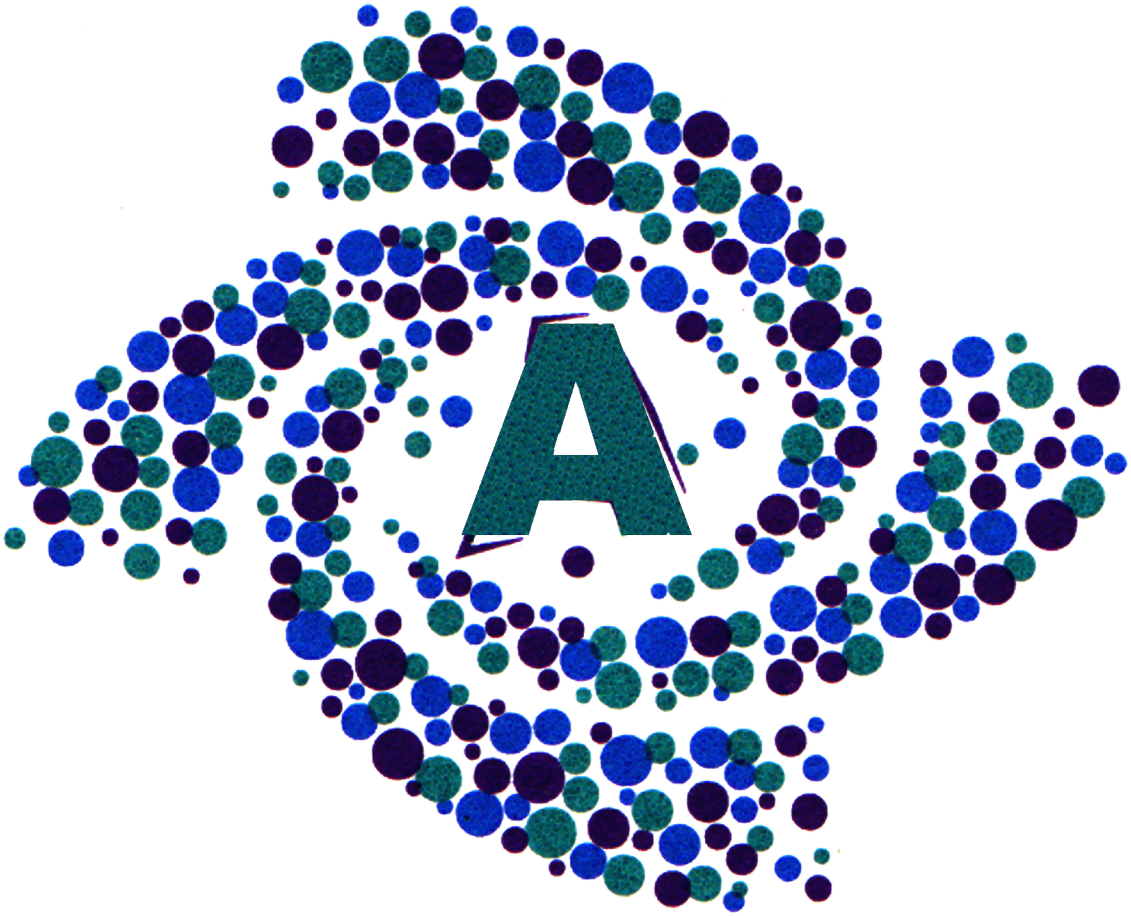

Aerobiology Research Laboratories

GRIPST-2009

Rotation Impaction Sampler

MANUAL

39-81 Auriga Drive
Ottawa, Ontario
K2E7Y5

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Rotation Impaction Sampling Technology

Rotation impaction samplers have become one of the most widely used mechanical devices for collecting air-borne particles in the world. They have been proven to be effective for collecting particles as small as 2 to 3 microns and are therefore suitable for collecting pollen grains and fungal spores.

