SEELEVEL II ™
Tank Fluid Monitor

MODEL 900-D6 QUAD 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-D6Q QUAD

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Congratulations on purchasing the Garnet Instruments Model 900D6 SᴇᴇLᴇᴠᴇL II ™ Fluid Monitor for Tanks. The SᴇᴇLᴇᴠᴇL II ™ represents the latest in state of the art liquid monitoring equipment for stationary tank applications. The SᴇᴇLᴇᴠᴇL 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 SᴇᴇLᴇᴠᴇL 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 and alarms are available via terminal blocks inside the gauge display.

Quad version displays volume of up to four tanks full time, with temperature, inches of level, and alarm status available at the press of a button.

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 fiber 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 3/4 inch aluminum reinforced polyethylene pipe or a 1 inch 316 seamless stainless steel tube with a head at the top end where the fiber 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. A stainless steel float is also available. 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 Fiber Optic Cable: The LED on the sender is connected to a plastic fiber optic cable which carries the information to the display. The fiber 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 fiber optic cable is housed in a conduit for protection, and it can be disconnected at both ends for servicing. The type of fiber 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 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 4 displays show the volume of the fluid of 4 tanks, the five numbers can be programmed to show any volume units (for example, barrels), so up to 99,999 can be shown, with the decimal able to be set as 9.9999, 99.999, 999.99, 9999.9, or 99999 with no decimal. The volume is programmed using the keypad. 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 increments. 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.

If the **INCHES** button is pressed, the LCDs show the level of the tanks in inches, based on the product level.

If the **TEMP** button is pressed, the LCDs show the temperature of the product in each tank. The temperature shown is the average of the sensors below the fluid level, eliminating the temperature of the air above the fluid and therefore not effecting the temperature reading. The display can be programmed via the keypad to read out in degrees Fahrenheit or Celsius.

If the **ALARMS** button is pressed, the LCDs show 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 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 set the alarm points.
- To test the alarms.
- 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 'D' cells in the display enclosure powers all gauge display functions. This allows for total stand alone operation of the gauge. The battery pack should last from 3 to 4 years, depending on usage of the LCD backlight. A display with the optional 901D6 cellular or 904D6 satellite communications board use 8 'D' cells. The battery life of the 901 cellular, 903 wireless, and 904 satellite very depending on their configured update frequency. The batteries can be field replaced with simple hand tools, and all programming is retained when the batteries are removed. The 902 Modbus option requires external 12 or 24 volt power.

Display Alarms: The display has 4 alarm points which can each be programmed via the keypad to turn on or off at any level in the tank. 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.

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.

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

1. To show inches, temperature, alarm status, and battery condition as described in the previous chapter.
2. To turn on the backlight.
3. To test the alarms.
4. To turn the gauge display on or off.
5. To select Fahrenheit or Celsius for the temperature display.
6. To program the SMS phone number for alarm updates. (901 only)
7. To set gauge identification numbers of each tank.
8. To view the satellite IMEI identification number. (904 only)
9. To view the last eight radio error codes.
10. To view radio signal strength level. (901,902,904 only)
11. To set the serial communication on or off.
12. To set the alarm points.
13. To select SMS phone on or off. (901 only)
14. To select data upload on or off. (901,904 only)
15. To set the gauge offset (the zero point).
16. To enter a linear calibration factor for the volume display.
17. To enter a point by point calibration table for the volume display.
18. To allow the memory to be copied or programmed remotely.
19. To set the serial output to match optional board installed.
20. To select satellite data logging on or off. (904 only)
21. To view satellite diagnostic values. (904 only)
22. To set the cellular TCP address destination and port. (901 only)
23. To enter the 4 digit short user code which permits access to functions 4 to 10 only.
24. To enter the 6 digit long user code which permits access to functions 11 to 14 only.
25. To enter the 8 digit master code which permits authorized personnel to set the user codes and to access functions 15 to 22.

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 controlling access to the gauge functions. For example, using the Short User Code, the tank owner may choose to turn off the gauge display for rental customers that do not want to rent the tank gauging system. In this case the gauge will display OFF instead of showing tank volume readings. When using the 901 cellular option, the tank owner may also turn off the data upload and SMS phone alarms using the Long User Code. When using the 904 satellite option, the tank owner may turn off the satellite data uploads by choosing SATELLITE OFF using the Master Code. When this is done only GPS location data is uploaded to the web site and all other satellite functionality is turned off.

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. 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. The short user code can also be used to change the SMS phone number used by 901 cellular alarm updates, to view the IMEI identification number for the 904 satellite, to set the gauge identification number, to view the last eight radio error codes, and to test the signal strength for the 901 cellular, 902 wireless, and 904 satellite options.

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 serial communication on and off and to set alarm points. The initial code out the door is 123456, this can be changed with the master code. The long user code can also be used to select whether SMS phone messages are sent for the 901 cellular option, and to turn data uploads on or off for the 901 cellular and 904 satellite options.

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. Each installer/service provider has their own Master code and the Master code is available upon

request from the installer/service provider. The master code can be used to configure the installed 900D6 optional boards, turn 904 satellite option uploads on and off, view 904 satellite options diagnostic information, and set the 901 cellular option's TCP address destination and port. **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:

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:

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 test the alarms:

Press the **3** button to test the alarms. The display will show "**Hi ALAr tESt 1234**" and the complement of the alarm status for level at 0 inches is sent to the alarm outputs.

