SeeLevel II™

Tank Fluid Monitor

MODEL 900-D4D DUAL MANUAL

IMPORTANT OPERATOR INFORMATION

DATE INSTALLED:_____

TANK NUMBER: _____

MINIMUM TANK READOUT: _____

MAXIMUM TANK READOUT:_____

	ALARM HIGH VOLUME	ALARM LOW VOLUME	Normally Open or Normally Closed
ALARM 1			☐ NO ☐ NC
ALARM 2			☐ NO ☐ NC
ALARM 3			☐ NO ☐ NC
ALARM 4			☐ NO ☐ NC

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SEELEVEL II ™

Tank Fluid Monitor

MODEL 900-D4 SINGLE

Table of Contents

900D4D Manual_v3.3 - 12-Dec-2019

CHAPTER 1 - OVERVIEW

Congratulations on purchasing the Garnet Instruments Model 900 SeeLeveL II ™ Fluid Monitor for Tanks. The SeeLeveL II ™ represents the latest in state of the art liquid monitoring equipment for stationary tank applications. The SeeLeveL II ™ is designed for reliable and accurate level, volume, and temperature measurement of sour or sweet crude oil, chemicals, acids, water, or fuels. The liquid level is determined by sensing the position of a magnetic float using a series of reed switches arranged in a vertical sensing bar. This technology has no moving parts except for the float, and can operate over a range of product temperatures from -40°C to +90°C (-40°F to +194°F). The temperature is sensed by semiconductor temperature probes spaced every 16 inches along the inside length of the bar.

The SeeLeveL II components are weatherproof to allow installation in any environment. Most monitor functions operate entirely on internal batteries, so external power is not required in many applications. The displays can be continuously seen in the daytime and are visible at night with the push of a button. All functions on the gauge, including calibration, alarms, and security, can be programmed with the built in keypad. Remote communications, via 4-20mA or 1-5V standards, and alarms are available via terminal blocks inside the gauge display.

CHAPTER 2 - SYSTEM DESCRIPTION

The SeeLeveL II consists of a sender bar, a donut shaped float, a fiber optic interconnect cable, and a display. The sender bar is mounted vertically in the tank with the float sliding up and down around it in accordance with the fluid level. The sender bar sends the fluid level and temperature information via fibre optic cable to the display. The temperature is the average value of the sensors below the fluid level, so the air temperature above the fluid is ignored. The display shows the level, volume, temperature and alarm status to the user, and provides alarm and remote communication outputs.

The Sender and Float: The sender bar consists of a flexible 1/2 inch diameter polyethylene pipe with a head at the top end where the fibre optic cable connects. It is secured at the top of the tank by a compression fitting just below the head, and is secured at the bottom of the tank by an anchor fitting. The compression fitting provides the seal where the sender exits the tank, and the anchor keeps the sender bar vertical in the tank. This mounting system allows the sender bar to be removed from the top of the tank for servicing without having to go into the tank.

The float is molded from polyethylene for high chemical resistance and durability. The float contains magnets which activate reed switches inside the sender bar to indicate the level of the fluid, which is measured with a resolution of 1/4" throughout the tank. The activated switches are detected by a microprocessor at the top of the bar. The use of a digital rather than analog sensing technique lowers power consumption to permit battery operation and ensures high accuracy with no drift or degradation. The sender optically transmits the level and temperature information every two seconds via an LED located in the head, so the LED will appear to flash once every two seconds. There are electronic temperature sensors located every 16 inches inside the bar, one sensor is sampled and a new average is obtained every 2 seconds. For a 50 foot long bar, there are 37 sensors, which would require 74 seconds to sample all of them. All of the sensors below the fluid level are included in the average; the sensors above the fluid level are excluded, so the average temperature is for the fluid only, not the air or vapor above the fluid. The microprocessor operates from a 3.6 volt lithium battery module giving over 5 years of life, the battery module can be field replaced with simple hand tools.

IMPORTANT NOTICE: SENDER BAR LIMITS OF RESISTIVITY

The temperature of the product in the tank should be limited to approximately +90°C (+194°F). Damage to the float and sender bar can occur if this value is exceeded.

The float and tube used in the manufacturing of the sender bar is polyethylene. **It should be noted that certain corrosive products, as well as high concentrations of acid products, may attack the polyethylene and cause perforations to develop. It is the operator's responsibility to determine the products compatibility with the sender bar.**

WARNING: Perforation of the sender bar or heat damage is not warrantable.

