Frequently Asked Questions

Q: When I view the system before starting the test, there are always about ± 0.005 kN (1 lb) load fluctuations. Why? There is no contact between the vertical load cell and specimen, so why is there a small fluctuation in the load and how can I make it zero?

A: There is always going to be a small load fluctuation of about 0.025% of load cell full capacity, which translates into about 0.1 lb not 1 lb.

To re-zero the load cell, please follow these steps:

1. Go to the System Monitor, and record the analog reading of the vertical load cell when it is at no load condition (when the load cell is not in contact with anything).
2. Go to Calibrate Summary.
3. Overwrite the Offset value for the vertical load cell with the analog reading value from step one.
4. Click on the Apply and Ok buttons.
5. You should now see in the system monitor that the vertical load cell is virtually zero.

***<u>Note:</u> This re-zeroing process can be applied to other sensors such as a pressure transducer.**

Q: The platen moves down at the beginning of the test until it triggers the lower limit, then the test stops, and an error message appears on the screen indicating that the lower limit switch is on. Why is this happening?

A: Here is what is going on:

Your first incremental consolidation step must be small enough, and the load cell must be registering a load that corresponds to a stress higher than your first step.

Re-zero your load cell and start the test again. See above for how to re-zero the load cell.

Q: After running a successful test we ran into troubles with the report. We were not able to generate a report because all links on the report pull down menu are inactive. Are we missing something, or is the software not entirely installed?

A: Once a test is finished or even while it is running,

1. Go to the File menu.
2. Click on Load; this will load the test data on the open window on the desktop.
3. Go back to Report. You should see now the Graph, Settings, and Edit menus all activated.
4. You can change units and scales, and edit the test data points.
5. Remember that every time you change or edit something, you will need to save the file, and load it again.

Q: I noticed that when running a test on a soft soil sample it takes a relatively long time for the load to reach the specified value. How can I change the rate at which the load is applied?

A: Even though the load PID settings are set for most of the soil types, sometimes for extremely soft or stiff soil, you will have to adjust the cell PID (Proportional Integral Derivative) parameters for the vertical load control.

These are under Options/PID.

The PID control parameters are adjustable due to the nature of the different soil types and large variations in their stiffness, from very soft peat and organic soils to highly over - consolidated clays or even soft to medium rocks.
The max PID value is 5.00 (soft soils) and the minimum is 0.10 (stiff soils).

PID CONTROL

Control of the pressure or load is accomplished by using a closed loop controller. At equally spaced time intervals called the control loop period, the controller compares the target load or pressure to the measured load or pressure. The loop error is the difference between the two. The controller uses this error to compute and send a signal to the micro-stepper motor in order to make adjustments to reduce the error by the next loop period.

The signal to the micro-stepper controls the micro-stepper's position. The loop error computed by the controller at every loop period is nothing but the additional required load or pressure to eliminate the error by the next loop period. In other words, the load rate is the error divided by the loop period.

Signal = Error / Loop Period / Stiffness

GP = 1 / Loop Period / Stiffness

Signal (P) = GP * Error

The above equation is the basic idea behind any proportional controller where GP is the proportional gain.

The controller employed by this system is actually a PID controller, where P is for proportional control, I is for integral control and D is the derivative controller.

Q: During the test, a controller error message appears on the screen telling me that a limit switch is on; what should I do?

A: An internal limit switch has been triggered, as evidenced by the red flashing limit switch LED.

Q: The swell stress beginning was only .25 tsf and the next loading increment was.5 tsf. The sample swelled and needed more than the .5 tsf and then when the swell

increment was done it went to the .5 tsf increment so the applied load was less. From what I remembered from the dos program the time I ran the same type of test, if the swell pressure was higher than the next loading increment then it would go to the next increment that was a larger load.

A: The ICON program for Windows has the capability of mixing constant volume swell and constant load steps. As a result, the DOS feature that makes the program go the higher step automatically, skipping all other steps in between, is no longer applicable.

The easy way to get around this is to put in a long duration (both the max. and min), say three days, so that you will be there to watch the swell step, then adjust the next step by manually deleting the steps with stresses lower than the swell stress reached during the constant volume swell step.

Q: In processing the information for the swell test, I noticed the total load needed to maintain the constant volume does not show up on the table printout. The original applied load does, but the only place it shows up is on the graph, and from that it is difficult to tell the exact load that had to be applied. Is there anywhere to find what the exact load went up to?

