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LaCoste & Romberg Gravity Meter

1) Handling of the Meter

Although LaCoste & Romberg G-meters are built to be rugged, they are basically very delicate instruments. Therefore, develop the proper respect, as well as good habits, when handling the gravity meter. For example, when taking the meter out of the aluminum carrying case or putting it back into the case, do not pull on anything but the leveling knobs and avoid bumping the meter on the sides of the case, or on the gravity dish. *Never use the measuring screw to lift the meter.* Any hard bump can cause a *Tare*, which is *a sudden change in gravity readings, at the same gravity station*. Especially on helicopter jobs, there is pressure to hurry and the few seconds that you save by quickly taking the G-meter out of the carrying case and placing it onto the gravity dish (as well as quickly putting it back into the case) can cause you a lot of headaches and expense, if you cause a tare. Take your time; *Work just as quickly as you can and still handle your gravity meter gently,* yes, even with respect.

2) Leveling the Meter

LaCoste and Romberg meters must be properly leveled, or the gravity reading will be wrong. Leveling the meter is extremely important, when reading gravity. The very first thing to do when you arrive at a gravity station is to firmly place the aluminum concave gravity dish (plate) on the ground. It is sometimes necessary to scrape the top few centimeters of rocks, soil or snow away in order to allow the gravity dish to stand on firm ground. *If the dish is not firmly planted on the ground and rocks back and forth, it will be difficult or impossible to take a proper reading*. When your gravity dish is set, remove the gravity meter from the case and *gently* place it onto the concave dish. The leveling process goes more quickly, if you *carefully* slide the meter up or down the sides of the concave dish until the levels indicate that the meter is approximately level. Now, you use the 3 black leveling knobs on top of the gravity meter box; these knobs turn the leveling screws. First, position the cross-level (the level on the right, on the short axis) by turning the 2 black knobs on the left. When the cross-level is centered, position the long-level (on the long axis) by turning the single black knob on the right. Normally, the cross-level does not move, when you adjust the long-level, but sometimes the leg of the G-meter will "walk" around the gravity dish, off-leveling the cross-level bubble. If this happens, repeat the process above.

Check that both levels are level before starting your gravity reading.

Reading the G-meter

There are several ways to read a L & R G-meter, but only 2 of them will be discussed here, *READING THE METER IN THE EYEPIECE* and *READING THE METER WITH THE ELECTRONIC READOUT (Capacitance Beam Position Indicator CPI). The important thing to remember is always to read the meter the same way; BE CONSISTENT; if you start to read the meter with the eyepiece, stay with the eyepiece.* If you approach the reading line from the left, do so for every point on the survey. And vice versa.

READING THE METER IN THE EYEPIECE. Now, the meter should already be leveled and you are ready to read it. Turn on the reading and level light switch, located on the right side of the top of the gravity meter. *Release the internal beam (= unclamp the beam) by turning the knurled arrestment knob counterclockwise to its limit.* This knurled knob is located beside the eyepiece. *Now, the meter is unclamped and very sensitive; DO NOT MOVE, BUMP, OR TRY TO RE-POSITION THE METER WHILE IT IS UNCLAMPED.* The beam position is observed by looking at the shadow of the cross-hair through the eyepiece. The cross-hair is a fine wire attached to the beam. The shadow of the cross-hair falls across a scale, which is the reading reference. The total motion of the beam is 14 to 15 scale divisions, from stop to stop. Every G-meter has it's own reading line, which is given on the meter lid (for exam., it is 2.4 for G-meter # 466). *The downscale/ downside (left side) of the cross-hair is used as the reading edge, and this reading edge is brought to the reading line, approaching from the right side*, that is to say, from upscale, moving counterclockwise. *Note that the cross-hair moves in the direction that you move the measuring screw; simply turn the dial the way that you want the cross-hair to move*, clockwise to move right and counterclockwise to move left. *To avoid any backlash (or play or slack) in the gears, it is good practice to always turn the measuring screw/dial at least a half to a full turn ABOVE the reading line and then slowly approach the reading line by turning the screw to the left (counterclockwise) until the left side (downscale side) of the cross-hair JUST touches the right side of the reading line.* If you over-shoot the reading line, it is necessary to repeat the above process *again* in order to avoid/eliminate the backlash in the system. If you just turn the dial clockwise back to the reading line, because you have over-shot the reading line, you will not have eliminated the slop in the mechanics of the system, and your gravity reading will be less accurate. So, repeat the whole process.

When you are satisfied with the reading, *recheck the levels* once more. If off-level, re-level the meter and repeat the process described above. *If, however, the levels are good, turn the knurled knob clockwise to it's limit* (=re-clamping the beam) and *record the dial reading. Turn off the reading and level light switch*. Now, the meter is ready to be moved. Carefully place the G-meter back in the aluminum carrying case.