The Fibre Optic Cable: The LED on the sender is connected to a plastic fibre optic cable which carries the information to the display. The fibre is used to maintain electrical isolation between the sender bar and the display, this way an electrical spark cannot occur in the tank, so no explosion hazard can exist with flammable liquids. The fibre optic cable is housed in a conduit for protection, and it can be disconnected at both ends for servicing. The type of fibre used has a 1.0 mm core diameter, and an outer jacketed diameter of 2.2 mm. It can be cut with a sharp knife; no stripping or other special preparation is needed.

The Display: The display receives the optical information from the sender, translates the signal into volume and temperature information to show to the user, generates 4-20 mA or 1-5V and digital signals for remote communication, and controls the alarm outputs.

Display LCDs: The display has 4 separate LCDs to show information. These LCDs have excellent daytime visibility, and have a backlight to allow night viewing as well. The backlight turns on whenever the ENTER/LIGHT button on the keypad is pressed.

The lower LCDs show the temperature of the products. It is the average of all of the sensors which are below the fluid level, so the temperature of the air above the fluid has no effect on the reading. The display can be programmed via the keypad to read out in degrees Fahrenheit or Celsius.

The upper two LCDs show product volumes. The upper left LCD shows fluid volume for tank 1 and the upper right shows volume for tank 2. Each LCD has 4 characters, these are programmed

to show any volume units (for example, barrels), so up to 9,999 can be shown, with the decimal able to be as 9.999, 99.99, 999.9, or 9999 with no decimal. The volume is programmed using the keypad, and a chart showing inches of level versus barrels of volume for the tank is required. If the tank has straight vertical sides so that the volume per inch of depth is constant throughout the tank, then the volume per inch can be entered and the display will calculate all of the inch versus volume table. Even though the gauge has 1/4" resolution, it is only necessary to program the volume for each whole inch; the display calculates the volume at the 1/4", 1/2", and 3/4" points. Programming is a two step process, first the chart of volume for the inches of level is entered, and then the offset has to be set to account for variations in tank height and sender mounting position. The display has different calibrations for the left and right displays.

If the INCHES button is pressed, the temperature LCD shows "Inch" and the other LCDs show the product level in inches for each of the volumes.

If the ALARMS button is pressed, the temperature LCD shows "ALAr" and the fluid temperature 2 LCD shows the current alarm status, based on the product level and the alarm set points. Alarms 1 to 4 are shown as "1234" on the LCD; if the alarm output is active, the number is shown and if the alarm output is inactive, the number is not shown. So for example, if the "12 4" is shown, it means that alarms 1, 2, and 4 are active, and 3 is not.

If the BATTERY button is pressed, the display will show the condition of the sender battery and the display batteries. The battery conditions can be "Good", "FAIr", or "Poor". If the batteries are FAIR, they should be replaced soon, and if they are POOR then the gauge may not function properly and the batteries must be replaced immediately.

The LCDs take on different roles during programming, but this is covered in the next chapter.

Display Keypad: The keypad consists of the 16 buttons on the front of the display. The keypad is used for the following functions:

- To show inches, alarm status, and battery condition as described above.
- To turn on the LCD backlight.
- To turn the gauge display on or off.

- To select °F or °C for the temperature display.
- To program the 4-20 mA outputs.
- To set the alarm points.
- To program the gauge calibration.
- To enter the security codes which control access to the various gauge functions.

Display Batteries: A set of four alkaline 'AA' cells in the display enclosure powers all gauge display functions except for the 4-20 mA outputs. This allows for total stand alone operation of the gauge. This battery pack should last from 3 to 4 years, depending on usage of the LCD backlight. The batteries can be field replaced with simple hand tools, and all programming is retained when the batteries are removed.

Display Alarms: The display has 4 alarm points each with a high and low set point all of which can each be programmed via the keypad to turn on or off at any level in the tank. Alarms 1 and 2 operate from the left volume (fluid volume 1) and alarms 3 and 4 operate from the right volume (fluid volume 2). The alarm outputs are transistors which conduct to ground, and are rated at 100mA at 24 volts. These outputs are for connecting to an external alarm system which has been designed to work with this type of output. The alarm outputs and ground are available at a terminal block inside the display enclosure.

WARNING: The use of alarm points is entirely at the owner's risk due to the nature of connecting external horns or lights, the reliability of external horns or lights, and the requirement for external switches to disarm them.