A: To find out the exact load reached during the swell step, you need to use the DUMP menu under File, following these steps:

1. Go to File > Dump
2. Select Engineering
3. Dump will generate an ASCII data file that can be viewed using either a spreadsheet program such as Excel or a text editor such as Notepad.

Q: We are looking to do some swell testing on a clay sample according to ASTM 4546, method C. My understanding is that this can be easily done with your equipment.
How can we do it?

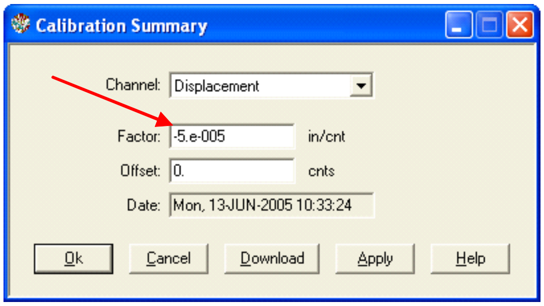
> 4.1.3 *Method C*—The specimen is maintained at constant height by adjustments in vertical pressure after the specimen is inundated in free water to obtain swell pressure. A consolidation test is subsequently performed in accordance with Test Method D 2435. Rebound data is used to estimate potential heave.

A: This is a perfect application of the use of automation in soil testing, instead of manually applying increments of vertical stress as needed to prevent swell, and keeping the deformation within 0.005 mm (0.0002 in.) to 0.010 mm (0.0004 in.). The fully automated LoadTrac-II will apply the required load without any human intervention. Follow these easy steps:

1. Prepare the sample as you would for a 1-D incremental consolidation test.
2. Go to the Consolidation Table. Select Step Type as Constant Volume. Your Stress value should correspond to the effective overburden stress. Then run your swell test.

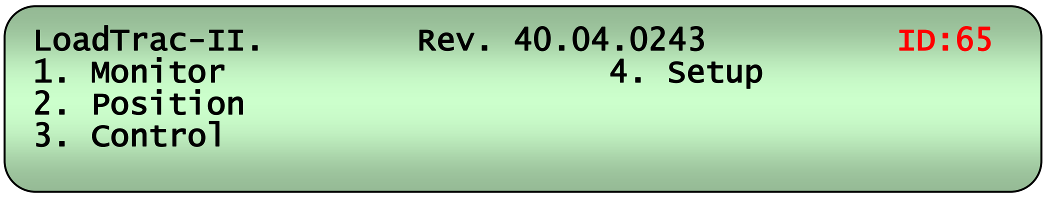
Q: When I start a test, the program gives me an error message that the calibration factor is too small. I cannot run the test. I checked the calibration summary table. All values for the calibration factors are there; however the LVDT calibration factor has a negative sign. What's wrong?

A: The software does not accept zeros or negative numbers for the calibration facto rs in the calibration summary. For convenience, we run the calibration on the LVDT backwards, hence the negative sign for the calibration factor. Remove the negative sign of the calibration factor in the summary table and you should be all set.

