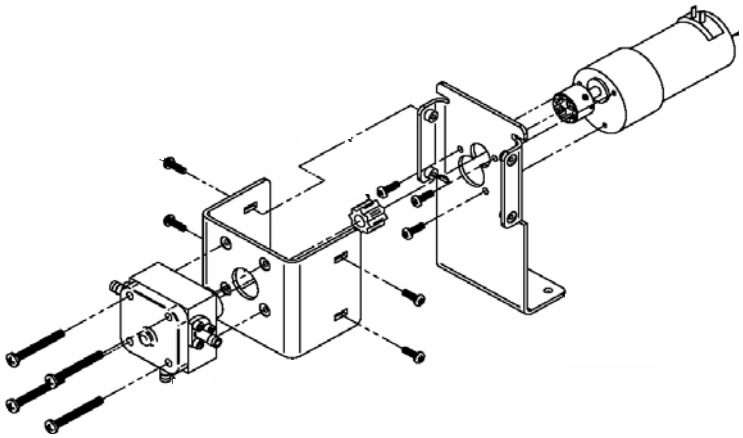


Fluid Module, viewed from the top

Valve Assemblies

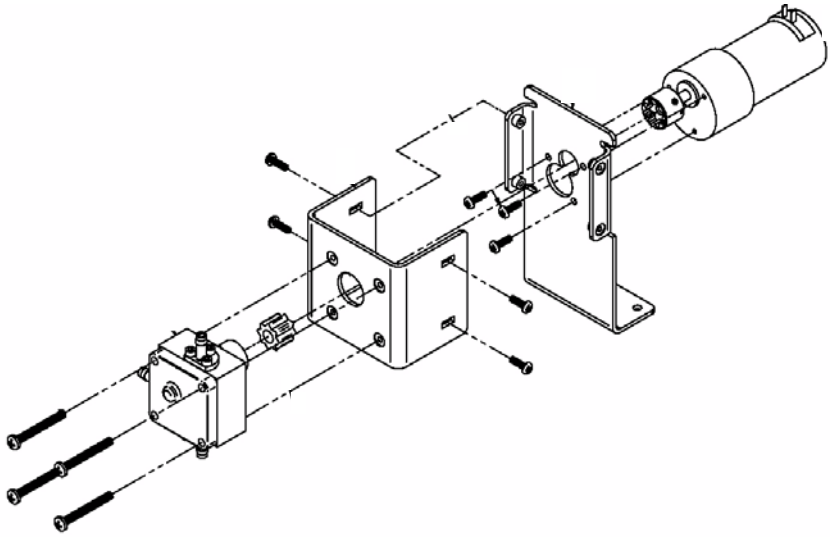
Located in the rear of the fluid module, the valve/motor assemblies are used to control the direction and routing of flow through the instrument. They are used in all automatic operations.

Waste & Rinse Valve



Waste and rinse valves (PN 512/34011/00) are located on the right hand side of the rear of the fluid module. These two valves are identical in construction and are interchangeable. The waste valve (far right looking into the fluid module) controls the flow to the waste receptacle or it closes to provide a closed system of flow. The rinse valve (middle valve when looking into the fluid module) operates to allow flow in from the rinse container and shuts off after a pre-determined time.

Air Valve



The air valve (PN 512/34012/00) is located on the left hand side of the rear of the fluid module. This valve is unique and cannot be used in another valve position. This valve is used during a rinse operation, or to help rid the cell of bubbles during a fill operation, or whenever the instrument determines there are bubbles in the sample.

Fluid pumps

There are two pumps used in the 5120, both are located at the front of the fluid module. Both pumps have EZ Load pump heads (PN 512/62800/00) and pump motors (PN 511/25889/00). Both pump head assemblies are attached to mounts which have vibration dampening grommets (to help cut down on vibration and noise).

Cell pump

This pump (PN 512/62800/00) controls flow (speed and direction) through the cell assembly. This pump is also used when 100% (full scale) runs are made before a sample is run. Loading, emptying and rinsing of the cell assembly all are accomplished using the cell pump. The flow rates of the cell pump are below: The tolerance of all of these speeds is ±10%.

- Speed 1 – 75ml/min
- Speed 2 – 138ml/min
- Speed 3 – 224ml/min
- Speed 4 – 275ml/min
- Speed 5 – 324ml/min

The cell pump motor (PN 511/25889/00) is directly behind the cell pump head and is coupled to the pump head by a small sleeve on the motor’s output shaft.

Mixer pump

The mixer pump (PN 512/62800/00) circulates the fluid left in the system after the cell has been loaded and the cell pump shuts off. The flow rate of the mixer pump is below: The tolerance of the speed is ±10%.

- 205ml/min

The mixer pump motor (PN 511/25889/00) is directly behind the mixer pump head and is coupled to the pump head by a small sleeve on the motor’s output shaft.

Fluid Module Serviceable items

Mixing Chamber

511/25870/00 Aluminum, (Standard) large bore

511/25870/02 Stainless Steel, for high PH or caustics, large bore

511/25875/00 Aluminum, small bore tubing

511/25875/02 Stainless Steel, for high PH or caustics, small bore

510/60817/00 Cable assembly

Valve assemblies

512/34011/00 Waste and rinse valve assemblies (complete assembly)

512/34012/00 Air valve assembly (complete assembly)

512/60837/00 Assembly, cable valve (motor and coupling)

Pumps/Stirrer

512/62800/00 EZ Load pump head

511/25889/00 Pump motor

512/34005/00 Assembly, Magnetic Stirrer

Card Cage and PCBs

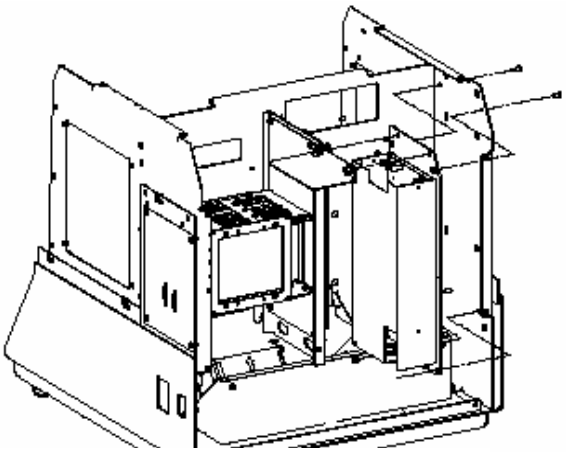
The card cage is located inside of the cabinetry and is used to hold the cards and backplane PCBs in a central location. It has all of the interconnections needed to interface to the instrument and the operating computer.

The following is a listing of the PCBs used in the 5120 and their main purpose.