NOTE: The 900D4D is available from the factory with either a 4-20 mA output or a 1-5V output for volume and temperature.

Display 4-20 mA Outputs: The display has four 4-20 mA outputs available at terminal blocks inside the display enclosure. Two of the 4-20 mA outputs are the volumes; they derive their output values from the volume displays. 4.00 mA corresponds to an empty tank (for example, 0 barrels) and the user sets the full scale (20mA) value of the output. The display only has to be programmed once for all three outputs, so they must all have the same scale calibration. For example, if the user set the full scale at 400.0 barrels and the barrel reading was 300.0, then the 4-20 output would be 16.0 mA (300/400*16mA+4mA). These outputs can also be programmed to be off.

The other two 4-20 mA outputs always indicate the temperature as shown on the temperature displays. An output of 4.00 mA corresponds to -54.4°F (-48°C) and an output of 20.00 mA corresponds to +233.6°F (+112°C), for a scale of 18.0 °F/mA or 10.0°C/mA. This output scale cannot be changed by programming, but it will be turned on or off with the volume 4-20 outputs.

All of these outputs must be provided with external power to operate. A typical connection would be to connect an external +24 volts DC power source to the positive 4-20 mA output terminal, and connect the negative output terminal to the "hot" side of the remote equipment load resistor. The other end of the load resistor goes to ground. The current would produce a proportional voltage across the load resistor, which would be read by the remote equipment. Do not apply more than 30 volts across the outputs, and at least 7 volts must be maintained across them to work properly.

Unlike the digital display, the 4-20 mA signal is analog, so there may be some degradation in accuracy with it. Consequently, the remote equipment may read slightly different than the gauge display.

Display 1-5 V Outputs: The display has four 1-5V signals available at terminal blocks inside the display enclosure. Two of the 1-5V outputs are volume, they derives their output values from the two volume displays. 1.0V corresponds to an empty tank (for example, 0 barrels) and the user sets the full scale (5.0V) value of the output. For example, if the user sets the full scale at 400.0 barrels and the barrel reading was 300.0, then the 1-5V output would be 4.75V (300/400*5V+1V). These outputs can also be programmed to be off.

The other 1-5V outputs always indicate the temperature as shown on the temperature displays. An output of 1V corresponds to -54.4°F (-48°C) and an output of 5V corresponds to +233.6°F (+112°C), for a scale of 72.0°F/V or 40.0°C/V. This output scale cannot be changed by programming, but it will be turned on or off with the volume 1-5V outputs.

These outputs must be provided with external power to operate. A typical connection would be to connect an external +24 V and ground from the power source to the 1-5V PWR IN and 1-5V GND of each 1-5V output terminal, and connect the signal line to the 1-5V OUT. Do not apply more than 30 volts across the outputs, and at least 7 volts must be maintained across them to work properly.

Unlike the digital display, the 1-5V signal is analog, so there may be some degradation in accuracy with it. Consequently, the remote equipment may read slightly different than the gauge display.

Unlike the digital display, the 1-5V signal is analog, so there may be some degradation in accuracy with it. Consequently, the remote equipment may read slightly different than the gauge display.

Display Enclosure: The entire display is enclosed in a weatherproof fiberglass enclosure with a hinged cover. This provides all weather operation and easy access to the internal batteries. The enclosure must always be kept tightly closed when not changing batteries to prevent water damage to the electronics. Never open the display enclosure when rain or water could enter the box.

CHAPTER 3 - KEYPAD OPERATING INSTRUCTIONS

The keypad consists of the 16 buttons on the front of the display, and is used for the following functions:

1. To show inches, alarm status, and battery condition as described in the previous chapter.
2. To turn on the backlight.
3. To turn the gauge display on or off.
4. To select Fahrenheit or Celsius for the temperature display.
5. To program the 4-20 mA outputs on/off or to set the volume 4-20 mA calibration scale factor.
6. To set the alarm points.
7. To set the gauge offset (the zero point).
8. To enter a linear calibration factor for the volume display.
9. To enter a point by point calibration table for the volume display.
10. To allow the memory to be copied or programmed remotely.
11. To enter the 4 digit short user code which permits access to functions 3 and 4 only.
12. To enter the 6 digit long user code which permits access to functions 5 and 6 only.
13. To enter the 8 digit master code which permits authorized personnel to set the user codes and to access functions 7 to 10.

Since the operation of the gauge can be severely compromised by improper keypad use, there are security features incorporated into the gauge. These security features also allow the owner of the tank to better manage rentals and billing by being able to control access to the gauge functions. For example, the gauge can be shut off, or only the visual display functions can be turned on.

