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Gravity Probe B Relativity Mission

OPERATION OF LIQUID PARTICLE COUNTER

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PROCEDURE FOR OPERATION OF LIQUID PARTICLE COUNTER

I EQUIPMENT

Particle Measuring Systems (PMS) Micro Laser Particle Spectrometer Model LPS-8
PMS Integrated Micro-Optical Liquid Volumetric Sensor Model IMOLV
PMS Liquid Batch Sampler Model LBS-100
Beaker, Pyrex, 600 ml
Jar, polyethylene, 2000ml

II MATERIALS

"Clean" sample, >300 ml, of liquid to be measured

III SAFETY PRECAUTIONS

There are several safety hazards associated with this Liquid Particle Counting procedure. First, be aware of all the risks associated with the liquid being sampled including flammability and toxicity. Since it is impossible to set up this equipment within an available fumehood, extra precautions should be taken when sampling hazardous liquids.

The second hazard arises in the method of sample extraction. This system uses pressure to force the sample from its container and through the sampling head. This increases the hazards of the material being sampled due to possibility of rupture of the sample tubing. In addition there is the possibility of explosion of the glass pressure vessel. If the pressure vessel gets scratched or chipped, it must be replaced immediately.

Finally, the sample measuring device contains a laser, all precautions for handling lasers, including exposure to the beam and high voltage should be observed.

IV PREPARATION

Roll cart to the location where you will be working.

Place air/vacuum pump on the floor in a safe place near the cart.

Check to make sure waste jar is in place and empty.

Place a removable label on the jar for the material you will be sampling. Be sure that drain tubes are properly inserted in the waste jar.

Turn on Particle Measuring Systems (PMS) Micro Laser Particle Spectrometer. Model µLPS-8.

Turn on PMS Liquid Batch Sampler Model LBS-100.

Allow equipment 1 hour to warm up and stabilize.

NOTE: Excessive counts, especially in the lowest size ranges result if the unit has not been warmed up sufficiently.

Thoroughly clean beaker or other sample container to remove all particulates.

V OPERATION

This operating procedure is based upon sampling a non-hazardous, low vapor pressure liquid, e.g. DI water. Use of this equipment with other liquids may require modifications to this procedure.

Place at least 200 ml of the "Clean" liquid to be sampled in the beaker or other sample container along with the magnetic stir bar.

NOTE: The sampler leaves about 1/4" of liquid in the container which it cannot access, therefore the container should have the amount to be sampled plus at least 1/4" additional liquid.

Verify that the CYCLING l.e.d. is out and no pressure is in the chamber. Release the chamber latches, clip them up out of the way, and lower the chamber bottom. Rotate the chamber bottom from beneath the chamber. Slide the beaker up into the chamber, making sure the eduction tube is inside the beaker. While holding the beaker in place rotate the chamber bottom under the chamber and lift it against the chamber. Release the latches and attach them to the chamber bottom, be sure they are properly seated before fastening.

Place VACUUM/PRESSURE switch in VACUUM and press START. Allow sample to degas until all bubbles have disappeared. When all bubbles have disappeared, place VACUUM/PRESSURE switch in PRESSURE. Wait until CYCLING l.e.d. goes out.

Select the 100 ml sampling volume, place the VACUUM/PRESSURE switch in the PRESSURE position and the CONTINUOUS/SINGLE switch in the SINGLE position.

Check set-up of the Micro Laser Particle Spectrometer, Model µLPS-8. Verify that it is set for a sample volume of 100 ml (SV:100.0), also that it is in the differential mode (DIFF) and is in the total counts mode (COUNTS). See the equipment manual if any changes are necessary.

Turn on the magnetic stirrer and adjust the speed control until satisfactory. Avoid vortex formation.

Press **START**. Observe pressure gauge, pressure should be 10±2 psi. Sample should begin to flow through sampling chamber and into measuring buret. After a few moments the START/STOP l.e.d. will flash and the display will start showing counts. Note that the sample interval timer (SI) will start to increase. When 100 ml has passed through the sample cell, the sampling process will automatically stop. After a short delay, about 30 seconds, the pressure in the chamber will be released and the CYCLING indicator will go out.

Check the final value of the sampling interval, (SI:00:02:00) it should be between 00:01:15 (1 min. 15 sec.) and 00:05:00 (5 min.), preferably closer to 00:05:00. If outside this value, adjust SAMPLE FLOW CONTROL, CW to increase SI and CCW to decrease SI and repeat with "Clean" sample.

Check reading for 1 µm and larger channels, if all channels hold counts of 1 or less, proceed to measure actual samples, otherwise repeat "Clean" sample.

NOTE: To obtain "Clean" sample, it may be necessary to filter a sample, although typical filters may not achieve zero counts.

NOTE: It is typical to see several hundred counts in the 0.3 µm size channel due to external influences and noise in the sensor.

When finished reading samples, flush system with "Clean" liquid sample. Repeat until readings of the same magnitude as the original "Clean" sample are obtained. Then remove the sample container from the chamber and cycle the system to flush liquid residue from sample cell and tubing.

Finally, empty waste from waste container into properly labeled disposal container and remove temporary label from waste container.

VI SET-UP

Refer to Particle Measuring Systems (PMS) Micro Laser Particle Spectrometer, Model µLPS-8, manual and SET-UP MENU Software Version 11.4 manual for detailed instructions on system set-up.

Typical set-up should look as shown below:

To change display from COUNTS to N/ml press the software defined key next to the display. This toggles between these two modes.

To change other values, press SET-UP key. This allows manipulation of the parameters which can be controlled through that screen. Generally, these are changed using the arrow keys, soft keys, and data entry keys.

The operation to enter words is a bit more complicated than numerals. To enter the letters which comprise a word, one must first note that the data entry keys are labelled much like the keys on an ordinary telephone. Each key with a number has three letters associated with it. In a field allowing alphabetic characters, pressing a numeral key causes the numeral itself to be displayed, pressing it a second time causes the first letter associated with the key to be displayed, a third time, the second letter, and a fourth time, the third letter. Pressing a fifth time causes the numeral to come up again and the order repeats itself from there. When the correct character is displayed, press ENTER to accept that character. A blank is entered by pressing the ENTER key twice with no intervening numeral key.