512/17701/011, Backplane PCB

The Backplane PCB's main purpose is to provide a connection point for the three PCBs resident in the card cage and the signals needed for operation of the instrument. The PCB features the following:

- MICBus interface for 3-card slot cage w/slot ID encoding.
- Board ID EEPROM with instrument ID
- System Configuration ID
- Enable jumper for I^2C Write protect signal
- i386 CPU board interface w/1600 pin DIN connector
- I/O & Control Interface w/96 pin DIN connector
- Cell Stepper PCB interface w/96 pin DIN connector
- Interface connectors for remote Fluid Control PCB
- Connector for front panel LED
- Surface mount design, except for thru-hole connectors



Top Cover Removed - Showing Card Cage

300/17700/011, i386EX CPU PCB

The i386EX CPU card features the i386EX chipset, 128kBytes of NVRAM (Non Volatile Random Access Memory), DRAM (Dynamic Random Access Memory) of up to 32MB with a SIMM socket, 16MB of Boot Block Flash with BIOS configuration, Boot selectable PCMCIA on board Flash, Watchdog timer interfaces with the SediGraph 5120 with a 160 pin DIN connector. The PCB features the following:

- This PCB controls the action of the SediGraph, generates its own clock and clocking signals as required for proper operation.
- There is one eight-bit parallel port printer interface at the backplane connector. In the SediGraph this port is not used.
- The 128kB of NVRAM will have a lifespan of greater than 10 years even with no power applied.
- There is a buzzer for notification of an error should one occur.
- There is a reset switch on this PCB, which will reset the CPU and the MICBUS when pressed. The reset switch is normally not accessible.

512/17702/011 I/O & Control PCB

The I/O & Control PCB allows connection of the 5120 to a computer, provides interfacing connectors for the instrument, and monitors critical functions of the 5120. The PCB features the following:

- An RS232 connector and a 9-pin connector on the edge of the PCB, addressed as Com2.
- X-ray & Photomultiplier tube interface - the PCB has four independent 1,000,000 count A/D channels used to monitor X-ray current, X-ray voltage, Photomultiplier voltage and the temperature. The PCB has a 2MHz clock to run the V/F converters on the PCB, monitors the Key-switch position, reports this position to software, monitors the interlock circuitry (Door, key-switch, top panel and the X-ray ON LED condition) This board latches into X-Ray OFF mode whenever the top panel is removed or when there is an over current condition of the X-ray tube. Both of these conditions require the operator to turn the key-switch Off and back On to generate X-rays.
- Period Averager interface - performs the period averaging function for both the Kilo-counts and the temperature conversions needed for proper operation.
- Fan monitor - there is a fan monitor bit for each fan to determine when the fan’s speed has fallen below a set threshold. When a fan’s speed gets below approximately 30% of the rated speed, an error message is generated to alert the operator to the problem.

- The Fluid Control interface has circuitry to control the three valves and two pumps in the Fluid module. The cell pump has an On/Off and direction bit. The cell has speed control through a 12 bit DAC. The Mixing pump, waste valve, rinse valve and the air valve have an On/Off bit. There is also a Status bit which reads the status of the pump kill switch.
- Board ID EEPROM with I^2C interface - this EEPROM is used to hold the board identification and configuration information.
- MICBus interface - to connect the PCB with the rest of the instrument.
- Surface mount design, except for thru-hole connectors.

512/17703/011 Stepper & Heater Control PCB

This PCB controls the generation of stepper pulses and direction, handles heater control and readings of the RTD, determines type of magnetic stirrer used, and monitors the status of the cell limit switches. The stepper and heater control PCB features:

- 2X stepper motor control w/L297, L298N and L6210 chipset for speed, direction and motor drivers. This board has two stepper motor channels to drive and control the cell stepper and the mixer stepper motors. The cell stepper operates from 0 to 500RPM, while the stirrer motor operates from 0 to 1000RPM. The cell stepper also has a direction bit for Up/Down operation.
- 2X Heater control and drivers 4A @ 24VDC. Heater drivers are controlled by two independent hardware control circuits. These read the RTD outputs to provide a control loop. The temperature for each circuit is compared to the provided set-point. If the temperature is out of range, an error signal is generated and the PWM output for each heater driver is adjusted. This signal is a 24VDC PWM signal @ approximately 200Hz.
- 2X RTD temperature channels w/ADC for software reading. Two interfaces are provided for the 2-wire 1000Ω RTDs used in this system. The temperature measurement range is 0 to 60°C. The signals are buffered and amplified then fed to a V to F converter for generation of either the mixing chamber temperature or Analysis module temperature.
- Mixing Chamber interface. The PCB will be able to determine the type of mixing chamber used by the 2 ID bits.

- 2X Logic level inputs (for cell limit switches). There are two logic level (+5VDC) inputs Up/Down. These are active Low signals. A Low signal (from either switch) stops cell movement in the associated direction. There is also an LED for each direction. The LED is lit when the associated switch is active.
- Status LEDs: for motors, heaters and limit switches
- Board ID EEPROM with I^2C interface, this EEPROM is used to hold the board identification and configuration information.
- MICBus interface to connect the PCB with the rest of the instrument.
- Surface mount design, except for thru-hole connectors.

512/17704/011 X-Ray/PMT Control PCB

This board will function the same as the 510/17720/01 PCB with the exception that all pots have been replaced with 12 bit DACs. The X-ray/PMT control PCB has the following features.

- No pots.
- A/D channels to monitor key voltages or current for troubleshooting. The voltages or current that can be monitored in the Service test mode include:
  - X-ray high voltage
  - X-ray current
  - Photo-Multiplier tube voltage
  - X-ray filament supply
- Board ID EEPROM with I^2C interface. This EEPROM is used to hold the board identification and configuration information.
- Surface mount design, except for thru-hole connectors, and specialized components.
- X-ray filament supply, a 5VDC switching regulator located on this PCB with the capability of being set for 8VDC.
- X-ray tube interface, DAC controlled at 13,600VDC and monitored as 0 to 5VDC corresponding to 1 to 15KVDC.
- PM Tube interface, DAC controlled at a voltage unique to a calibrated Photo-multiplier tubes voltage and monitored as 0 to 7.5VDC corresponding to 0 to 1500VDC.

512/17708/011 Fluid Control PCB

The Fluid Control PCB has the controls for the two pumps, three valves, magnetic stirrer and the mixer RTD. This PCB has the following features:

- There are two servo control 12-bit DACs and circuitry to control the pump speeds.
- There are three identical valve control circuits on the PCB. The valves have a relay for directional control and R/C network to provide the initial surge current to move a valve with a resistor to provide the holding current.
- Board ID EEPROM with I^2C interface, this EEPROM is used to hold the board identification and configuration information.
- Surface mount design, except for thru-hole connectors, and specialized components.

512/17709/011 Fluid Interconnect PCB

The Fluid Interconnect PCB is a cable interconnect board providing a single, convenient and reliable connection point for the electric assemblies in the Fluid Control module. It provides a direct slide-in connection to the stirrer module. The mixing chamber connector interfaces to the new Mixer ID signals. This PCB is mounted inside the 5120 near the mixing chamber.