The sampling head was designed to support two removable clear polystyrene rods. These rods have a sampling surface that is 1.59 mm by 32 mm. When the sampler is at rest the rods are retracted inside the sampling head. Using a 12 Volt (DC) power source, the motor spins the sampling head at a nominal rate of 2400 RPM.* Centrifugal force then causes the rods to extend downwards at a 90° angle at which point particles may be impacted against the leading surfaces. The amount of particles collected is a function of the volume of air sampled. This, in turn, depends on the size of the rods, the speed of the rotation and the length of exposure time. In order to retain these particles the rods must be coated with a substance that is both tacky and allows for in situ examination under visible light. We recommend a silicone grease solution. Hexane may be used as a carrier when dipping.

In some instances it is necessary to collect samples over long periods of time. This poses the problem of rod overload. If too many particles are collected the rods will become difficult, if not impossible, to accurately analyze. When long collection periods are required, it is recommended that the collection be made in timed cycles. The Model GRIPST 2009 is a timed sampling device. The timer activates the retracting head to spin intermittently. When it is at rest the rods are retracted inside the head to prevent particle impaction. Professionals who study aeroallergens often use this model to collect samples over 24 hour periods. With this model they are able to produce counts which are both accurate and representative of the time period that they are interested in.

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* *PLEASE NOTE:* We have found that a 12 Volt battery (ie, a car battery) is the most reliable device for supplying power to our samplers. However an AC/DC adapter will usually also suffice; we recommend an unregulated 12V adapter which is capable of supplying up to 1A. The GRIPST-2009 contains an adjustable voltage regulator that can be tuned to ensure your power supply spins the motor at 2400RPM. Regular testing is advised (see Maintenance section in this manual).

The model GRIPST-2009 is designed primarily for aeroallergen research. This sampler has a NEMA4 rated weatherproof casing suitable for all types of extreme weather, and a heavy duty Maxon motor. The sampler head mounting post is one and a half inches long to reduce air turbulence and optimize pollen and spore collection, and is computer machined for balance and to reduce motor wear. This sampler also incorporates a solid state relay timer set at a 10% sampling rate. Interval timing can be adjusted. The ON–OFF switch is mounted on the exterior of the sampler to enable easy access.

Since the GRIPST 2009 is a non-selective sampler it will collect all air-borne particles, including debris. This should be an important consideration when setting the timer. For continuous operation, we suggest collection cycles of one minute in every ten, or a 10% duty cycle, so that the samples are not overloaded.

When sampling is complete the removable rods may be mounted in a special grooved stage adapter for examination under the microscope.

Choosing A Sampling Site

When collecting aeroallergens the location of the sampling site is extremely important as it must be representative of the air that people breathe. Ideally the sampler should be placed slightly above standing level. This is usually around six feet from the ground.

Air turbulence is another factor that must be considered. Samplers should never be placed near ventilating systems or air conditioning units as these will disrupt natural airflow and alter particle content. The site should be free of obstructions and equally exposed to ambient air from all directions. Few locations are ideal and compromises will inevitably have to be made. Generally, if one can achieve a straight line-of-sight into the prevailing wind direction with minimal obstruction for 50 yards or more, the air that contacts the sampler will represent a blend of air masses from both distant and local sources.

Contamination is, perhaps, the most difficult problem to overcome when choosing a location for the sampler. Excessive debris from near by dirt roads or smoky chimneys can make samples difficult to analyze. Contributions from certain species of pollen and/or spores may be exaggerated when the sampler is placed in proximity with their sources.* Decorative gardens should be avoided as they may yield unusual and atypical pollen and/or fungal spores.

Ideally, samplers should be placed at several sites throughout the region of interest. This method would ensure the greatest level of accuracy, though, it is often not practical or financially feasible given the number of samplers required and the resulting number of samples to analyze.

When only the identification of particles in the air is sought, there are fewer guidelines for sampler location. This is often the case when samplers are used for agricultural purposes such as detecting plant pathogens and/or crop pollination seasons. Perhaps the biggest concern in these circumstances is the potential for rod overload, particularly when using samplers without timing devices. Rod overload simply means that too many particles are collected on the rod, making it difficult to analyze under a microscope. It is often a function of both bad location and the duration of the sampling period.