There are three levels of security, as indicated by three different access codes:

1. Short User Code: this is a four digit code used by the customer to turn the gauge on and off and to select Fahrenheit or Celsius temperature readouts only. This can be used when a customer rents a tank with the gauge turned off, and later decides to use the gauge, but without any remote communications or alarms. The customer can be told the code over the phone

so he can turn the gauge on, which saves the tank owner the trouble of having to travel out to the tank to turn on the gauge. The initial code out the door is 1234; this can be changed with the master code.

2. Long User Code: this is the short code with two more digits added to it, thus by knowing the long user code the customer also knows the short user code. This allows the customer to turn the gauge on and off, select Fahrenheit or Celsius temperature readouts (using the short user code), turn the 4-20 mA/1-5V and digital outputs on or off, set the volume 4-20 mA/1-5V calibration, and set alarm points (using the long user code). This is useful when a customer rents a tank with the gauge or remote communications turned off, and later decides to use these functions. The customer can be told the code over the phone so he can activate these functions, which saves the tank owner the trouble of having to travel out to the tank to program the gauge. The initial code out the door is 123456; this can be changed with the master code.
3. Master Code: this is an eight digit code used by management and the installer to set the user codes and the gauge display calibration. It provides complete access to all gauge functions. It cannot be changed; it is coded into the microprocessor permanent memory. The Master code is available when requested. This code should not be revealed to anyone who does not need to know.

The following are instructions for accessing and programming various gauge menus and functions.

To turn on the backlight:

1. Press the LIGHT button. The backlight will turn on and remain on for a few seconds. Do not hold the button down, since if it is held down too long the gauge will enter programming mode.

To show battery condition:

2. Press the BATTERY button on the bottom right side of the keypad. The backlight will turn on and the battery status of the display and sender bar will be shown for a few seconds.

To access the Short User Code (SUC) menu (display on/off & °F/°C selection):

1. Press and hold **ENTER** until "**SECU COdE"** appears (this will take approximately 5 seconds).
2. Enter the 4 digit short user security code (it will be shown as you enter it) and press **ENTER**. If the code is incorrect, the gauge will exit programming mode.
3. **DISPLAY ON/OFF MENU:** If the code is correct the display on/off menu will be accessed, the display will show **"dISP On"** or **"dISP OFF"** indicating whether display is currently on or off. Press the ↑ **UP** button to turn the display on, or the ↓ **DOWN** button to turn the display off.
4. Press **ENTER** to store the new display status, **"Stor"** will be shown momentarily.
5. **DEGREES F/C MENU:** Press ↑↑ **FAST UP** to access the °F/°C menu, the display will show **"tEPr °F"** or **"tEPr °C"** indicating which mode is currently active. Press ↑ **UP** to select degrees Fahrenheit or ↓ **DOWN** to select degrees Celsius.
6. Press **ENTER** to store the new temperature format, **"Stor"** will be shown momentarily.
7. **TANK ID MENU:** Press ↑↑ **FAST UP** to access the Tank id menu. This allows the tank to be given a four digit number. The feature will be fully implemented in the future.
8. **EXIT MENU:** To exit the programming mode, press ↑↑ **FAST UP** to access the exit menu, the display will show **"SUC donE"**. Press **ENTER**, **"Prog donE"** will be shown momentarily and the gauge will return to normal operation.
9. If a menu is left without pressing **ENTER**, any change to that menu item will NOT be stored. If no button is pressed for 3 minutes then the gauge will exit programming mode and any changes which have not been stored will be ignored.

To access the Long User Code (LUC) menu (alarm point & 4-20mA calibrations):

1. Press and hold **ENTER** until **"SECU COdE"** appears (this will take approximately 5 seconds).
2. Enter the 6 digit long user security code (it will be shown as you enter it) and press **ENTER**. If the code is incorrect, the gauge will exit programming mode.
3. **ALARM SET MENU:** If the code is correct then the alarm set menu will be accessed, the display will show **"A1HC"** or **"A1HO"** followed by some volume amount. For interface

displays, A1 and A2 are driven by the total volume, and A3 and A4 are driven by the interface volume. For dual displays, A1 and A2 are driven by the left volume, and A3 and A4 are driven by the right volume. The display shows the alarm number, the polarity, high or low set point, and the alarm set point. Each alarm now has two points for activating and deactivating the alarm, a high point and low point. The alarm will be activated when the display goes above the high set point but will not be deactivated until the display goes below the low set point. For example, for alarm 1 high set at 535.4 barrels with the alarm contacts closed (alarm active) when the product level is below the set point (contacts open/alarm inactive at the set point and above), the display would read **"A1HC 535.4"**. Another example, for alarm 3 low set at 45.2 barrels with the alarm contacts open (alarm inactive) when the product level is below the set point (contacts closed/ alarm active at the set point and above), the display would read **"A3LO 45.2"**.