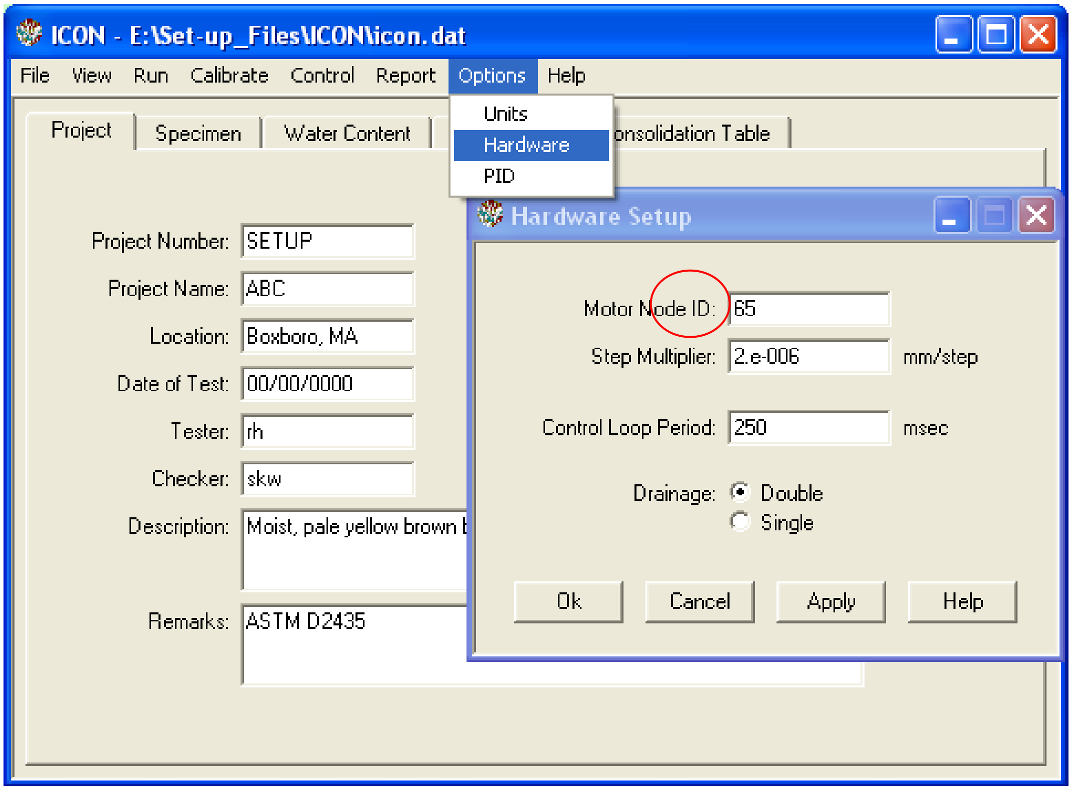


Q: There is no communication between the LoadTrac-II and the PC. What is going on?

A: Check that the Node ID on the LoadTrac-II matches the one in the ICON software program:



On the ICON software program go to Options then Hardware:



Q: We have several units connected to the same PC. We were running only one of the units, so we shut off the remaining units. Then we got an error message stating that the unit was not responding. It seems that we lost communication with the unit. What is happening?

A: A temporary loss of communication is a normal thing when you either shut off or boot up another unit connected to the same network. Any time a unit connected to the network is powered down or powered up, the network goes into a re-configuration mode, during which no communication is allowed. Depending on how many other units are on, this process may take some time. If you're lucky, the Windows software will miss it. If you're not so lucky, you get the normal 'LoadTrac not responding' message. All you have to do is hit the Retry button and you should be all set.

Q: I noticed that the engineering readings on the LCD screen are different than the ones on the PC screen. Are they supposed to be the same? Did it affect the results of a test I just ran?

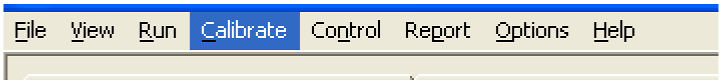
A:

<u>SYNCHRONIZING LCD AND PC SCREENS:</u>

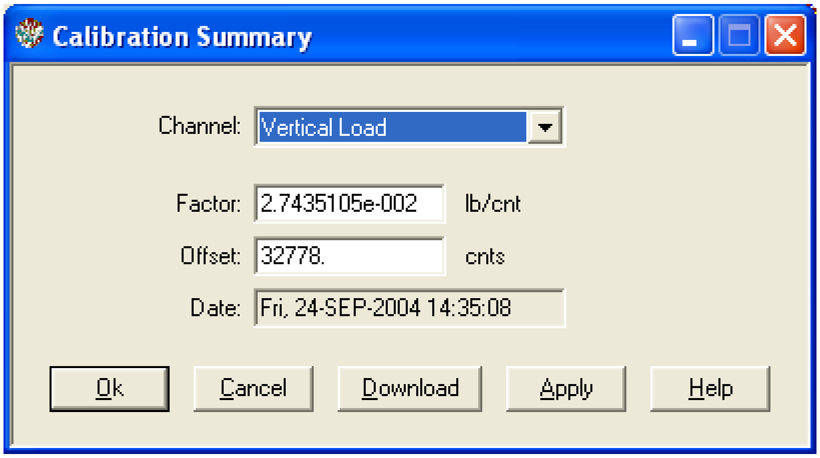
First, I would like to assure you that the mismatch of the engineering readings values between the LCD and the PC screens will not affect the results of any test that you have run through the PC software program.