Card Cage Serviceable items

512/17701/011 Backplane PCB (board that CPU, I/O Control and the Stepper and Heater PCB connects) integral part of the card cage

300/17700/011 i386 CPU PCB (first PCB from the right hand side)

512/17702/011 I/O and Control PCB (second PCB from the right hand side)

512/17703/011 Stepper & Heater Control PCB (third PCB from the right hand side)

512/17704/011 X-ray and PMT control PCB (located on the PMT side of the Analysis module)

512/17708/011 Fluid Control PCB (located on the back side of the card cage)

512/17709/011 Interconnect PCB (located in the fluid module; this is where the mixing chamber, valves and pumps connect)

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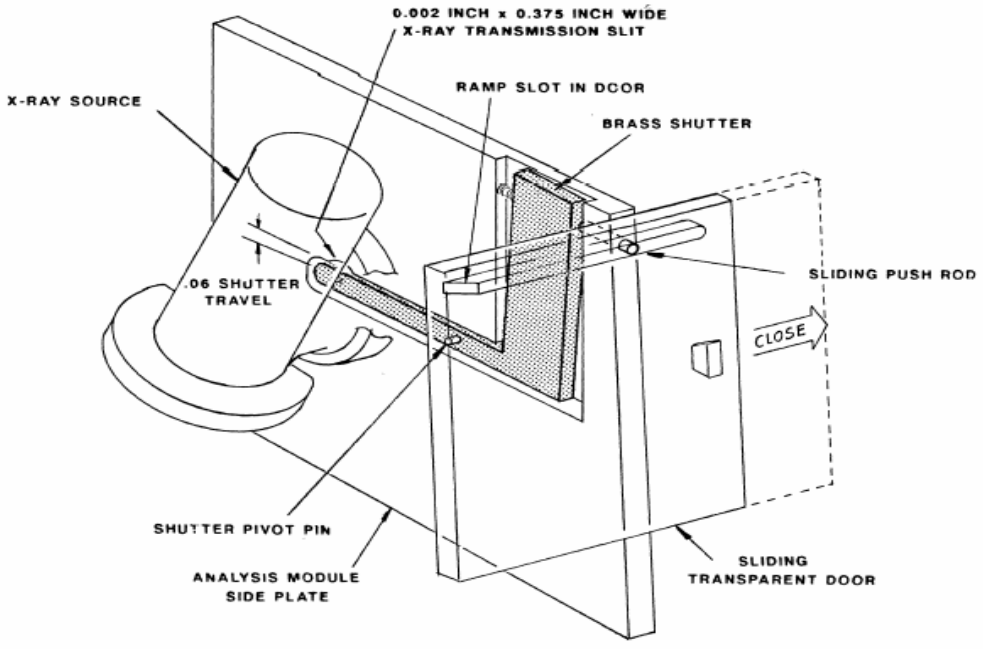
Interlock Circuitry

The interlock circuitry in the 5120 is very similar in operation to the 5100.

- Top panel switches - there are two top panel magnetic interlock switches which have been moved to the mid section of the right hand side panel of the 5120 (due to cabinet construction). Both of these switches must be on to generate X-rays. There is an interlock defeat tool similar to the 5100 top panel interlock defeat tool for use in servicing the 5120.
- There are also two magnetic switches on the rear panel, which have to be on to generate X-rays.
- A magnet (located on the Analysis module door) and reed door switch (located on the side panel of the Analysis module) form a series circuit that requires the door to be completely closed before X-rays are generated.
- There are two magnets located at the rear of the fluid module that form an X-ray interlock. For X-ray generation the fluid module must be installed in the instrument.
- The X-ray On/Standby lamps (PN 003/39046/00) form a series circuit and must be complete to generate X-rays. The X-ray On lamp must be operable and the key-switch must be cycled (Stand-by then back On) whenever an over-current occurs or the top panel has been removed. Either of these conditions will cause the Stand-by light to come on, and will not allow the generation of X-rays until the key-switch has been cycled. When the switch is ON, X-ray generation is allowed, when in the Stand-by position, X-rays cannot be generated.



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- The X-ray key-switch (located on the front panel) controls whether X-ray generation is allowed or not. When the switch is in the ON position X-rays can be generated, when the key-switch is OFF X-rays cannot be generated.
- The X-ray shutter assembly is operated by a push pin that rides in a plunge cut in the Analysis module door. One end of the plunge cut is not as deep as the other, which allows the push pin to open or close the mechanical shutter as the door's position is changed. The door must be completely closed to generate X-rays. There is a spring behind the shutter pin. If the shutter pin is lost, this spring will keep the shutter closed and not allow X-rays to be generated.

Interlock Serviceable Items

003/39041/00 Socket, Lamp

003/39046/00 Lamp, 28VDC

003/51149/00 Switch, keylock

003/51170/00 Magnet

003/51170/02 Magnet switch

004/28764/00 Spring Compression

510/25836/00 Pin, Shutter Interlock

512/60808/00 Cable, Dual magnetic switches

Analysis Module

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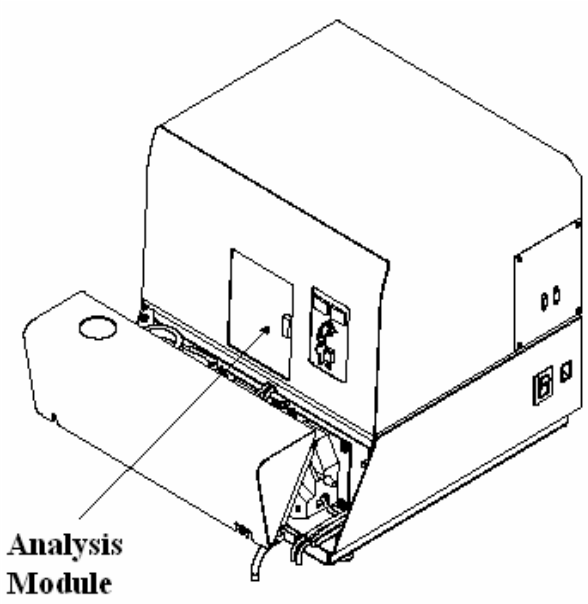
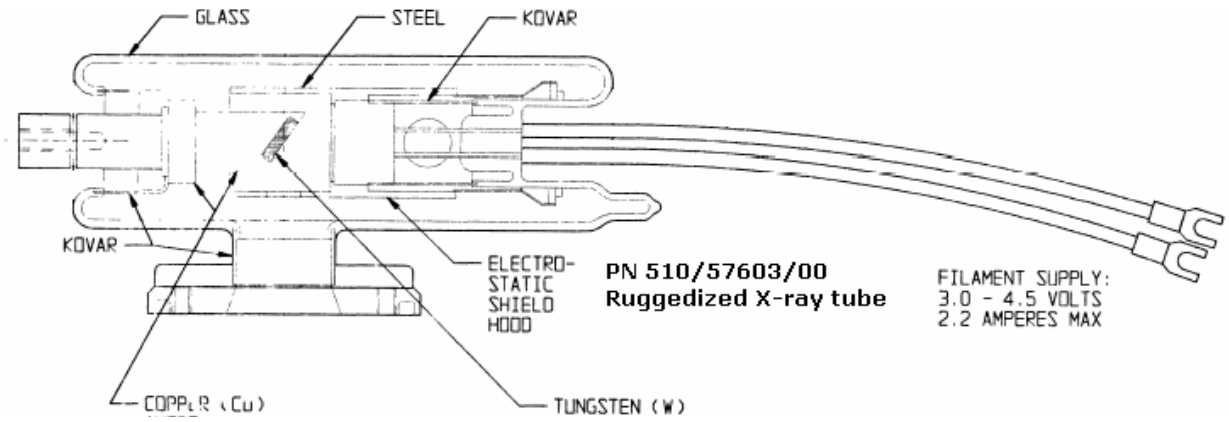


The Analysis module on the 5120 is basically the same Analysis module used for the 5100 with these exceptions: there is no stepper drive card on the top of the Analysis module assembly, and an updated (electronically) X-ray control board is used.

The 5120 was engineered using the same reliable safety features used in the 5100, providing protection against accidental exposure to high voltage or x-rays. The cabinet's color and the updating of the electronics are the biggest changes.