4. Press ↑ **UP** or ↓ **DOWN** to move the alarm set point up or down. Each time the button is pressed the point is moved by one inch. To get close to a point quickly, there are five speed buttons: press **4** to increase by 10 inches, press **1** to decrease by 10 inches, press **5** to increase by 50 inches, press **2** to decrease by 50 inches, or press **0** to set the alarm point to zero. To toggle the polarity (alternate between closed and open) press the decimal point button.
5. Press **ENTER** to store the new alarm setting, **"Stor"** will be shown momentarily.
6. To access other alarm menus, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN**. If an alarm menu is left without pressing **ENTER**, any change to that menu item will NOT be stored.
7. **4-20mA MENU:** To access the 4-20 mA menu, press ↓↓ **FAST DOWN** until the display shows "**4-20**" followed by some volume amount. This menu is always labeled as 4-20 even if the display is configured as 1-5V. The volume amount is the full scale (20 mA) value. To obtain the scale, simply divide this amount by 16 to get the number of barrels per mA. If the 4-20 output is off, then the display will show "**4-20 OFF**" indicating that the output is turned off. If the display has been shipped with the 1-5V option, then 5 volts corresponds to 20 mA.
8. Press the number buttons (and the decimal if required) to enter the desired full scale 4-20 mA volume (that is, the value in barrels for 20mA output); the existing value will disappear and the new value will be shown. The decimal point location must match the decimal point for the calibration, for example,

if the calibration is entered with 2 numbers after the decimal point, then the 4-20 full scale value must also have 2 numbers after the decimal point as well. The display will show "dECI" after ENTER is pressed if the decimals do not match, if this occurs simply re-enter the correct value. If more than four digits are entered, the first ones will scroll off the left side of the display. If a second decimal point is entered, the first one will disappear. The minimum value is 0.051/0.51/5.1/51 barrels, the status display will show "toLo"(too Low) after ENTER is pressed if a smaller number is attempted, if this occurs simply re-enter the correct value. The decimal point is only valid as X.XXX or XX.XX or XXX.X, a trailing decimal (XXXX.) will be ignored.

9. To turn the 4-20 mA output off, enter a single "0" and press ENTER.
10. Press **ENTER** to store the new 4-20mA value, the display will show "**CALC**" while the gauge calculates the 4-20 calibration, then "**Stor**" will be shown momentarily. If **ENTER** is pressed without any number buttons being pressed, a blank value will be stored and the 4-20 output will not function properly.
11. **EXIT MENU**: To exit the programming mode, press ↑↑ **FAST UP** until the exit menu is accessed, the display will show "**LUC donE**". Press **ENTER**, "**Prog donE**" will be shown momentarily and the gauge will return to normal operation.
12. If a menu is left without pressing **ENTER**, any change to that menu item will NOT be stored. If no button is pressed for 3 minutes then the gauge will exit programming mode and any changes which have not been stored will be ignored.

To access the Master Code menu (volume calibration, user code, and copy mode):

1. Press and hold **ENTER** until "**SECU COdE**" appears (this will take approximately 5 seconds).
2. Enter the 8 digit master security code (it will be shown as you enter it) and press **ENTER**. If the code is incorrect, the gauge will exit programming mode.
3. **USER CODE MENU:** If the code is correct then the user code menu will be accessed, the display will show "**USEr CodE XXXX XX**", which is the existing user code.
4. Press the number buttons to enter the new six digit code, the existing code will disappear from the appropriate display and the new value will be shown. If exactly six digits are not entered, then "**Err**" is shown momentarily and the

previous code reappears. If the number of digits is correct, then "**Stor**" will be shown momentarily and the new code will be stored.