Assuming that your calibration factors are correct, or that you have just finished a new calibration and need to update the calibration parameters on the embedded controller of the LoadTrac-II or FlowTrac-II or the ShearTrac-II, you can synchronize the engineering readings between the LCD and the PC screen by following these steps:

1. Go to the Calibrate Summary menu



2. Select the sensor that you want to synchronize



3. Click on the Download button. This will automatically transfer (copy and save) the current calibration parameters (Factor and Offset) into the embedded controller.

4. Repeat the above procedure for the other sensors.

You should now see that the PC and LCD screen values match.

Q: After an electrical power problem in our building, it seems that the system is not working properly. We suspect that the set-up values on the embedded controller are not correct. How do we revert to the original set-up values or default values set at the factory?

A: The default values may change either after an electrical power problem such a power surge or brown out or due to inadvertent actions by an inexperienced end user.

You will need to revert back to the internal default values of your system by following these easy steps:

1. Turn off the LoadTrac-II (or FlowTrac-II or ShearTrac-II) unit.
2. Wait about 10 sec.
3. Turn it back on and immediately press the ESC key on the keypad to reset everything back to the default values.
4. You may have to manually reenter the Node ID number. (For example, the default value for the LoadTrac-II is 65.)

Q: Can the software detect wrong values that are manually entered by the end user?

A: Yes, the software program detects any erroneous data entry; examples include:

1. Negative values for sample dimensions, calibration factors, and PID control parameters
2. Zero values for sample dimensions, calibration factors (except for offset value), and PID control parameters
3. Wrong Node ID number
4. A malfunctioning sensor that it is giving an analog reading of either 0 (the minimum value) or 65535 (the maximum value)
5. Any unit (LoadTrac-II or FlowTrac-II) that is not on.

Q: I am running a test right now. Do I need to wait until the end of the test to see the results?

A: You do not need to wait until the end of the test. While the test is running:

1. Go to the File menu.
2. Select and click on Load.
3. Go to the Report menu. You should now be able to see the partial data up to the point when you did the Load.
4. Repeat the above steps as the test progresses.

Q: In many of our different test files, the calibration values in the Summary Table and the values in each sensor's individual calibration table are not in sync. Could you please explain which values the program uses, and how to make sure they are correct?

A: All of the Geocomp control programs have similar menus for performing the calibration of any of the sensors related to the test. However, you must then copy the calibration that you obtained into the Summary Table. (If you have had to repeat the calibration procedure, be sure to use the correct value.)

The calibration factors in the Summary Table are the ones that the particular program uses when running a test.

In the case that you have multiple software test program modules, it is possible to have no calibration data in the calibration menu if a sensor was calibrated with a different one program than the one that you are using. Each program will only use the calibration factors contained in its Summary Table.

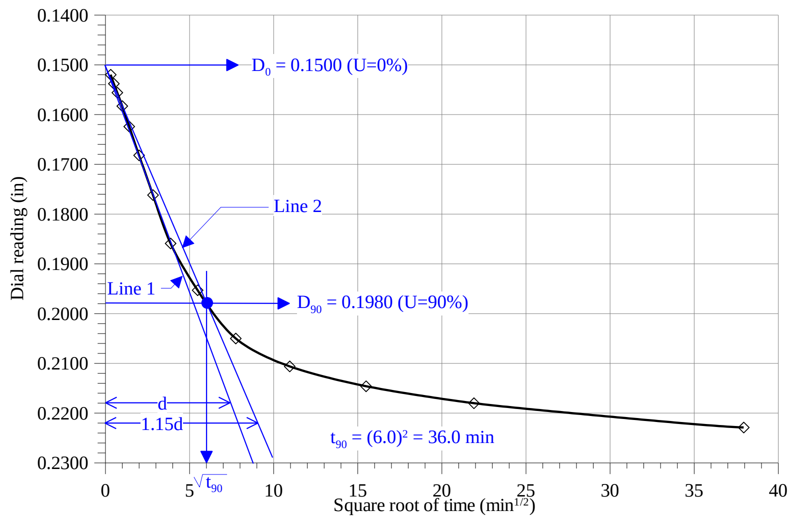
Q: If we set the maximum time for one loading to 24 hours, will the machine stop the stage after it detects that the displacement reading become constant? We set 10 loadings for the test and now, after almost 16 hours, it reached number 8. Can I know what criteria the machine uses to stop a certain stage?