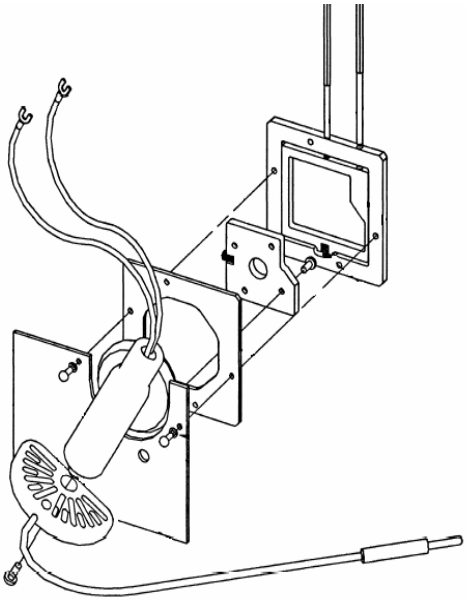
The Analysis module consists of:

- X-ray tube
- X-ray adjusters
- X-ray control PCB
- X-ray tube high voltage supply
- Collimator assembly
- Cell stepper motor
- Photo Multiplier tube
- Photo multiplier high voltage power supply
- Shutter pin
- Double clamp coupling
- Anti-backlash nut
- Heaters
- Fan assembly



X-ray tube

The X-ray tube (PN 510/57603/00) used in the SediGraph 5120 is the same type as that used on previous SediGraph models. It has the same potentials set for its use, 13,600 Volts for the high voltage accelerant and no more than 3 mA for current is set during calibration.

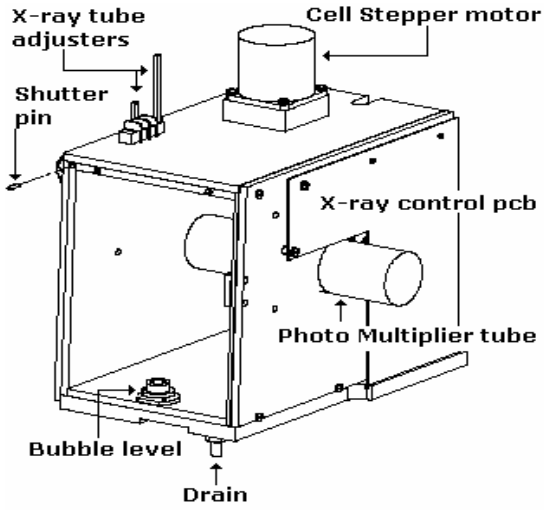


The x-ray adjusting system, method, and set up are the same as previous models. The springs (PN 004/25702/00) used in the alignment process are the same as the 5100. The system works with two alignment adjusters, which are threaded in a manner to cause the tube to move up/ down with one of the adjusters while the other adjuster moves the cell side to side.

The X-ray tube (PN 510/57603/00) and its floating mounting system are the same type as used in previous models.

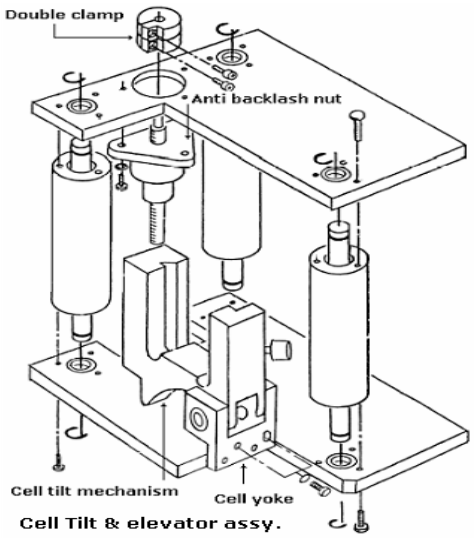
The high voltage is connected to the X-ray tube by a High Voltage cable (PN 510/60838/00).

Cell movement is accomplished by sending pulses to a stepper motor which is coupled to a drive screw, an anti-backlash device which moves the cell to the correct position for the operation in progress.



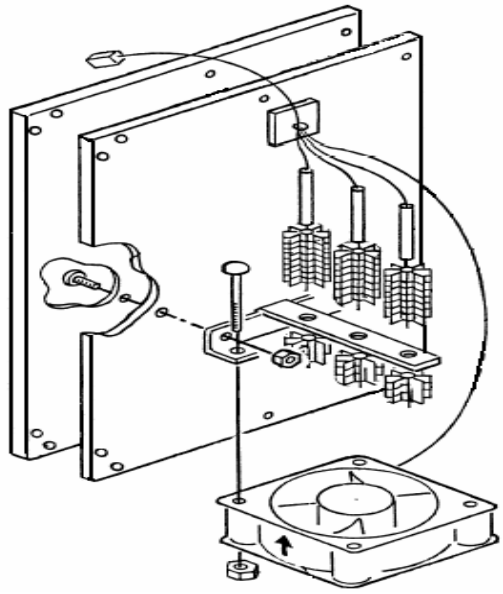
The cell stepper motor (PN 510/60829/00) has the same characteristics as the 5100 stepper motor - 1.8° per step delivered to the motor.

The anti-backlash nut (PN 511/25600/00) is designed to take up any misalignment of the drive mechanism. The spring keeps a constant tension on both sides of the threads it engages, this allows the cell assembly to start moving as soon as the first pulse is delivered.



The cell tip mechanism has a radius cut into the cell yoke holder that engages a stationary stud on the X-ray tube side of the Analysis module wall. This in turn tilts the cell out (around 45°) to facilitate filling and eliminating air bubbles in the cell assembly.

The calibrated PM tube's (PN 511/25894/01) high voltage must be set to match the calibrated voltage which is written on the tube.



The Analysis module rear panel heater and fan assembly (PN 510/34002/04 whole picture) is located at the rear of the Analysis module and contains three heaters and a fan assembly (PN 510/60830/00).

Analysis Module Serviceable items:

004/25702/00 Spring Compression

510/57603/00 X-ray tube

510/60829/00 Cable, Cell Stepper Motor

510/60830/00 Cable, Cell Compartment Heater, Fan

510/25836/00 Pin, Shutter Interlock

510/33615/00 Service Kit, Anode Cable assy.