* Some have obsreved a particular problem with ragweed, especially near construction sites, since ragweed is a colonizing species and will tend to dominate these areas.

As with aeroallergen sampling, proximity to dirt roads or smoky chimneys is not advised. Sampling close to pollinating fields may also cause high density particulate impaction. When such a location represents the area of interest the sampling period should be adjusted to reduce the exposure of the rods. It is important to note, however, that many particles vary in distribution density at different times of the day. This may represent an important consideration when sampling is to be limited to a portion of the day.

Installation and Operating Instructions

Package Contents

Main Sampler Casing	1
Pipe Clamps	2
Power Cord	1
Retracting Head	1
Rods	100

Assembly

The casing of the GRIPST-2009 sampler has a bracket at the back for the pipe clamps. Thread the pipe clamps through the holes in this bracket.

Firmly plant a solid three-quarter-inch (¾") diameter post, or a minimum one-inch (1") diameter steel pipe, or a steel fence post, into the ground. For a sampler height of six feet (6'), we recommend embedding a post at least two feet (2') into the ground. Slide the sampler assembly over the post so that the shaft is facing towards the ground and the lid is facing upwards. Wrap the pipe clamps around the post and tighten to secure the sampler in place. We recommend wrapping a piece of heavy-duty tape (duct tape), or a couple of tie-wraps, around the post just below one of the pipe clamps to avoid slippage.

With the switch in the OFF position, connect the sampler to your power source with the cord provided. POLARITY MATTERS – please ensure that the black terminal goes to Negative / Ground / Common on your power source; there is a tab on one side of each plug on the power cord to help distinguish the polarity.

Screw the retracting head to the mounting post with the open end facing down. Place the switch in the ON position to ensure that the power has been hooked up properly.

If the retracting head spins in the counter-clockwise direction, the sampler has been properly assembled, if not check the troubleshooting section located at the back of this manual.

Sampling Rate and Timing

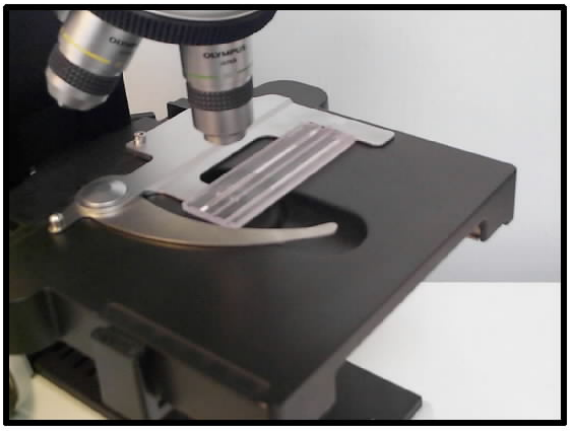
The model GRIPST-2009 incorporates a solid state relay timer preset at a 10% sampling rate (1minute ON, 9 minutes OFF), located inside of the sampler casing. The timer is fully adjustable and can handle intervals of up to seventeen minutes "On" or "Off."

There are two columns on the timer, the "On" column (right) and the "Off" column (left). Each column has ten switches labeled in seconds as follows: 1, 2, 4, 8, 16, 32, 64, 128, 256, 512. The preset 10% sampling rate (540 seconds "Off" and 60 seconds "On") is set with switches 4, 8, 16 and 512 activated in the "Off" column and the switches 4, 8, 16, and 32 activated in the "On" column.

The settings can be changed at any time. Simply calculate the number of seconds desired in either the "On" or "Off" mode and set the timer accordingly.