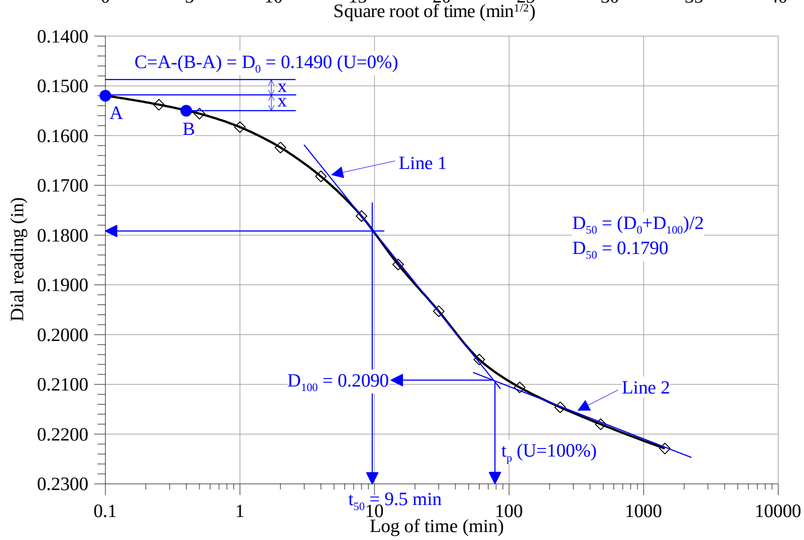
A: The program computes 100 % primary consolidation in real time (t), and then obtains T100. Once the time reaches T100, the program checks the max, min, and T100 offset times in the Consolidation Table.

If (t) > Tmin, it will wait an additional time equal to the T100 offset, then automatically move to the next step.

If (t) < Tmin, then it will wait until (t) equals Tmin, wait an additional time equal to the T100 offset, and then automatically move to the next step.

Thus, (t) will always be less than Tmax.





For example, T_{max} = 24 hrs, T_{min} = 1 hr, and T_{100} offset = 2 hr are entered by the end user.

Note: these T values can be different for each step, and the T values for subsequent steps can be changed EVEN during the test.

Case 1: If the T_{100} computed by the program is 1/2 hr, then the step will last 1 hr (T_{min}.) + 2 hrs (T_{100} offset) = 3 hrs, which is still less than T_{max} = 24 hrs.
Case 2: If the T_{100} computed by the program is 5 hrs, then the step will last 5 hrs (> T_{min}.) + 2 hrs (T_{100} offset) = 7 hrs, which is again less than T_{max} = 24 hrs.

Q: Can we turn off the PC while the test is running (because this test is time-consuming)?

A: No, absolutely NOT, but you can use other windows programs while the test is running. Also you can turn off the monitor only.

Q: While starting the test, the machine will ask "Position Platen?" When I press "Yes", the LoadTrac-II should move the platen up until it just touches the load cell, but how do I know whether the load cell is being touched? (The computer immediately asks me to "Press OK when ready," but I am not aware of any other indication that the proper condition for starting the test.)

A: The LoadTrac-II is an intelligent system with a closed loop control with the load cell sensor providing the feedback. It detects the contact by sensing a small load typically less than 0.50 lbs.

Q: Why is my final saturation value higher than 100%?

A: This value is sensitive to several factors:

- The specific gravity of the sample
- The water content
- The exact measurements of the inside diameter and height of the ring. (For instance, the diameter may be 2.489 inches instead of 2.500 inches, and the height may likewise vary. We recommend using precise calipers to measure the dimensions of the ring. This should only have to be done once.)

Q: How do you correctly enter the water content information?

A: In order to achieve proper computations of results of the consolidation test using the LoadTrac software and loading machine, it is important that careful attention to detail is necessary for the entry of data into the computer program.

<u>Specimen</u>

On the tab for specimen in the ICON computer test program, be sure the actual dimensions on the height and diameter of the sample are entered. The actual or specified Specific Gravity value must be inputted. If the Liquid Limit and Plastic limit are known or specified, these two items should be entered for reporting purchase in the printout of the test results produced by the software. Initial Sample Weight should be based on the actual mass of the sample to be tested (do not include the tare value).

Water Content

Proper entries of the correct values as used by the computer program must be entered to allow the program to correctly compute initial water content, final water content and void ratio. In this part of the computer program you will see sections labeled Before Test and After Test. Data entry should be as follows.

