Low Flow Sample Pump
222 Series

Operating Instructions

SKC Inc.
863 Valley View Road
Eighty Four, PA 15330 USA

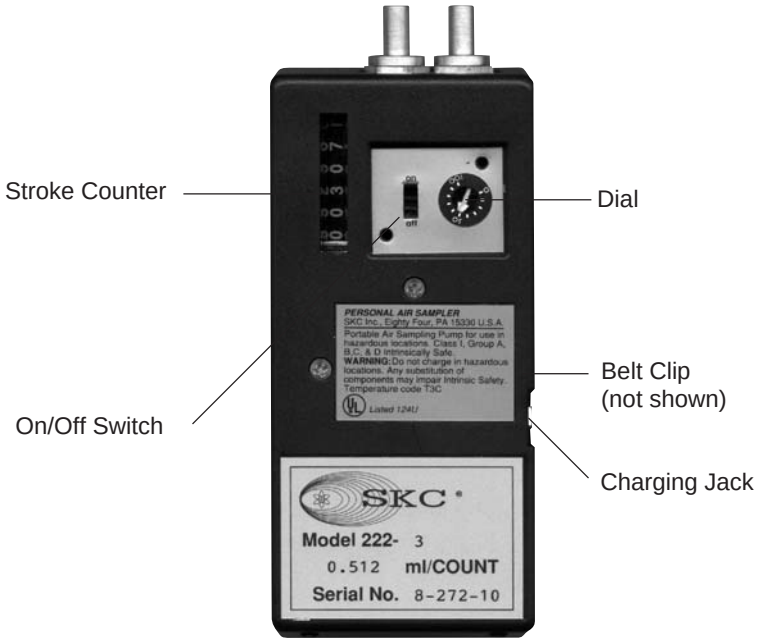
Form #3707—Rev 0606

Table of Contents

Notice: This operating instruction may not address all safety concerns (if any) associated with this product and its use. The user is responsible for determining and following the appropriate safety and health practices and regulatory limitations (if any) before using the product. The information contained in this document should not be construed as legal advice, opinion, or as a final authority on legal or regulatory procedures.

Description

SKC 222 Series Low Flow Pumps are miniature diaphragm-type pumps for personal or area sampling of gases and vapors in air. These reliable lightweight pumps are motor-operated and powered by a rechargeable battery pack. Featuring reliable stroke counter technology, the pump's stroke counter indicates the number of times the pump's diaphragm has pulsed (or stroked) during the sampling period. By multiplying this stroke number by the volume of air per stroke, an accurate determination of air volume can be made. SKC sample pumps have special patented valves that close positively; ensuring "zero leaks." All working parts are housed in a sturdy, shock-resistant case with belt clip.



222 Series Low Flow Pump

Model	Description	Flow Range
222-3	For use with sorbent tubes or sample bags	50 to 200 ml/min
222-4	For use with sample bags, sorbent tubes, or long-duration color detector tubes	20 to 80 ml/min

Performance Profile

Flow rate:	**222-3:**	50 - 200 ml/min
	222-4:	20 - 80 ml/min
Operation time:	10 hours per battery charge	
Case:	Sturdy, lightweight plastic	
Battery:	Rechargeable NiCad	

Intrinsic safety is invalid without SKC-approved battery.

Battery regulator:	Holds voltage constant	
Counter readout:	Shows pump strokes up to six digits.	
Valves:	“Zero-leak” valves	
Pumping Action:	Diaphragm	
Temperature Ranges:	**Operating:**	32 to 113 F (0 to 45 C)
	Charging:	32 to 113 F (0 to 45 C)
	Storing:	-4 to 113 F (-20 to 45 C)

Protect sample pump from weather when in use outdoors.

Size:	5.1 x 2.5 x 1.25 inches (13 x 6.4 x 3.2 cm)
Weight:	12 oz (340 gm)
Intrinsic safety:	UL listed for Class I, Groups A, B, C, and D

Intrinsic safety and other approvals may be void if SKC pumps are not repaired by SKC or authorized SKC repair centers. In addition, replacing parts with non-SKC parts can void intrinsic safety approvals and the manufacturer warranty.