5. **COPY MENU:** To access the copy menu, press ↓↓ **FAST DOWN** until the display shows "**COPY**". This allows remote copying or programming by releasing control of the memory so that the 900M remote programmer can access it.
6. Follow the directions for the remote programmer to perform the desired functions. The gauge will stay in this mode for about 3 minutes, and will automatically return to normal operation if no button is pressed. If more time is needed then press any number button before the 3 minutes is up to reset the timer.
7. **OFFSET MENU:** The display must be connected to the sender bar in order to set the offset. To access the offset menu, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the top left display shows "**OFFS**". The top right display will show "**XXX.X**" which is the fluid level in inches using the existing offset programmed into the display, and the lower displays will show the number of inches the bar output is changed to obtain the proper fluid level (this number can be positive or negative). This bottom number is for reference only; it is never shown during normal operation. If the top right display shows "**tohi**" then the fluid level has been set to over 960 inches, which is taller than the tallest possible sender bar.
8. Determine where to set the offset. If the tank is empty, measure from the bottom of the tank to the middle of the vertical part of the float (for interface displays measure to the top float, making sure that there is at least two inches between the floats). If the tank has fluid in it manually gauge the fluid level (top fluid level for interface displays). Set the top left display inch reading to match this value using the ↑ **UP** or ↓ **DOWN** buttons, or to quickly get close to a desired value, there are three speed buttons: **0** resets the offset to zero, **1** decreases the offset by 10 inches, and **4** increases the offset by 10 inches.
9. The volume calibration (barrel) displays, the 4-20mA/1-5V outputs, and the alarms will all track with the inch reading, so it is only required to set the offset once using the inch reading for the float.
10. Press **ENTER** to store the new offset value, "**Stor**" will be shown momentarily.
11. **LINEAR CALIBRATION MENU:** For a tank with straight vertical sides, the volume per inch of depth is constant throughout the tank. In this case, it is not necessary to enter a complete calibration table; the gauge can calculate the table

from a single value.

12. Determine the volume corresponding to one inch of level, for example if the tank was a 400 barrel, 20 foot tank, this would be 400 bbls / (20 ft * 12 in/ft)" = 1.66666666--- barrels per inch. Determine how many decimal places you want to show on the display, in our example the volume could be shown as 400.0 or just 400 with no decimal. The display can only have 4 digits, so 400.00 would not be an option. It is best to match the gauge resolution with the number of decimal places, so in this case 1/4" of level would be about 0.4 bbls, so one decimal place would be appropriate. The gauge would read 0.0, 0.4, 0.8, 1.2 bbls etc. If no decimals were used, then the gauge would show the same barrel reading for 2 or 3 different inch readings in a row. Once this information has been determined, write down the volume per inch with 4 additional digits after the last digit to be displayed, these are used to prevent round off error. In our example, if we chose one decimal place to be displayed, we would write down 1.6 6667 as our volume per inch, the first 6 is displayed and the 6667 are for round off error prevention. As another example, if we had a 1000 bbl, 16 foot tank, then the volume per inch would be 1000bbls/(16ft*12in/ft)=5.2083333 bbls/in. The gauge resolution is 5.208333/4=1.3 bbls per 1/4". In this case displaying only even barrels would be appropriate, since we cannot resolve less than one barrel. So the volume per inch to write down for this example would be 5 2083, no decimal is used by the gauge in this case.
13. The gauge requires exactly 8 digits to be entered for the volume per inch, so extra zeros need to be added in front of the number to get 8 digits. For our examples, in the first case we would get 001.6 6667 and for the second case we would get 0005 2083 as the numbers to enter into the gauge. These numbers should be recorded with the gauge for any future servicing requirements.
14. To access the linear calibration menu, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the display shows "**Lin CAL**".
15. Enter the volume per inch from the previous step, if you make a mistake press ↑↑ **FAST UP** and ↓↓ **FAST DOWN** to restart the program. Enter the digits and decimal exactly as written from the previous step, including the leading zeros. The numbers will appear on the top displays as you enter them.
16. As soon as the eighth digit is entered, the display will show "**Stor**" on the bottom display and the gauge will calculate the calibration for the entire tank. This will take a few seconds, when it is done the gauge will go to the table calibration

menu to allow viewing of the calculated calibration table.