Before Test

Tare ID: This the name, number or other identifying label of the tare container itself. e.g. Icon1, Test2, canA, etc.

Tare Weight: this is the actual weight of the container identified above.

Wet Weight: this is the combined weight of both the tare and portion or trimmings of the wet sample to be tested.

Dry Weight: this is the combined weight of both the tare and portion or trimmings of the oven-dried sample to be tested.

After Test

This portion of the Water Content section has two parts: Specimen weight and Trimmings weight.

Specimen

Specimen Tare ID: insert the label "ring" as you will actually be inserting the weight of the ring without any sample and will clearly identify the actual part of the test apparatus used during the test.

Specimen Tare Weight: insert the weight of the consolidation ring, the separate component into which the test sample is extruded.

Specimen Wet Weight: insert the combined pre-test weight of the ring and the original wet sample (this should not include the weight of the filter papers and porous stones).

Trimmings

Trimmings Tare ID: this is the label name of the container, usually a large evaporating dish.

Trimmings Tare Weight: this is the weight of the tare or container identified above.

Trimmings Wet Weight: this the wet weight of the immediate post test sample plug which has been carefully ejected from the consolidation ring after the top and bottom filter papers have been removed, including the weight of the tare.

Trimmings Dry Weight: this is the oven dried weight of the tare and sample.

The computer program uses the water content of the trimmings to compute the After Test Dry Weight, the final water content of the sample and, together with the initial water content, the void ratio values, dry unit weight and saturation.

Q. How do I increase the responding time for the loading in the consolidation ?

A. According to ASTM standard D2435: **Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading** 1

Section 6.0

"Load application generally should be completed in a time corresponding to 0.01 t100 or less. For soils where primary consolidation is completed in 3 min, load application should be less than 2 s."

It is easy to increase the response time of the closed-loop control by increasing the P-Gain under Options→ PID.

The higher the P-Gain the faster the load is applied; however the control may overshoot the target load depending on the stiffness of the soil. You should use increments of 0.5 or less at a time.

One should keep in mind that when a load specially a high one is applied rapidly, a very soft soil can be 'shocked' (or even liquefied) and it is a very stiff one, the load may take time to converge to the target value by a steeper over and under shots (see plots below).

Note: The gain values can be changed on the fly while the test is running if further fine-tuning of the control is deemed necessary.

Sample stiffness	Recommended P-Gain

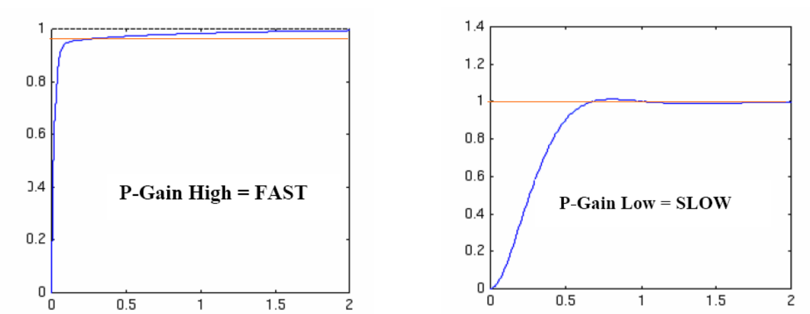
	value
LOOSE /VERY SOFT	5.0
MEDIUM SOFT/MEDIUM	2.0
DENSE/STIFF	0.5

Typical Elastic Moduli E, and Shear Moduli G values for soils are:

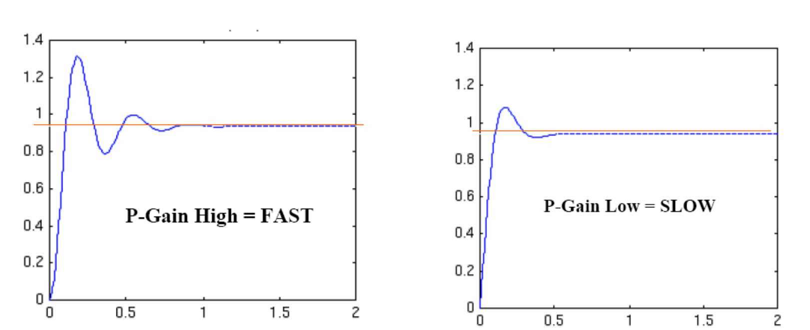
SOIL TYPE	Description	E kPa,	G kPa,
CLAY	Soft	1000-15000	500-5000
	Medium	15000-30000	5000-15000
	Stiff	30000-100000	15000-40000
	Very Stiff	> 100000	> 40000
SAND	Loose	10000-20000	5000-10000
	Medium	20000-40000	10000-15000
	Dense	40000-80000	15000-35000
	Very Dense	> 80000	> 35000

The default values are the recommended values that should work fine with the majority of soils. The following diagrams illustrate the effect of the PID control on different soils stiffnesses. See illustrative graphs.