Operation with Sorbent Tube

Setting the Sampling Rate

1. Using a screwdriver, remove the metal plate on the front of the pump.
2. The dial with an arbitrary scale is used to set the sampling rate. Turning the dial clockwise increases the sampling rate, turning it counterclockwise decreases it.
3. Adjust the dial to the desired position. Select the minimum setting (position #0 on the dial) for sampling rates at the low end of the pump's flow range. Select the maximum setting (position #10) for sampling rates at the high end of the pump's flow range.

Operation Using a Stroke Counter

1. Record the initial counter reading.
2. Break open the ends of a sample tube.
3. Using flexible tubing, connect the inlet of the pump to the outlet of the sample tube.
4. Turn the pump on, using the on/off switch next to the counter, and sample for the desired time period.
5. When finished sampling, turn the pump off.
6. Disconnect and seal the sample tube.
7. Record the final counter reading and calculate the air volume using the following equation. To determine the pump factor, see page 4.

$$\text{Air Volume} = \left(\text{Final Counter Reading} - \text{Initial Counter Reading}\right) \times \text{Pump Factor}$$

Measuring Flow Rate with a Calibrator

1. Using flexible tubing, attach the outlet of a representative sample tube to the pump inlet.
2. Attach the inlet of the sample tube to a film flowmeter or electronic calibrator.
3. Turn the pump on, using the on/off switch next to the counter, and measure the flow rate following the calibrator instructions. Adjust the flow by using a screwdriver to turn the dial clockwise to increase or counterclockwise to decrease flow.
4. When ready to sample, break the ends off a new tube, insert the tube into the tubing, and sample for the desired sampling period.

Protect sample pump from weather when in use outdoors.

Determining the Pump Factor

To determine the relation between the counter to the pump volume:

1. Using flexible tubing, connect the pump inlet to the outlet of a film flowmeter.
2. Turn the pump on, using the on/off switch next to the counter.
3. Calibrate the pump to 100 ml/min. Turn the dial to adjust the flow.
4. Turn the pump off.
5. Record the counter reading, then turn the pump on and allow the pump to run for one minute.
6. Turn the pump off and record the counter reading.
7. Subtract the first counter reading from the second reading. This yields the number of counts per 100 ml.
8. Calculate the pump factor (ml per count) using the following equation:

$$\text{Pump Factor (ml per count)} = \frac{100}{\text{Number of Counts per 100 ml}}$$

The pump factor should be checked periodically. SKC recommends this procedure after every 40 hours of operation.

Other Sampling Applications

Sampling with Long-duration Color Detector Tubes

Long-duration color detector tube samples should be taken at a rate of approximately 10-20 ml/min. The 222-4 pump is the appropriate pump for this application. Set the pump rate at the minimum setting (position #0 on the dial) on the 222-4 pump. The flow rate of the pump can be measured with a calibrator or the stroke factor can be used to calculate the air volume.

Long-duration Color Detector Tubes require a special tube cover that accommodates an in-line trap tube. The trap tube protects the pump from caustic fumes that are often released from detector tubes. Please read closely all precautions when using these tubes. Failure to use the necessary traps will damage the pump and void the warranty.

1. Insert the outlet of a long-duration color detector tube into a tube holder attached to flexible tubing.
2. To protect the pump from chemicals that may off-gas from the color detector tube, connect the other end of the tubing to the inlet of a trap tube. Use a trap tube (SKC Cat. No. 222-3D-2) and holder (Cat. No. 222-3D-1) in line. The trap tube should be closest to the pump.

3. Record the initial counter reading.
4. Turn the pump on, using the on/off switch next to the counter, and sample for the desired time period.

> ***Protect sample pump from weather when in use outdoors.***

5. Turn the pump off.
6. Record the final counter reading and the color band result from the detector tube. Each tube is calibrated for a specific volume.
7. Calculate and correct the data as follows:

a. Determine the air volume using a stroke counter:

Air Volume (liters) =

$$\frac{[(\text{Pump Factor}) \times (\text{Final Count Reading} - \text{Initial Count Reading})]}{1000}$$

b. Correct detector tube reading:

Corrected Detector Tube Reading =

$$\frac{(\text{Absolute Detector Tube Reading})}{(\text{Air Volume in Liters})}$$

Sampling with Bags

The SKC 222 Series Low Flow samplers are also designed for sampling with bags. It is important that precautions be taken to prevent contamination of the pump when performing bag sampling.