Preparing and Handling Rods and Retracting Heads

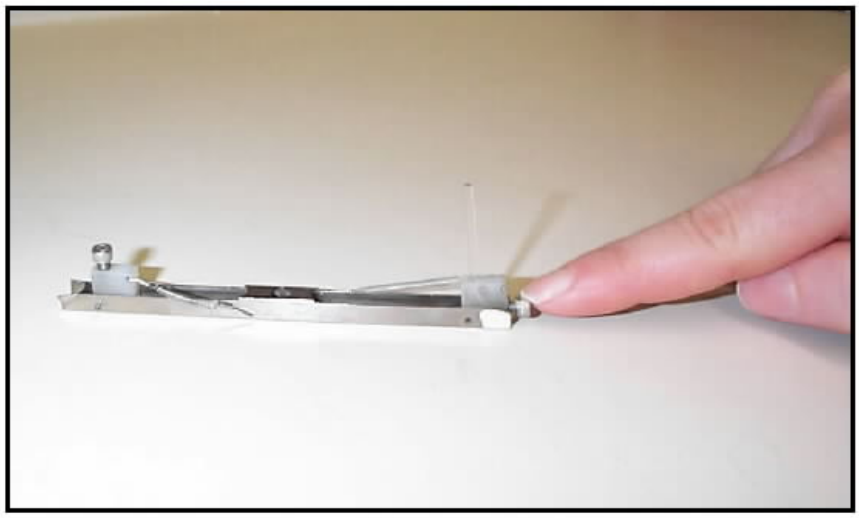
A supply of “Type I” rods is usually provided with the sampler. These rods have been formed using clear polystyrene to facilitate examination of the samples under the microscope. They were designed to collect particles as small as 2 µm and are therefore suitable for collecting both pollen grains and fungal spores. Each rod is marked with either an “X”, indentation, or raised bump at one end. This is to indicate the collection surface and should be orientated with the leading edge of the retracting head.



The rods can be mounted on specialized adapter slides (also available at Aerobiology Research Laboratories) for microscopic examination.

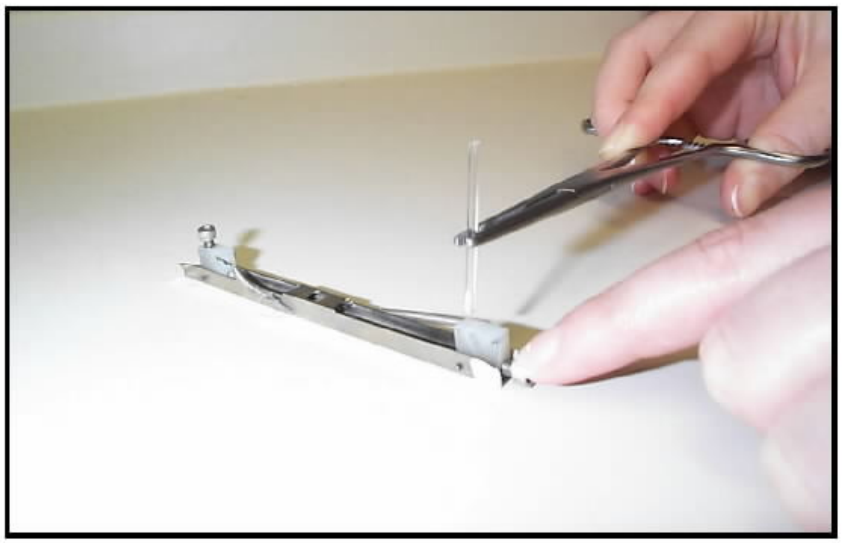
Placing Rods in the Retracting Heads

To place the rods in the retracting head the head must first be removed from the sampler. Unscrew the knurled thumbscrew and carefully lift off the head.



Using the index finger, press the thumb screw towards the outside edge of the retracting head. The square opening of the block should now be facing upwards. This is the point of insertion for the rods. See photograph below.

Invert the head and loosen one of the thumb-screws embedded in the pivot blocks by turning it counterclockwise. Flip the pivot block and collector rod into the extended position with the thumb of the same hand. Hold the pivot block securely in the extended position while removing and replacing the rods. The marked faces of the rods should correspond with the LEADING EDGE of the retracting head. We suggest marking the leading edge of the retracting head with nail polish or liquid paper to avoid confusion when replacing the rods. Gently press the rod in the square hole of the pivot block until it touches the metal flange of the head assembly.



The leading edge of the rod must be oriented in the same direction as the leading edge of the retracting head. In this photograph both are marked with liquid paper. Be careful not to brush the leading edge of the rod against fingers or forceps as this will disturb the silicone coating.