Soft or Loose Soil Samples
Load or Pressure vs. Response Time



Stiff or Dense Soil Samples
Load or Pressure vs. Response Time



Q. What are the effects and correlations between the PID values?

A. Effects of each of controllers P-Gain, D-Gain, and I-Gain on a closed-loop system are summarized in the table shown below.

CL RESPONSE	RISE TIME	OVERSHOOT	SETTLING TIME	S-S ERROR
P-Gain	Decrease	Increase	Small Change	Decrease
I-Gain	Decrease	Increase	Increase	Eliminate
D-gain	Small Change	Decrease	Decrease	Small Change

Note that these correlations may not be exactly accurate, because P, I, and D are dependent of each other. In fact, changing one of these variables can change the effect of the other two. For this reason, the table should only be used as a reference when you are determining the values for P, I and D.

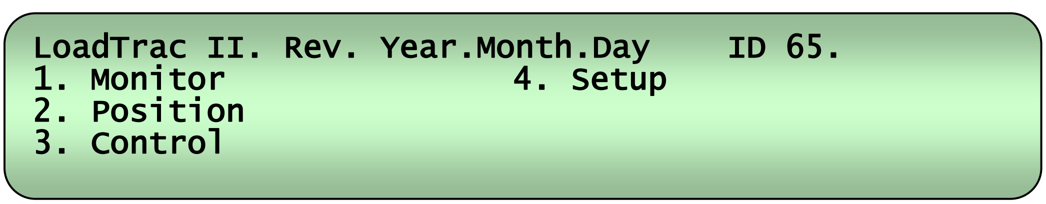
Q. I am processing the data from the consolidation test we ran on the new load frame. From the looks of the results, it appears that when the data is dumped in engineering units that the machine's compression of members corrections are NOT accounted for in the data dumped out. Is this correct?

A. Yes, the dumped data is not corrected for the machine compression. Use the corrected data from the Report-→ Table.

Q. I used our calibrated gauge blocks to check our displacement sensor on the load frame. It appears to give readings roughly one half the actual distance. I double checked that the calibration factor (in/cnt) from the certificate you gave us is in both the load frame and the software (factor = 3.6498841x10-5). Does this factor seem to be off by a factor of two, based on the other similar sensors you have calibrated?

A. The displacement sensor set-up in the LoadTrac-II must be reset to UNIPOLAR instead of BIPOLAR. Please follow these easy steps to change it:

- Using the keypap and the LCD screen go to option 4. SETUP



- Option 3: A/D setup
- Option 2: Channel 2
- Option 2: Polarity
- Select Unipolar

Next turn off the LoadTrac-II and back on for the changes to take effect.

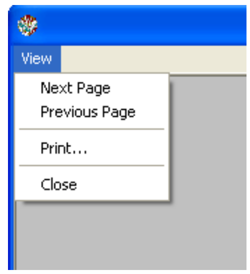
Q. Can I use a new calibration factor and apply it to the previous test I have already ran and get the correct results?

A. Yes, you can.

Q. The Network LED is RED on the front panel and there is no communication between the PC and the frame, all of our ID numbers are correct, what else should we check?

A. The network communication cable (gray cable) must be plugged into the Ethernet plug on the back of the PC instead of the network communication card that we provided. Please unplug the cable and replug into the card. The LED should turn into solid green.