17. **CALIBRATION TABLE MENU:** If the tank does not have straight vertical sides (such as a round tank on its side), the volume per inch of depth is not constant throughout the tank. In this case, it will be necessary to enter a complete calibration table. Fortunately, only the whole inch values need to be entered, the gauge will calculate the 1/4" values.
18. To access the calibration table menu, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the bottom displays show "**CAL tAbL**". The top left display will go to 0.0 inches, and the existing volume calibration for 0 inches will be shown on the top right display (which will likely be 0).
19. Press the number buttons (and the decimal if required) to enter the desired barrel calibration value, the existing value will disappear from the top right display and the new value will be shown. If more than four digits are entered, the first ones will scroll off the left side of the display. If a second decimal point is entered, the first one will disappear. The decimal point is only valid as X.XXX, XX.XX, or XXX.X, there is no decimal for .XXXX or XXXX., they will be ignored and not displayed if entered. It is important to maintain the same decimal location for the entire table, since the calibration value and decimal location for the 1/4, 1/2, and 3/4 inch points may be incorrect between the points where the decimal point is moved.
20. Press **ENTER** to store the entered volume calibration and to advance to the next inch value. IF **ENTER** is pressed without putting in a numerical value, then "0" will be stored. Note "**Stor**" does NOT show during this procedure, since that would slow down the table entry process.
21. Continue entering the calibration values for the rest of the table. You can review the calibration entries by pressing ↑**UP** or ↓ **DOWN** to move through the table. Press and hold ↑**UP** or ↓ **DOWN** to scroll quickly. Note that even though only even inch values are entered and shown in the review, the gauge will calculate and display the values for the fractional inch points during normal gauge operation. Also, the gauge will automatically show the correct number of leading zeros during normal operation, even if they are not entered. For example, if .08 is entered, it will be shown as 0.08 during normal operation, or if 004 is entered it will be shown as 4 during normal operation.
22. When the table has been entered, scroll through the table

values to verify the values.

23. If it is confusing to see existing volume calibration values during table entry, you can erase the entire table by entering all zeros in the linear calibration menu. This will put a single "0" throughout the table.

24. EXIT MENU: To exit the programming mode, press ↑↑ **FAST UP** until the exit menu is accessed, the display will show "**CAL donE**". Press **ENTER**, "**Prog donE**" will be shown momentarily and the gauge will return to normal operation. The software release number is shown in this menu as well, for example "**rEL 3.00**".

25. If a menu is left without pressing **ENTER**, any change to that menu item will NOT be stored. If no button is pressed for 3 minutes then the gauge will exit programming mode and any changes which have not been stored will be ignored.

CHAPTER 4 - INSTALLATION GUIDE

Since installation details can vary widely with application, contact Garnet Instruments Ltd. for installation details.

CHAPTER 5 - TROUBLESHOOTING GUIDE

There are only 5 serviceable components in the monitor: the float, the sender bar, the interconnecting fibre optic cable, the display, and the batteries. If the float is sunk, the display will read the bottom tank reading all the time. If the float is partially sunk, the reading may rise and then fall as the tank is filled. If the float has lost its magnets, the reading on the display will show "noFL".

If the fibre is damaged or the sender bar is dead, the display will read "no L". If the light level is poor due to a damaged or excessively bent fibre, or if the fibre is not fully inserted, the display may show bad light as "bL:xx" where xx is the number of bits received. If the fibre optic cable is disconnected from the display, a flashing red light should be visible from the end of the fibre.

If the display batteries are dead, the display will be dim or blank, or read "no L" or "bL:xx", and the LCD backlight will not work. If the display reads erratically, check for water inside the sender head or display.

To test a sender bar:

1. Make sure the sender is flashing once every 2 seconds from the optical connector. If not, replace the battery module. If this doesn't help, the sender is dead and must be replaced.
2. If the sender is flashing, plug a piece of fibre into the sender optical connector and the other end of the fibre into the optical input of a display that is known to be good, the display should show a volume value.

To test a display:

1. The display should show "no L" with no fibre connected, if not then the display must be replaced. However, if the optical input is exposed to ambient light the display may read "bd L" or "Sun". The display may "hang up" or freeze if it is exposed to a static shock or strong radio signals, it should automatically reset within several seconds.
2. If the LCD works but not the backlight, check the batteries and the battery holders. Make sure no corrosion or debris is preventing contact. If the backlight still does not work, the display must be replaced.
3. For other problems, plug the display into a bar that is known to be good to see if it is operating properly.

CHAPTER 6 - MASTER CODE

The Master code is available upon request.

Note: This code should not be revealed to anyone who does not need to know.