511/25600/00 Anti-Backlash nut

511/25894/01 Assy. PMT, Calibrated

Power Supplies and Power Entrance

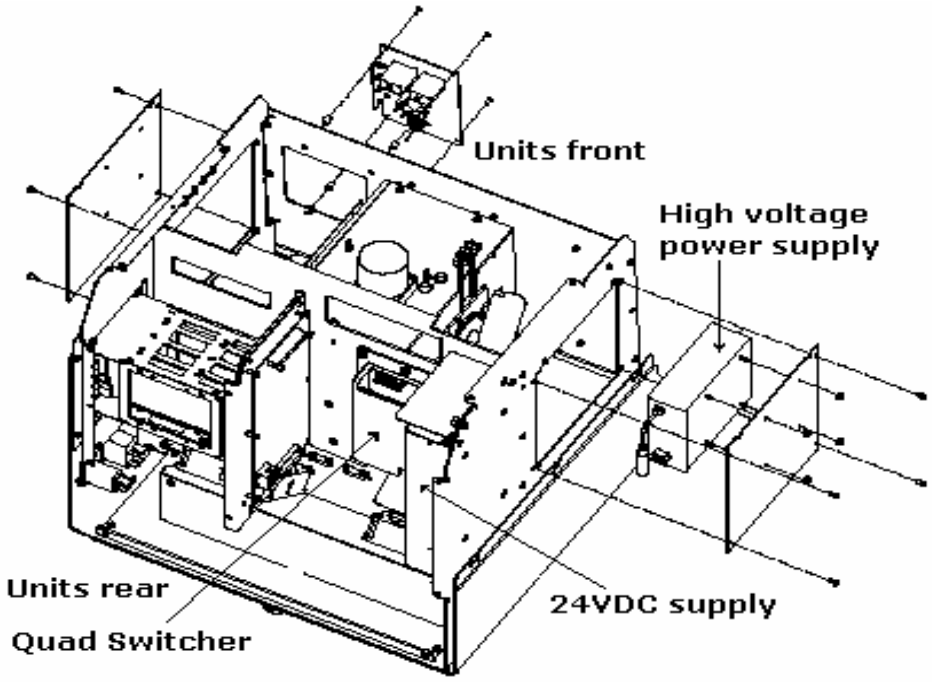
There are four power supplies used in the SediGraph:

- X-ray High Voltage
- Photo Multiplier Tube high voltage
- 24VDC
- Quad Switching power supply

Two of these supplies are located in the back of the instrument, behind the rear panel. The 24VDC supply is on the right hand side of the instrument, while the quad switcher is on the panel facing you when the rear panel is removed. The X-ray high voltage is located under the X-ray shield, which is mounted on a heat sink on the inner cabinetry. The Photo Multiplier Tubes supply is located on the X-ray control PCB.

Exercise extreme caution when measuring or setting the high voltage. Follow all safety precautions as voltage in excess of 13,000 volts DC is present.

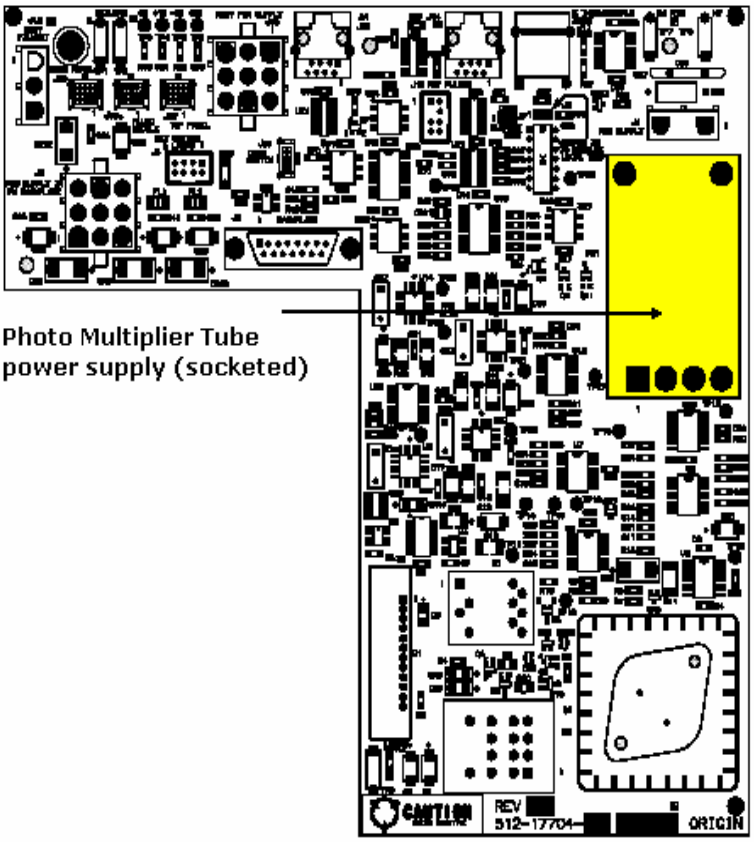
The high voltage (PN 003/40062/00) supply is used to operate the X-ray tube. This power supply is located under the top panel on the left side (looking from the front) under the X-ray shield. It provides the accelerating voltage for the X-ray tube and has sense lines feeding back to the X-ray control board, which are used to control the supply. The maximum output voltage is 15,000VDC. The voltage is set for an output of 13,600VDC.



Access to the high voltage supply is gained by removing the top panel, then removing the internal side mounting panel.

Quad switching power supply (PN 003/40002/00) supplies 5VDC, ± 15VDC and 24VDC. The 5VDC is used for the front panel Power Led, logic and enables while the ± 15VDC is used for the CMOS logic, the 24VDC output goes to the three fans in the instrument.

Access to the quad switcher is gained by removing the top panel then locating the supply in the rear of the instrument.



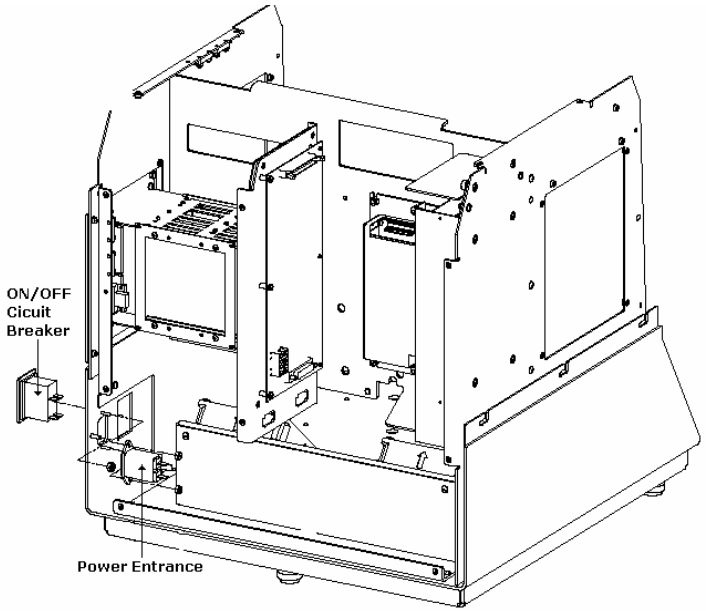
There is also a high voltage supply for the PMT supply (PN 003/40023/02) located on the X-ray control PCB. This supply powers the Photo Multiplier Tube and is internally controlled. Its output range is 700VDC to 1300 VDC, typically the final setting is around 1000Volts.

Access to the PMT high voltage supply is gained by removing the top panel, then removing the internal side mounting panel opposite the X-ray tube.

The 24VDC power supply (PN 003/40049/00) with universal input, is capable of 350 watts and supplies power to the X-ray tubes HI voltage power supply, PMT HI voltage supply, pump motors, valve assemblies, cell drive motor, key-switch lamps, instrument fans, RTDs and heaters, the fan in the Analysis module used for the heaters, and the stirrer motor.

Access to the 24VDC power supply is gained by removing the top panel, then locating the supply in the right side in the rear of the instrument.

Power (AC) is fed to the instrument through an IEC Power entrance rated at 250V and 10Amps.



Power is fed to the 24VDC power supply through a circuit breaker integral to the power switch; this switch/breaker is rated at 250V and 6Amps.

Power supplies and Serviceable Items

003/40023/02 Power Supply, 1.5HVDC, DC-DC, Reg.