> ***Protect sample pump from weather when in use outdoors.***

1. Loosen the setscrew on the outlet fitting at the top end of the pump.
2. Remove the fitting by unscrewing counterclockwise.
3. Attach Teflon® tubing to the exposed special fitting. Attach the other end of the tubing to the inlet valve on the sample bag.
4. See the bag operating instructions for details on the operation of the bag fitting(s).

> ***When collecting bag samples, the contaminant passes through the interior of the pump. The pump should be purged after bag sampling to remove any remaining contaminant. To purge the pump, run it for several minutes in a clean air environment. If the contaminant is hazardous, take all necessary safety precautions.***

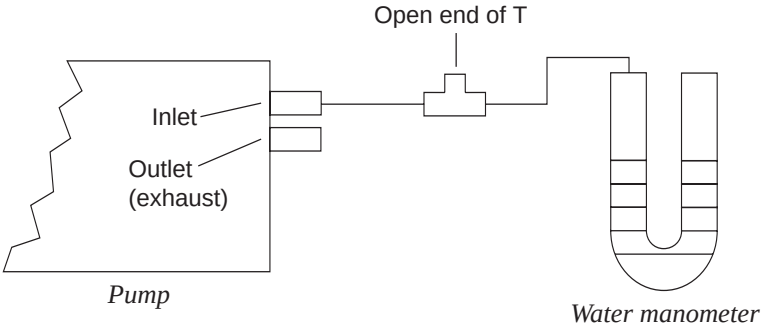
Maintenance

Checking for Leaks

To function properly and provide correct pumping volume, the diaphragm must be free from leaks and close positively. Remove cover plate and check as follows:

Intake Valves

1. To check the intake valves for leaks, connect a water manometer and a “T” connection to the pump inlet as shown below:



2. On the open end of the "T," draw vacuum by mouth until 4 to 5 inches of water vacuum register on the manometer.
3. Seal off the open end of the "T" and watch the manometer. The water level should drop less than one-half inch in ten seconds.

Diaphragm and Valve System Integrity

1. With the water manometer and “T” connected to the inlet, as in the previous test, seal off the outlet of the pump and introduce positive pressure through the open end of the “T” to 4 to 5 inches of water on the manometer.
2. While maintaining the pressure, seal off the open end of the “T” and watch the manometer. The water level should drop less than one-half inch in ten seconds.

Exhaust Valve Seating

1. Disconnect the “T” and water manometer from the pump inlet and connect them to the outlet of the pump.
2. Introduce positive pressure through the open end of the "T" to 4 to 5 inches of water on the manometer.
3. While holding this pressure, seal off the open end of the “T.” Watch the manometer. The water level should drop less than one-half inch in ten seconds.

Changing the Battery

1. Remove the six screws on the back of the pump case.
2. Gently pull the battery pack from the case.
3. Grasp both sides of the white connector and pull apart.

> ***Do not pull on red and black wires.***

4. Remove old battery pack and replace with new battery pack.
5. Push the two sides of the white connector together ensuring that the two pins on the left side of the connector align with the two sockets on the right side of the connector. Push firmly until the connector clicks.
6. Place the battery pack back in the pump case with the label facing you.
7. Ensure that the white connector is seated down into the pump case.
8. Place the back plate back onto the pump with the belt clip facing downward.
9. Replace and tighten the six screws.

> ***Tampering with the battery pack voids the SKC warranty and the UL Intrinsic Safety listing.***

NiCad Battery Notes and Recommended Maintenance

- ***NiCad batteries self-discharge at an average rate of 18 to 20% per month at room temperature. The rate of self-discharge increases with temperature. Ultimately, self-discharge results in an increased need for charging.***

  Recommended Maintenance:
  - Cycle battery use on a monthly basis (quarterly for pumps not used on a regular basis).
  - "Exercise" your battery pack! Use an SKC battery conditioning system (MasterCharger® or PowerFlex®) that automatically exercises batteries. Perform this procedure before storage and monthly (quarterly for pumps not used on a regular basis).
  - Store and charge batteries in the recommended temperature range.
  - Discharge and recharge battery packs fully before use and storage.

- ***Stated battery capacity will not be reached "right out of the box," but only after the battery is exercised. Often new NiCad battery packs require 5 to 7 cycles to reach the stated capacity.***

  Recommended Maintenance:
  "Exercise" your battery! Use an SKC battery conditioning system (MasterCharger or PowerFlex) that automatically exercises batteries. Perform this procedure before storage and monthly (quarterly for pumps not used on a regular basis).