CHAPTER 7 - SPECIFICATIONS

Resolution:	1/4 inch (6 mm)
Accuracy:	+/- 1/8 inch (3 mm)
Display temp. range:	-40 to +140°F (-40 to + 60°C)
Product temp. range:	-40 to +194°F (-40 to + 90°C)
Display temp. drift:	0
Alarm temp. drift:	0
Sender materials:	Sender bar is polyethylene or optional 316 SS.
Sender temp. sensors:	Number of senders is the sender bar length divided by the sender spacing of 16”.
Sender battery:	3.6 volt lithium battery module, 5 year expected lifetime. Battery module can be replaced by field personnel.
Float:	Cylindrical, approximately 7.25 inches diameter by 4.5 inches high. Float material is polyethylene.
Display enclosure:	NEMA 4 rated fiberglass molded enclosure, 6 inches wide by 8 inches high by 4 inches deep.
Display type:	Four LCD displays, 0.50 inch character height, backlit for night viewing. Volume displays can show up to 9999, and is programmed from tank volume chart. Level (inch) display can show up to 959.7 inches of level. Temperature display can show from –40°C to 100°C in 1° increments, or from –40°F to 212°F. Displayed temperature is an average of all immersed sensors. Alarm display shows active alarms. Battery display shows display and sender battery conditions.
Display batteries:	Four alkaline “AA” batteries power all display functions, expected lifetime is 3 to 4 years. Batteries can be replaced by field personnel.
Display keypad:	16 button pad for calibration entry, alarm setting, remote communications programming, security code entry, gauge on/off control, and backlight activation.
Remote communications:	Four 4-20 mA outputs, three programmable for volume, the other for temperature (fixed calibration). These outputs must be externally powered with at least 8 volts available for the outputs.
Alarms:	4 alarms, each consisting of a transistor conducting to ground with a rating of 1mA @ 24VDC. Alarms 1 and 2 operate from the total (top float) fluid level, and alarms 3 and 4 operate from the below interface (bottom float) fluid level. An external alarm manager is recommended to operate alarm devices.

CHAPTER 8 - SERVICE & WARRANTY INFORMATION

The warranty will only apply if the warranty has been registered online from the Garnet Instruments registration web page.

Go online to seelevelsupport.com/ and select "Register Warranty".

DISCLAIMER OF WARRANTY ON HARDWARE

Garnet Instruments warrants equipment manufactured by Garnet to be free from defects in material and workmanship under normal use and service for a period of one year from the date of sale from Garnet or an Authorized Dealer. The warranty period will start from the date of purchase or installation as indicated on the warranty card. Under these warranties, Garnet shall be responsible only for actual loss or damage suffered and then only to the extent of Garnet's invoiced price of the product. Garnet shall not be liable in any case for labor charges for indirect, special, or consequential damages. Garnet shall not be liable in any case for the removal and/or reinstallation of defective Garnet equipment. These warranties shall not apply to any defects or other damages to any Garnet equipment that has been altered or tampered with by anyone other than Garnet factory representatives. In all cases, Garnet will warrant only Garnet products which are being used for applications acceptable to Garnet and within the technical specifications of the particular product. In addition, Garnet will warrant only those products which have been installed and maintained according to Garnet factory specifications.

LIMITATION ON WARRANTIES

These warranties are the only warranties, expressed or implied, upon which products are sold by Garnet and Garnet makes no warranty of merchantability or fitness for any particular purpose in respect to the products sold. Garnet products or parts thereof assumed to be defective by the purchaser within the stipulated warranty period should be returned to the seller, local distributor, or directly to Garnet for evaluation and service. Whenever direct factory evaluation, service or replacement is necessary, the customer must first, by either letter or phone, obtain a Returned Material Authorization (RMA) from Garnet Instruments directly. No material may be returned to Garnet without an RMA number assigned to it or without proper factory authorization. Any returns must be returned freight prepaid to: Garnet Instruments, 286 Kaska Road, Sherwood Park, Alberta, T8A 4G7. Returned warranted items will be repaired or replaced at the discretion of Garnet Instruments. Any Garnet items under the Garnet Warranty Policy that are deemed irreparable by Garnet Instruments will be replaced at no charge or a credit will be issued for that item subject to the customer's request.

If you do have a warranty claim or if the equipment needs to be serviced, contact the installation dealer. If you do need to contact Garnet, we can be reached as follows:

CANADA
Garnet Instruments
286 Kaska Road
Sherwood Park, AB T8A 4G7
CANADA
email: info@garnetinstruments.com

UNITED STATES
Garnet US Inc.
5360 Granbury Road
Granbury, TX 76049
USA
email: infous@garnetinstruments.com