Q. How can I print my tables and graphs at the end of the test?

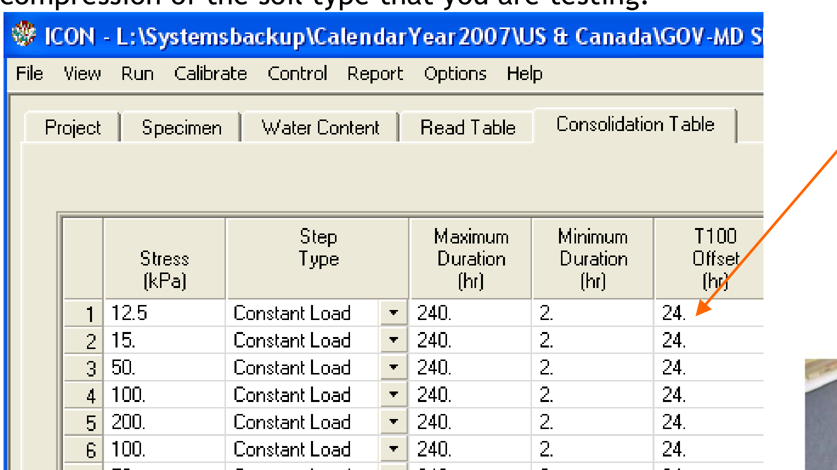


A. Follow these easy steps:

- Go to Report
- Graph
- Click on View on the upper left corner, then print

Q. We are doing some consolidation tests and we are unable to reach the secondary consolidation. What settings we have to change.

A. You need to increase the T100 offset time value to account for the particular secondary compression of the soil type that you are testing.



	Stress (kPa)	Step Type	Maximum Duration (hr)	Minimum Duration (hr)	T100 Offset (hr)
1	12.5	Constant Load	240.	2.	24.
2	15.	Constant Load	240.	2.	24.
3	50.	Constant Load	240.	2.	24.
4	100.	Constant Load	240.	2.	24.
5	200.	Constant Load	240.	2.	24.
6	100.	Constant Load	240.	2.	24.
7	50.	Constant Load	240.	2.	24.

Q. This is our first time that we are preparing a consolidation sample. Do you have any recommendation?

A. Preparing a sample for testing in Geocomp automated equipment is similar to normal sample preparation techniques.

Each consolidometer cell contains a stainless steel sample ring. Remove the sample ring. Note the knife edge of the sample ring. This must be the top of the sample as the edge also serves to center the sample within the cell. Weigh the sample ring to the nearest 0.01 gm. Use vacuum grease to lightly coat the inner

wall of the consolidation ring.

Your objective now will be to push the sample ring into your soil sample with a minimum of disturbance to the sample and with as little rocking of the ring relative to the sample as possible. It is possible to extrude a sample directly from a tube into the sample ring with the right setup. With some care you can extrude 40 mm to 50 mm (1.5 to 2.5 inches) of sample, set it on a flat surface, and with your hand press the sample ring into the sample, taking care to keep the ring from rocking. You may have to use a tool to trim away the excess soil outside the sample ring.

Once you have pressed the sample ring completely into the sample, use a wire saw to trim off excess material from the top and bottom of the sample. Save representative trimmings for a water content determination. Take care to trim both ends of the sample as cleanly as possible. When you are finished, you will have a 25.4 mm (1 inch) high sample.

Clean any soil from the exterior of the ring. Weigh the sample and ring to the nearest 0.01 gm. Place a moist piece of filter paper trimmed to the sample diameter on the bottom of the sample. Remove the bottom stone from the cell and place the sample plus ring onto it. Take care to avoid movement of the sample within the ring. Now carefully place the combination of bottom stone and sample into the cell so that the stone fits into the recessed bottom of the cell. The sample ring should be in the center of the bottom stone.

Place a moist piece of filter paper trimmed to the sample diameter on the top of the sample. Install the centering ring and add the knurled nuts. Tighten the nuts hand tight making sure that the sample is properly centered.

Position the top cap in place. You have now completed preparation of the sample.

Use the Lower option on the front panel to move the platen completely to the bottom position. Carefully place the cell containing the sample onto the platen. Try to avoid any drops or vibrations, slide and center the platen. The sample is ready to begin testing. Do not add water to the cell yet. Follow your standard testing procedure to test your sample.

Q. Although the Instruction Manual advises not to change the default PID values, the Troubleshooting section at the end of the booklet suggests different PID values for use with soft and hard samples? Is it possible to use other values than the three choices given? If so, how are we going to decide on what values to use? Please clarify.

A. The default values work for most of the soils; however in some case they do need to be fine-tuned to reflect the soil out of the normal range of stiffness such as for soft organic or highly stiff clays. So yes, you can change them by exercising caution (small increment in change at a time) in doing so.