The rods should always be handled on the marked end either using the thumb and forefinger or a pair of strong forceps. Handling the rod on the opposite end may wipe off some of the silicone and/or the sample.

Once the rod is fully inserted, return the pivot block to the retracted position and turn the thumbscrew clockwise to secure the rod in place. Return the head to the sampler, with the open end facing down. Tighten the corresponding thumbscrew.

If a rod breaks off in the sampling head's pivot block, the remaining piece can be pushed out from the rear of the sampling block with a straightened piece of paper clip.

The retracting head may be cleaned in hot soapy water or alcohol on a fairly regular basis. This will remove excess debris from the pivot and spring mechanism. Do not oil this mechanism as it will pick up and retain dirt and debris more rapidly and possibly cause contamination of the sample.

Rod Dipping

In order to retain impacted particles the rods must be coated with a tacky substance. This substance should be commercially available, easy to apply, and it must facilitate the analysis of the sample under a light microscope. A variety of tacky media satisfy these requirements including silicone grease and water-soluble coatings. We have found, however, that a hexane-silicone solution provides the most uniform coating while allowing a standardized method of preparation.

Using a Hexane Silicone Suspension

Silicone grease has become one of the most popular coatings for collector rods due in part to its particle retention properties and commercial accessibility. Traditionally, the silicone grease was applied to collection surfaces by hand. The finger method often resulted in non-uniform coatings, which invariably affected the samples.

By using an appropriate carrier for the silicone the uniformity of the coating can be improved. Hexane, a solvent, is volatile at room temperature. It is EXTREMELY FLAMABLE and should NEVER BE HEATED. A liquid dipping solution can be made by vigorously mixing the silicone grease with hexane. Rather than using fingers the rods are simply inverted and dipped into the solution. The bottom tips of the rods should be lightly dabbed on a paper towel immediately after dipping to remove any excess solution. The hexane evaporates shortly after dipping leaving a thin, uniform coat of silicone grease.

Since hexane evaporates quickly at room temperature it is recommended that dipping be done in small quantities with remaining solution sealed from the air until it is used.

The solution should be stirred frequently since the silicone grease tends to settle if it is left to sit for long periods of time.

The Following is a recipe for the hexane silicone suspension taken from the PAAA Newsletter, Winter 1994 Edition:

Hexane Silicon Suspension

Caution Hexane is extremely flammable

DO NOT HEAT

Silicone Grease (10 - 20% v/v)

In any grade of Hexane or Hexanes

Store in glass bottle

Mix well to suspend (re-suspend) before use

Don Street

PAAA Newsletter Winter 1994

Cleaning Rods

Once the rods have been used they can be cleaned and used again. Silicone grease is insoluble in water and resistant to many detergents. By wiping off as much grease as possible before cleaning the job can be made much easier. We recommend the use of a sonic machine for cleaning if one is available.

Once cleaned, the rods should only be re-coated with the same media as their original coating. This reduces the risk of interference between old residues and subsequent coatings.

Determination of Particle Concentration

It has been universally excepted that pollen and spore counts should be reported in "particles per cubic meter" (P/m^3). This serves to reduce ambiguity when comparing samples from different areas and/or different equipment.

In order to determine the particle concentration (P/m^3) one must first perform three separate operations.

1. Calculate the number of particles in the sample.
2. Calculate the total volume of air sampled.
3. Calculate the number of particles per cubic meter using #1 and #2

A description of how to perform each of these steps has been included in this manual solely for the purpose of understanding the procedures required for calculating the particle concentration. Ted Brown, the originator of rotation impaction sampling technology, developed these calculations and charted a graph which can be used to eliminate all but the first step; the calculation of the number of particles in the sample (Ted Brown & Associates, 1984). We will begin with the first step in the calculation.

Step 1: Total Number of Particles in the Sample

This is the number of particles counted during microscopic analysis. For the most accurate results we suggest that at least fifteen fields be counted at both 20X and 40X in order to obtain this number. Fifteen fields are just enough to cover most of the surface area of the rod at 20X. Once the number of particles has been determined it is time to calculate the volume of air sampled.