READING THE METER WITH THE ELECTRONIC READOUT (Capacitance Beam Position Indicator CPI) is basically the same procedure as using the eyepiece. The main difference is that your field of vision is very much restricted when using the electronic readout, as opposed to reading gravity thru the eyepiece. As mentioned above, the total motion of the cross-hair is 14 to 15 small scale divisions, and all this movement of the cross-hair is visible when using the eyepiece. However, you can only observe 8 to 9 of these (14 to 15) scale divisions movements, when using the electronic readout *alone* to read gravity. And, you have no way of knowing, if the beam is stuck on one of the stops, if you are *only* using the electronic readout. Because of this, it is practical to also use the eyepiece to initially observe the position of the cross-hair, when reading gravity with the electronic readout. The eyepiece can tell you that the beam is *free of the stops* and *if it is approaching the reading line from the correct side*. The Electronic Readout gravity reading is completed when (following exactly the same procedure as when reading gravity thru the eyepiece!) the left side of the cross-hair is just touching the right side of the reading line, and the small needle in the Electronic Readout Dial is pointing straight up at the middle hash mark.

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One advantage of using the Electronic Readout is that operator fatigue is reduced, since the eyepiece needs only to be used or "consulted" periodically while reading gravity. This is a good thing, if you are reading many gravity points every day. Another bonus with using this form for reading gravity is that the meter can read with greater sensitivity than when reading with the optical system alone.

Recording Dial and Counter Readings

When the meter has been read, the observation is recorded from both the 5-digit counter and the 2-digits of the dial. The first 4 digits (before the decimal) are the first 4 digits read from the counter; the last digit should correspond to the dial. The 2 dial digits are the 2 after the decimal. For example, if the counter numbers read 45558 and the dial setting is 86, then the reading is 4555.86. Be careful when recording the counter readings; problems can occur when the dial reading is about 95 to 99, since the counter unit numbers are slightly ahead of the dial readings, anticipating the next whole number. For example, a true value of 4879.99 may read as follows: on the counter - 48800; on the dial - 99 . It would be easy to mistake these counter & dial values for 4880.99, exactly 1 counter unit too much.

Sticking of the Beam (or Cross-hair)

This is a problem on many Gravity Meters, although it is more common on older gravity meters, which have been in use for several years. It is important to know what to do with a sticking beam, or cross-hair. When the beam is stuck, it is simply stuck on one (or, if your are really lucky, both) of the stops and cannot move freely. Normally, *a few light taps on the top (or side) of the gravity meter is enough to free the beam.* Keep in mind that an unclamped meter is delicate, so don't use any more force than absolutely necessary.

Once the beam (or cross-hair) is free, you can proceed with your gravity reading. Sticking beams are an annoying and time consuming problem, but the accuracy of your gravity measurements should not be affected, unless you have used a 1 kilo hammer and/or a karate kick to "free" the beam.

The source of this sticking beam is usually dust, polluting the mechanical system. Periodically, gravity meters have to be returned to LaCoste & Romberg to be serviced, and one of the servicing procedures is to take the meter apart and to clean the beam stops. According to LaCoste & Romberg, gravity meters should have a "long term servicing" done every 8 to 10 years, depending upon how much the meter is used, and where it was used. However, a well functioning meter need not be returned, even after many years of service. As the old Scottish proverb goes: "If it works, don't fix it!"

There is *another kind of sticking beam problem* to be aware of, ***the beam positioners can get stuck*** (see photo of Variable Damped G-meter). To better explain this problem, first, a few words about meter design. LaCoste & Romberg have produced 4 basic gravity meter designs:

1) Standard Gravity Meter
2) Standard Gravity Meter *with Electronic Readout*
3) Standard Gravity Meter *with Variable Damping*
3) Standard Gravity Meter *with both Electronic Readout & with Variable Damping*

Furthermore, there are additional options that you can add onto/use with these 4 basic L & R meter designs such as: a *Voltimeter* or an *Hannover SRW-E Feedback System*. We are interested in # 3, Meters with Variable Damping.

L & R Gravity Meters which have the Variable Damping option have 2 little white buttons on the top of the meter. These are called beam positioners and they sometimes get stuck. They are designed to give the beam a little boost, to move the beam away from the stops and towards the reading line, when the meter is damped. *Whenever a meter is damped, it has a slower response time, and using the beam positioners speeds up the process of taking a gravity reading.* You move the beam upscale by pushing the beam positioning switch on the Right. Pushing the switch on the Left moves the beam downscale. *Damping the meter is useful whenever you are working in swampy areas or in areas where there are lot's of vibrations.* However, *the beam positioners are seldom needed when Standard Damping is used on a Variable Damping meter, although they can SOMETIMES be used to free a stuck beam.*

It is not uncommon for these beam positioners to occasionally get stuck down due to dust, dirt, or even freezing water. When this happens, you've got a severely stuck beam. When a beam positioner is stuck, no amount of tapping, kicking and/or hammering can free the beam. The beam or cross-hair *appears* to be super-glued to the stop. *The solution to this problem is simply to push these beam positioner buttons in and out a couple of times.* Normally, they will easily click in and out, but, if they do not, *free up the stuck beam positioner (pull it up) and the meter should behave normally again.*

This is a serious problem to have when reading gravity in the field, and knowing what to do about it is essential in order to continue a survey. Many a gravity loop has been aborted, because the surveyors did not know about this problem.