003/40062/00 Power Supply, X-ray High Voltage

003/40049/00 Power Supply, 24VDC, 350W, Universal input

003/40002/00 Power Supply, Quad Switching, Universal input

003/51191/00 Circuit Breaker, 6A, 2 pole

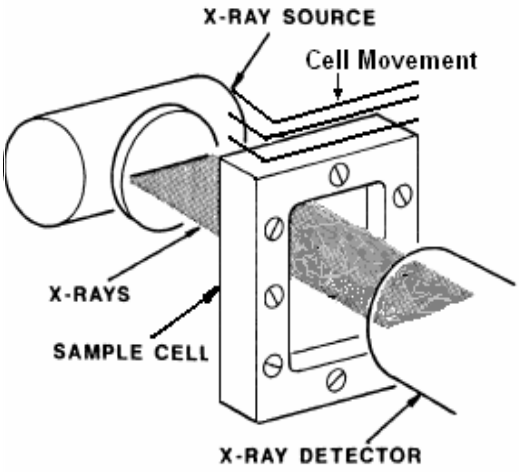
003/60822/02 Cable IEC, Power Inlet 10A, w MOV

3. ANALYSIS SEQUENCE

The SediGraph III 5120 analyzes particle sizes using the sedimentation method. In this method, particle sizes are determined by knowing the gravity induced falling rates of particles in liquid with known density, temperature and viscosity properties.

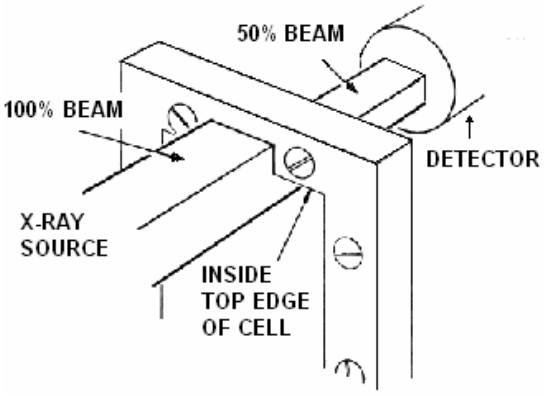
Before an analysis, the operator uses the SediGraph software to enter the sample density and starting/ending diameters for a particular analysis. The operator also enters the density and viscosity of the sedimentation liquid. This information can be entered in either of two ways. The operator can enter the density and viscosity at the current analysis temperature, or the operator can create a liquid properties table for the density and viscosity at a high, an intermediate, and a low temperature. When a liquid properties table is used, the analysis program calculates the density and viscosity of the sedimentation liquid at the current cell temperature by interpolating between the previously entered values.

0% Concentration Determination



Prior to the first run, a baseline value needs to be established. Pure, clean sedimentation liquid is used for this purpose. An analysis is started, the cell full of the sedimentation fluid is scanned and the maximum number of X-ray kilo-counts is detected and recorded at 220 data collection points. During this process, the SediGraph III 5120 passes a finely collimated X-ray beam through the transparent windows of the analysis cell to the photomultiplier detector as the cell moves vertically between them. At 220 data collection points, the X-ray intensity is recorded and a baseline value is calculated. The baseline value is for 0% concentration because the cell contains only the sedimentation liquid. These baseline values remain valid as long as there are no changes in the sedimentation liquid, the shape of the cell, or the X-ray intensity.

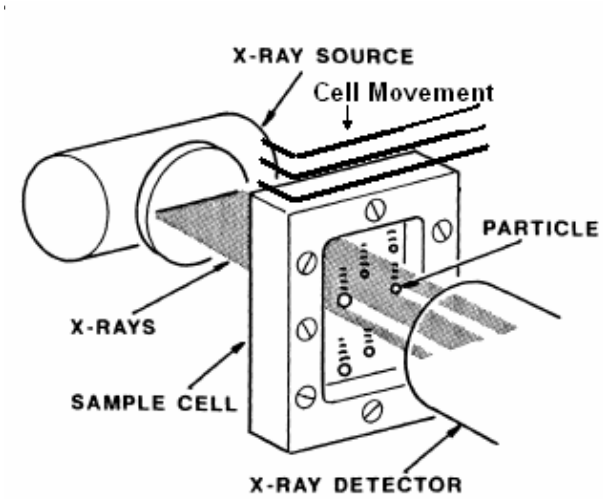
Beamsplit Determination



At the beginning of any automatic run, the SediGraph III 5120 determines the exact position of the top of the cell relative to the X-ray beam to establish a known starting point for the cell movement. The SediGraph establishes a known position of the cell by moving it to the point where the top edge of the cell splits the X-ray beam in half. This beamsplit data is stored in the SediGraph software for use in the analysis. A beamsplit is performed by the SediGraph for each analysis.

Immediately before an analysis, the operator disperses the sample in the sedimentation fluid. This dispersed sample and fluid mixture is added to the SediGraph mixing chamber where it is stirred to maintain dispersion and heated to the analysis temperature. At the appropriate time, the fluid is pumped into the analysis cell. The SediGraph maintains circulation through the cell to prevent sedimentation as a second scan determines the maximum (or full scale) concentration of the sample to fluid mixture.

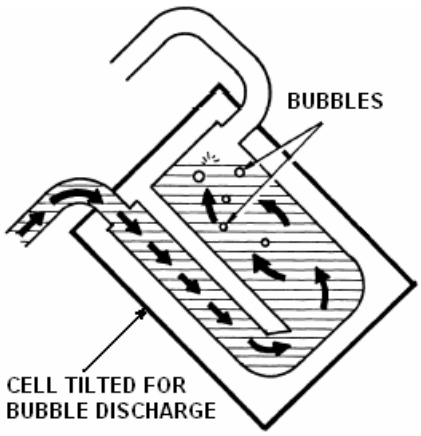
Full Scale Determination



Shown at the left is a sample cell full of sedimentation liquid and particles. The particles absorb some of the X-ray energy as it travels from the X-ray tube through the windows (and sample slurry) to the transparent window of the Photo-Multiplier tube. The actual change in absorbance with time is what the SediGraph uses in determining the particle size. To speed up the time required for a test, the SediGraph will move the cell assembly down looking at finer and finer particles.

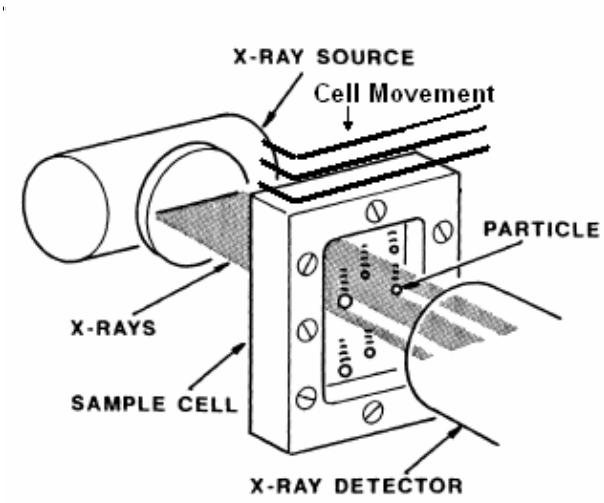
At the 220 data collection points, the X-ray intensity is recorded and a full-scale value is calculated. The full-scale value is used for 100% sample concentration because the cell contains suspended particles, representing the highest particle concentration for the analysis. These particles are not allowed to settle because the cell pump is running during the operation. For the top 2 mm of the cell, full scale values are extrapolated from the lower portion of the cell. This practice prevents any small variation in concentration of large particles at the top of the cell from affecting the accuracy of the analysis.