- ***Battery packs are typically shipped less than fully charged to meet testing and shipping requirements.***

  Recommended Maintenance:
  Discharge and recharge battery packs fully before use and storage.

- ***A NiCad battery should not sit on a charger for long periods of time.***

  Recommended Maintenance:
  Remove battery pack from its charger within 24 to 48 hours after charging is complete.

For further information on Maintaining NiCad Battery Packs, request SKC Publication 1363 (available for download at www.skcinc.com).

Technical Note: Battery Pack Life

- Battery manufacturers typically indicate expected battery life as the number of usable cycles within an approximate number of years (e.g., 300 charge/discharge cycles or 3 years).
- The number of usable cycles/years of useful life for a battery pack is determined by the number of cycles/amount of time it takes for the battery to decline to 80% of its initial capacity when used under ideal conditions. The battery should be replaced at this point.
- Battery life ratings are nominal (±5%) and are generally based on ideal conditions of use such as those in which they are tested (*for testing criteria, see IEC 61436 and IEC 61951 test methods at www.iec.ch*).
- Individual conditions of use, charging procedures, and applications (high versus low current drain, intermittent versus steady current drain) may affect battery life.
- While nickel-metal hydride (NiMH) batteries provide longer run times than NiCad batteries on a single charge, the user can expect less cycles life from an NiMH battery when compared to NiCad cycles life.

Replacement Parts and Accessories

Part Description	Catalog No.
Motor (Model 222-3)	P222301
Motor (Model 222-4)	P222402
Battery Pack	222-3SR-04
Voltage Regulator	P22231202
Eccentric	P222302
Counter	P222304
Bearing/Ring/Stem Assembly	P222305
Diaphragm Disc Assembly	P222308
Switch	P222310
Links - Counter/Eccentric	P222313
Pump case with Meter, Switch, Pot, and Window	P222314UL
Potentiometer Control	P222316
C-1 Connector	P222317
C-2 Connector	P222319
Window	P222322
Body/Valve Assembly	P222323
Neoprene Gasket	P222324
Stainless Steel Back Plate	P222325
Case Fitting - Inner-Male	P222326
Case Fitting - Outer-Female	P222327
O-ring (pk/10)	P222328
Jack	P222331
Angle Bracket	P222332
Body Valve Set	P222334

Accessories	Catalog No.
PowerFlex Charger	
5-station, 100 - 240 V	223-1000
Single, 120 V	223-2000
Single, 100 - 240 V	223-2000B
PowerFlex Charging Cable for 222 Low Flow Pumps	223-1005
Tube Holders:	
Type A fits tubes 6 mm OD x 70 mm L	222-3-1
Type B fits tubes 8 mm OD x 110 mm L	222-3L-1
Type C fits tubes 10 mm OD x 150 mm L	222-3XL-1
Type D fits tubes 10 mm OD x 220 mm L	222-3XD-1
Type J fits tubes 8 mm OD x 110 mm L used with filter cassettes (not included)	222-3XJ-1
Tandem style for color detector tubes	222-3D-1

Service Policy

To return products to SKC for servicing:

1. Call 800-752-8472 (724-941-9701 for international customers) to obtain a Return Materials Authorization (RMA) number and Product Decontamination Form.

2. Carefully package the product. Mark the RMA number on any correspondence relating to the return and on the outside of the package.

3. Ship to SKC, freight prepaid, to the following address:

SKC Inc.
National Service Center
863 Valley View Road
Eighty Four, PA 15330

Package product carefully to prevent damage during transit. Include a contact name, phone number, shipping address, RMA number, and a brief description of the problem. For nonwarranty repairs, a purchase order number and billing address are also required. The Service Department will contact nonwarranty customers with an estimate before proceeding with repairs.

Intrinsic safety and other approvals may be void if SKC pumps are not repaired by SKC or authorized SKC repair centers. In addition, replacing parts with non-SKC parts can void intrinsic safety approvals and the manufacturer warranty.

SKC INC.
LIMITED ONE YEAR WARRANTY

1. SKC warrants that its instruments provided for industrial hygiene, environmental, gas analysis, and safety and health applications are free from defects in workmanship and materials under normal and proper use in accordance with operating instructions provided with said instruments. The term of this warranty begins on the date the instrument is delivered to the buyer and continues for a period of one (1) year.