Step 2: Volume of Air Sampled

A conversion factor (K) is used to calculate the sampling rate in liters/minute from the RPM. The conversion factor (K) is (0.0197) when "Type I" rods are used. This constant includes the area of the collecting surface of both faces multiplied by the diameter of the circle cut through the air when the rods are extended from the sampling head. Assuming that the sampler is running at an optimum speed of 2400 (RPM) we can then calculate the volume of air sampled in liters/minute as follows:

Sampling Rate in liters/minute = RPM x K

Or:

2400 x 0.0197 = 47.28 liters/min.

The volume of air sampled can then be obtained by multiplying the Sampling rate by the elapsed time in minutes:

47.28 liters/min x 60 min = 2836.80 liters

Since there are 1000 liters per cubic meter (m^3) this equals 2.8m^3.

Step 3: Calculating the Concentration of Particles Per Unit Volume

Finally the calculation of particles can be determined by dividing the number of particles counted by the total volume of air sampled.

$$\frac{\text{Total Particles}}{(\text{RPM}) \times (\text{K}) \times (\text{Min})}$$

Examples:

Retracting "Type I" rod constant	= 0.0197
Sampling Period	= 60 min
Total Particles	= 1200
RPM	= 2400

2400 x 0.0197 x 60 min = 2836.80 liters or 2.8m^3

$$\frac{1200 \text{ particles}}{2.8 \text{ m}^3}$$

$$= 428 \text{ particles/m}^3$$

Retracting “Type I” rod Constant (K)	= 0.0197
Example Period	= 10% (1min/10 min)
Total Time	= 24 hours
Total Particles Counted	= 1200
RPM	= 2400

24 hours x 1min/10min x 60min/hour = 144 minutes

2400 (RPM) x 0.0197 (Constant K) x 144 min = 6808 liters or 6.8m^3

$$\frac{1200 \text{ particles}}{6.8 \text{ m}^3}$$

= 176 particles/m^3

This represents the average concentration over a 24-hour period.

Once the rational of the calculations is understood this procedure can be greatly simplified. Included in this manual is a graph (Ted Brown & Associates 1984), which can be used to plot the particles per cubic meter (P/m^3) given the time of collection and the number of particles counted.

Maintenance and Warranty

Maintenance

The samplers should be cleaned on a regular basis to reduce motor wear. Use a tachometer to test the RPM of the GRIPST-2009 at least once per year. The optimum rate should be 2400 RPM. If it is not running at 2400 RPM the voltage regulator may require adjusting: Once the lid of the sampler is opened, a circuit board will be visible on one side. Facing up, there is a potentiometer that can be adjusted with a small flat-head screwdriver, this screw provides a fine level of speed adjustment to the motor.

The GRIPST-2009 should also be timed at least once per year, preferably just before the sampling season. Using a stop watch, check to see that the duty times and rest periods are correct. If, for instance, the timer is set to the factory-default 10% sampling rate, it should spin for one minute and then rest for nine.

The equipment can also be sent to Aerobiology Research Laboratories for routine maintenance. For $75.00 U.S. we will test the equipment RPM, check the timing, and clean the sampler. Repairs will cost extra when no longer covered under the warranty.

PLEASE NOTE: when shipping the equipment to Aerobiology Research Laboratories, please be sure to protect the sampling post. This can be done using large detergent bottle caps taped over the post, or by re-using the protector from the original packaging.

NEVER OIL THE MOTOR – THIS WILL INVALIDATE THE WARRANTY

Warranty

The GRIPST-2009 is covered for **one-year parts and labor**. Please call Aerobiology Research Laboratories with any problems, questions or concerns before shipping the sampler. Again it is very important that the sampling post be protected during shipping and the machine was set up with the post facing down and not up. Contact us at:

Aerobiology Research Laboratories
39-81 Auriga Drive
Ottawa, Ontario
K2E7Y5
(613) 226-9820
www.aerobiology.ca