Bubble Determination



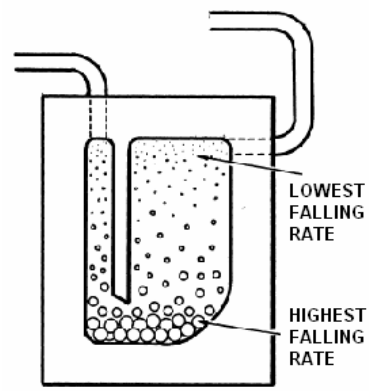
During the full-scale scan, the SediGraph III 5120 performs a bubble detection test. Because bubbles in the sedimentation liquid could affect the accuracy of the analysis, the pumping system attempts to remove any detected bubbles before the analysis proceeds. Shown for illustration is a “Small Bore” cell, most cells are the “Large Bore” configuration and the In/Out tubing is slightly different but, the operation is exactly the same.

Particle Size Analysis



After the full-scale concentration data have been collected, circulation of the sample/fluid mixture is stopped abruptly and sedimentation begins to occur. During sedimentation, the SediGraph III 5120 again passes the X-ray beam through the analysis cell taking absorbance readings at the 220 data collection points as in the 100 percent scan. An elevator moves the cell down during this sedimentation process to accelerate the data collection. The analysis program compensates for the movement of the cell when calculating the particle falling rates.

Particle Size by Sedimentation



As the sample particles fall, they absorb some of the X-rays and prevent them from reaching the detector. The X-ray intensity is recorded at each step in the cell movement. The analysis program collects data at up to 220 sedimentation heights based on the operator-specified starting and ending diameters for the particle analysis. The analysis program determines the target sedimentation heights and times based on the run type (High speed, Standard or High Resolution) and calculation of the particles' terminal velocities. The rate at which particles fall through the liquid is described by Stokes' Law. The largest particles fall at the fastest rate, while the smallest particles fall at the slowest rates, until all of the particles have settled and the liquid is clear.

Each collected intensity value is compared to the X-ray intensities at the corresponding heights for both the baseline and full-scale concentrations for the sample. The resulting percentage is used to determine the total particle mass at each point in the cell. The analysis program uses the percentage of particle mass and calculated particle falling rates to determine the maximum particle size for each point in the cell (particle distribution).

The analysis data is stored in the control module and can be displayed or printed in a variety of graphic and standard report formats. Because particles rarely exhibit a uniform shape, each particle is reported as an Equivalent Spherical Diameter (the diameter of a sphere of the same material with the same terminal velocity).

The SediGraph III 5120 is designed to provide analysis results which vary by no more than 2 mass percent among samples from a homogenous lot.

When the analysis is complete, the sample and fluid mixture is drained from the cell into the mixing chamber, and then the mixing chamber is drained into a waster reservoir. If the operator has selected the rinse option, a rinsing liquid is then drawn into the analyzer and the entire system is rinsed and drained. The rinse operation may be set to a specific number of cycles or to continue until the previously obtained baseline concentration is achieved. Rinsing always occurs when a MasterTech is used with the SediGraph III 5120.

4. PREINSTALLATION

This chapter contains the Preinstallation Instructions and Checklist for the SediGraph III 5120. This document helps to ensure that the customer has prepared the laboratory for installation of the instrument and that the supplies, equipment, and personnel are available for installation.

Double-click on the following link to access the preinstallation instructions and checklist.

Preinstallation Instructions and Checklist P/N: 512-42870-01.

5. INSTALLATION

This chapter contains the Installation Instructions and Checklist for the SediGraph III 5120.

Double-click on the following link to access the installation instructions and checklist.

- **Installation Instructions and Checklist** P/N: 512-42870-02

6. OPERATOR TRAINING

The Operator Training Checklist is used in conjunction with the operator's manual and software to train the person(s) who will be operating the analyzer. Click below to access the Operator Training Checklist.

- Operator Training Checklist**,** P/N: 512-42870-03.

7. MAINTENANCE DOCUMENTS

The documents listed below are included in Service PM kits, which may be purchased by the user for maintenance of his analyzer. Use of these PM plans also help to prolong the life of the analyzer.

- **Maintenance Schedule**, P/N: 512-42890-00
- **Scheduled Maintenance Checklist,** P/N: 512-42891-00
- **Scheduled Maintenance Instructions**, P/N: 512-42892-00
- **As-Found Datasheet**, P/N: 512-42893-00
- **Calibration Certificate**, P/N: 512-42894-00

8. CALIBRATION PROCEDURE

This chapter contains the calibration and test procedure used in Micromeritics' Final Assembly Department. It is provided as a reference so that you will be familiar with the calibration procedures and instrument tests that are performed on the instrument during manufacture.

The methods used at the factory may differ from the methods documented in Chapter 7, Maintenance Documents. Use the established service calibration and test procedure unless otherwise directed by a Micromeritics Service Managers or Service Specialist.

- **Product Calibration Procedure,** P/N: 512-34000-76.

9. MECHANICAL AND ELECTRICAL DRAWINGS

This section contains mechanical and electrical drawings for the SediGraph III 5120. These drawings show assemblies in great detail. Some parts listed in these prints may be available only as an assembly or in a kit.

Click on a drawing part number to view the drawing.

Do not provide copies of these drawings to a customer.

Mechanical

.

Part Number	Description
510-25800-00	Sample cell complete SB assembly
511-60829-00	Cable cell stepper motor assembly
511-25889-00	Pump motor assembly
511-25892-00	Cell SediGraph 0.156 tubes LB assembly
512-00000-20	Core unit LB
512-00020-20	Core unit SB
512-09801-04	Magnetic alignment tool
512-10300-00	Unpack & Installation instructions
512-14830-00	Bkt, switch magnetic
512-14838-00	Door 5120
512-25830-XX	Tube, large bore
512-25831-XX	Tube, small bore
512-25850-00	Magnetic by-pass assembly
512-25890-00	Drip-tray assembly
512-27600-XX	Air filter
512-32812-XX	Small bore tube set
512-32813-XX	Small bore pump tube replacement set
512-32820-XX	Air valve body
512-32821-XX	Air valve closure
512-34000-00	Semi final assembly

Part Number	Description
512-34001-00	Chassis assembly
512-34002-00	Card cage assembly
512-34003-02	Power supply 24V assembly
512-34003-01	Quad power supply assembly
512-34004-00	Analysis module assembly
512-34005-00	Magnetic stirrer assembly
512-34006-00	Fluid module assembly
512-34007-00	Analysis module PMT side
512-34010-00	Control and display assembly
512-34011-00	Rinse and waste valve assembly ptfe Large bore
512-34012-00	Air valve ptfe Large bore
512-34014-00	Large bore waste and rinse valve
512-34015-00	Large air valve
512-34016-00	Small air valve
512-34017-00	Small air valve assembly
512-34020-00	Small bore semi-final assembly
512-34801-00	Small bore fluid control assembly
512-60837-00	Valve motor assembly

Electrical

.