This warranty does not cover claims due to abuse, misuse, neglect, alteration, accident, or use in application for which the instrument was neither designed nor approved by SKC Inc. This warranty does not cover the buyer's failure to provide for normal maintenance, or improper selection or misapplication. This warranty shall further be void if changes or adjustments to the instrument are made by other than an employee of the seller, or if the operating instructions furnished at the time of installation are not complied with.

2. SKC Inc. hereby disclaims all warranties either expressed or implied, including any implied warranties of merchantability or fitness for a particular purpose, and neither assumes nor authorizes any other person to assume for it any liability in connection with the sale of these instruments. No description of the goods being sold has been made a part of the basis of the bargain or has created or amounted to an express warranty that the goods will conform to any such description. Buyer shall not be entitled to recover from SKC Inc. any consequential damages, damages to property, damages for loss of use, loss of time, loss of profits, loss of income, or other incidental damages. Nor shall buyer be entitled to recover from SKC Inc. any consequential damages resulting from defect of the instrument including, but not limited to, any recovery under section 402A of the Restatement, Second of Torts.

3. This warranty extends only to the original purchaser of the warranted instrument during the term of the warranty. The buyer may be required to present proof of purchase in the form of a paid receipt for the instrument.

4. This warranty covers the instrument purchased and each of its component parts.

5. In the event of a defect, malfunction, or other failure of the instrument not caused by any misuse or damage to the instrument while in possession of the buyer, SKC Inc. will remedy the failure or defect without charge to the buyer. The remedy will consist of service or replacement of the instrument. SKC Inc. may elect refund of the purchase price if unable to provide replacement and repair is not commercially practicable.

6. (a) To obtain performance of any obligation under this warranty, the buyer shall return the instrument, freight prepaid, to SKC Inc., at the following address:

SKC Inc., National Service Center
863 Valley View Road
Eighty Four, PA 15330 USA

(b) To obtain return authorization information or for further information on the warranty performance you may telephone 724-941-9701 at the above address. See Service Policy section in operating manual (if applicable).

7. This warranty shall be construed under the laws of the Commonwealth of Pennsylvania which shall be deemed to be the situs of the contract for purchase of SKC Inc. instruments.

8. No other warranty is given by SKC Inc. in conjunction with this sale.

Form #3755 Rev 0207

UNDERWRITERS LABORATORIES INC.
333 PFINGSTEN ROAD · NORTHBROOK, ILLINOIS 60062
an independent, not-for-profit organization testing for public safety

CERTIFICATE NO. Ex. 070386-62011
07 March 1986

Issued to: SKC Inc.
R.D. 1 No.395 Valley View Rd.
Eighty-Four, PA 15330
U.S.A.

This is to certify that: Portable Air Sampling Pump Models 222- with suffixes 0.5-1.5, 0.5-1.5P, 1-4, 1-4P, 3-12, 3-12P, 10-30, 10-30P, 12-40, 12-40P, 3, 3P, 4, 4P, 9. for use with self-contained 2.4v battery pack SKC P/N 222-3SR-04 have been investigated by Underwriters Laboratories Inc. in accordance with the standard indicated in this certificate.

UL Standards for Safety:

ANSI/UL/NFPA 4913-1979 (UL913-1979) Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, II, and III, Division 1, Hazardous Locations, Third Edition.

The Air Sampling Pump complies with the requirements as defined by the standards indicated in this document for use in Class I, Division 1, Groups A,B,C and D hazardous locations when used with self-contained 2.4v battery pack SKC P/N 222-3SR-04.

To establish that the product is under the certification program, it is necessary to determine that the Listing Mark is affixed to the product. The Listing Mark of Underwriters Laboratories Inc. on the product is the only method provided by UL to identify products manufactured under its Listing and Follow-up Service. The Listing Mark includes the symbol of Underwriters Laboratories Inc., Ⓤ together with the word "Listed" and the control number 124U on the nameplate of each product.

Code: Intrinsically Safe Apparatus: Class I,Division 1 and 2,Groups A,B,C and D, Temperature Code T3C.

Tamb. = 40 C.

Albert A. Bartkus
Associate Managing Engineer
Hazardous Location
Casualty and Chemical
Hazards Department

Investigation and Test
Report Reference:
E62011, 20 January 77

Look For The Ⓤ Listing or Classification Mark On The Product

Phone: (312) 272-8800 MCI Mail No. 254-3343 Cable: ULINC NORTHBROOK, IL Telex No.: 291227