Part Number	Description
003-40062-00	Power inlet cable, 10AwMOVs
003-60822-02	Power inlet cable, 10AwMOVs
300-17700-011	1386EX cpu assembly
300-17700-511	1386EX cpu schematic
510-57603-00	X-ray tube ruggedized
511-60820-00	Assembly, 24 Volt fan
512-09800-00	Assembly, Calibrated standard temperature
512-17701-011	Backplane assembly
512-17701-511	Backplane schematic
512-17702-011	I/O & Control assembly
512-17703-011	Stepper & Heater assembly
512-17703-511	Stepper & Heater schematic
512-17704-011	X-Ray and PMT assembly
512-17704-511	X-Ray and PMT schematic
512-17708-011	Fluid control assembly
512-17708-511	Fluid control schematic
512-17709-011	Fluid interconnect assembly
512-17709-511	Fluid interconnect schematic
512-17750-011	Temperature calibration assembly
512-17750-511	Temperature calibration schematic
512-34003-01	Quad power supply
512-34003-02	Power supply, 24V, assembly
512-34005-00	Magnetic stirrer assembly
512-60801-00	Cable pump kill switch
512-60802-00	Cable, 24 VDC, AC in
512-60803-00	Lamps and keyswitch cable
512-60804-00	X-ray filament cable

Part Number	Description
512-60805-00	X-ray power supply
512-60806-00	10 Conductor 12-pin UML
512-60807-00	Magnetic door switch cable
512-60808-00	Magnetic switches assembly
512-60809-00	AC breaker to bulkhead cable
512-60810-00	24V PS DC Out
512-49001-54	Electrical block diagram

Archived Drawings

Part Number	Description
003-40052-00 rev-	High voltage power supply specification control
510-25800-00 revF	Sample sell complete SB assembly (Rev F)
511-60829-00 revH	Cable cell stepper motor assembly (Rev H)
511-25889-00 revE	Pump motor assembly (Rev E)
511-25892-00 rev-	Assembly, Cell SediGraph 0.156 tubes (Rev -)
512-00020-20 rev-	Core unit SB
512-10330-00 rev-	Unpack and Install Instructions
512-14838-00 rev-	5120 door
512-25830-00 rev-	Magnetic by-pass assembly
512-25831-XX rev-	Small bore tube
512-25890-00 rev-	Drip tray assembly
512-27600-00 rev-	Air filter(s)
512-32813-XX rev-	Small bore pump tube replacement
512-32820-XX reva	Large bore tube set
512-32821-XX reva	Large bore pump tube replacement set
512-32830-XX rev-	Large bore tube
512-34001-00 rev-	Chassis assembly

Part Number	Description
512-34002-00 rev-	Card cage assembly
512-34003-02 rev-	Power supply 24V assembly
512-34005-00 rev-	Magnetic stirrer assembly
512-34007-00 rev-	Analysis module PMT side
512-34008-00 revB	Waste-Rinse valve assembly
512-34009-00 RevB	Air valve assembly
512-34009-00 revA	Air valve assembly
512-34010-00 rev-	Control and display assembly
512-34800-00 rev-	Small bore air valve assembly
512-34801-00 rev-	Small bore fluid control assembly

10. SERVICE PARTS

PCBs

Part Number	Description
300/17700/011	MIC 386 CPU PCB
512/17701/011	Backplane PCB (power distribution)
512/17702/011	I/O & Control PCB
512/17703/011	Cell Stepper & Heater Control PCB (in Analysis module)
512/17704/011	X-Ray & PMT Control PCB
512/17708/011	Fluid Control PCB
512/17709/011	Interconnect PCB

Power

Part Number	Description
003/40069/00	Power supply, Hi-Voltage
003/40049/00	24VDC, 350W (Hot=Brown, Neutral = Blue, Ground = Green)
003/40051/00	Quad switcher
003/51191/00	Circuit Breaker 250VAC, 6A (power On)

Accessories & Other Parts

Part Number	Description
003/39046/00	Lamp28V, T 1-3/4 Wedge, GI #85
003/51050/00	Switch, Leaf activated, sub mini
003/51149/00	Switch, key-lock
003/51170/00	Magnet, switch (door & top panel)

Part Number	Description
004/25702/00	Spring, Compression
004/28184/00	Grommet, 5/8 x 9/32 x 1/8 x 3/8
004/28600/00	Foot, Leveling, ¼-20 x 5/8
200/60836/00	Assembly, 24 volt fan
500/39604/00	Lens cap w/legend, X-Ray On
500/39605/00	Lens cap w/legend, X-Ray Stand-By
510/09800/00	Tool, Yoke Leveling
510/09801/00	Tool, Collimator leveling
510/17711/75	Assembly, Cal Standard 5100 Temperature
510/25606/00	Level, Cell Compartment
510/25800/00	Assembly, Sample Cell .125 Tube (small bore)
510/25819/00	Coupling, Double clamp
510/25836/00	Pin, Shutter Interlock
510/25846/00	Cover, Mixing Chamber
510/25873/00	Block, Foam
510/25873/01	Block, Foam, Cell shipping
510/25873/02	Stopper, Foam, L8008 14-20mm diameter
510/25878/01	Absorber
510/25890/00	Clamp, small bore cell tubing
510/25896/00	Assembly, Cell Yoke & Pivot
510/25911/00	Spring, Cell Yoke
510/32801/01	Window, Cell set of 2
510/32804/01	Window, Cell Homalite, set of 2

Part Number	Description
510/33605/00	Accessory, Homalite Windows
510/33615/00	Service Kit, Anode Cable assembly
510/34009/00	Assembly, Yoke & Pivot
510/57603/00	X-Ray Tube, Ruggedized
510/60830/00	Cable, Cell Compartment heaters & fan
510/60838/00	Assembly, Cable, High Voltage X-Ray w/Anode heat sink
510/60839/00	Assembly, cell step limit switches
511/14838/00	Door, 5100
511/24801/00	Door, Knob
511/25600/00	Nut, Elevator Shaft & Backlash
511/25811/00	Collimator, Upper member
511/25866/00	Assembly,
511/25870/00	Assembly, Mixer Chamber, large bore
511/25870/02	Assembly, Mixer Chamber, SST, large bore
511/25871/01	Tube, Large Bore (rigid tubing)
511/25871/02	Tube, Large Bore (rigid tubing)
511/25873/00	Clamp
511/25875/00	Assembly, Mixing Chamber (small bore)
511/25875/02	Assembly, Mixing Chamber, SST, (small bore)
511/25889/00	Pump Motor Assembly
511/25892/00	Assembly, SediGraph cell, .156 tube (large bore)
511/25894/01	Assembly, Photomultiplier
511/60801/00	Assembly, Cable Compartment RTD

Part Number	Description
512/25830/01	Rigid Tube, Large Bore cell
512/25830/02	Rigid Tube, Large Bore cell
512/25831/01	Rigid Tube, Small Bore cell
512/25831/02	Rigid Tube, Small Bore cell
512/34005/00	Assembly Magnetic Stirrer
512/34008/00	Valve assembly (Waste & Rinse)
512/34009/00	Valve assembly (Air, different pinch set-up)

11. SOFTWARE

To view a demo version of the SediGraph III 5120 software, click below.

- **SediGraph III 5120 Demo Software**

12. OPERATOR'S MANUAL

This chapter contains the Operator's Manual for the SediGraph III 5120 system.

Double-click on the following link to access the Operator's Manual.

- **SediGraph III 5120 Operator's Manual**, part number 539-42801-01

13. SERVICE TRAINING

NOT AVAILABLE AT THIS TIME