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

1. Press and hold **ENTER** until "**SECUr 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**. The ↓ **DOWN** button will backspace if an incorrect button is pressed. 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 IS On**" or "**dISP IS 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, "**StOrE**" will be shown momentarily.
5. **DEGREES F/C MENU:** Press ↑↑ **FAST UP** to access the °F/°C menu, the display will show "**tEPErAturE UnitS °F**" or "**tEPrAturE UnitS °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 , "**StOrE**" will be shown momentarily.

7. **GAUGE ID MENUS:** Press ↑↑ **FAST UP** to access the Tank id menus, the display will show "**GAUGE IdEnt**" in the top LCD displays and "**GAU 1**", "**GAU 2**", "**GAU 3**", or "**GAU 4**" in the bottom left LCD. This allows each tank to be assigned a five digit number in the bottom right LCD.

8. **PHONE NUMBER MENU:** Press ↑↑ **FAST UP** to access the Phone no. menu, the display will show "**PhonE no.**". Enter the ten digit cellular phone number for alarm notifications to be sent to. This is only shown if configured with 901 cellular option.

9. **SATELLITE IMEI ID:** Press ↑↑ **FAST UP** to access the Satellite IMEI id menu, the display will show "**SAt Id.**" followed by the 15 numeric IMEI identification number. This is only shown if configured with 904 satellite option.

10. **SATELLITE DATE MENU:** Press ↑↑ **FAST UP** to access the Satellite date menu, the display will show "**dAtE**" in the upper left and the numeric month-date in the upper right window. The display will show "**UtC**" followed by the Coordinated Universal Time "hour" in the bottom left window and "minute.seconds" in the bottom lower window. This is only shown if configured with 904 satellite option.

11. **LAST ERROR MENU:** Press ↓↓ **FAST DOWN** from the Display ON/OFF menu to access the Last radio error menu, the display will show "**LASt rAdio Error**". This menu displays the last 8 error codes. Use ↑ **UP** and ↓ **DOWN** to scroll through the error codes.

12. **RADIO SIGNAL STRENGTH MENU:** Press ↓↓ **FAST DOWN** from the last radio error menu to access the radio signal strength menu, the display will show "**rAdio SIgnL StrEn**". This gives a signal level of the cellular phone. Position the antenna so the level is between 9 and 30 for the 901 cellular option or verify that the signal is greater than 1 for the 904 satellite option. Accessing this menu while a 901 cellular board or 904 satellite board are connected will cause an upload to the web server when the short user menu is exited. This can be useful for testing. This is only shown if configured with 901 cellular, 902 wireless, or 904 satellite option.

13. **EXIT MENU:** To exit the programming mode, press **FAST UP** to access the exit menu, the display will show "**Short USEr CodE donE**". Press **ENTER**, "**Prog donE**" will be shown momentarily and the gauge will return to normal operation.

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14. 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 & serial communications):

1. Press and hold **ENTER** until "**SECUr 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 "**A1Hi GAU 1**" followed by some volume amount and "**n OPn**" or "**n CLS**". Each tank has only one alarm point. 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. Each alarm can also be opened or closed if the display goes into a "**noL**" or "**bdL:xx**" condition. This is done in the "**A1noL**", "**A2noL**", "**A3noL**",or "**A4noL**" menu. 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 "**A1 Hi GAU 1**" and "**535.4 n CLS**". 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 "**A3 LO GAU 3**" and "**45.2 n OPn**".

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 six 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, press **0** to set the alarm point to zero, or press **7** while in the low alarm menu to set the low alarm equal the high alarm set point. To toggle the polarity (alternate between closed and open) press the decimal point button.

5. Press **ENTER** to store the new alarm setting, "**StorE**" will be shown momentarily.

6. To access other alarm menus, press ⇈ **FAST UP** or ⇊ F**AST DOWN**. If an alarm menu is left without pressing **ENTER**, any change to that menu item will NOT be stored.

7. **SERIAL ACTIVATION MENU**: Press ⇊ **FAST DOWN** until "**SErIAL** On" or "**SErIAL OFF**" is shown. Press the ↑ **UP** button to turn the serial port on, or the ↓ **DOWN** button to turn the serial port off. Press **ENTER** to store the new setting, "**SErIA StorE**" will be shown momentarily.

8. **PHONE/SMS (TEXT MESSAGE) ACTIVATION MENU**: Press ⇊ **FAST DOWN** until "**PhonE On**" or "**PhonE OFF**" is shown. This enables or disables the SMS function. Press the ↑ **UP** button to turn the SMS alerts on, or the ↓ **DOWN** button to turn the SMS alerts off. Press **ENTER** to store the new setting, "**PhonE StorE**" will be shown momentarily. This setting does not affect the cellular data transmission. This is only shown if configured with 901 cellular option.

9. **TCP DATA UPLOAD MENU**: Press ⇊ **FAST DOWN** until "**tCP dAtA UPLOd On**" or "**tCP dAtA UPLOd OFF**" is shown. Press the ↑ **UP** button to turn it on, or the ↓ **DOWN** button to turn the it off. This menu enables or disables the data upload to the stationary tank website. Changing this menu clears the historical data in the 901 cellular board. This data will be lost and will not get uploaded to the web server. This is only shown if configured with 901 cellular or 904 satellite option.

10. **EXIT MENU**: To exit the programming mode, press ⇈**FAST UP** until the exit menu is accessed, the display will show "**Long USEr CodE donE**". Press **ENTER**, "**Prog donE**" will be shown momentarily and the gauge will return to normal operation.

11. 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 "**SECUr 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**. The ↓ **DOWN** button will backspace if an incorrect button is pressed. 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. Press **ENTER** to save the new code. If exactly six digits are not entered, then "**Error Error**" is shown momentarily and the previous code reappears. If the number of digits is correct, then "**StorE StorE**" 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 917 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 "**OFFSt**". The top right display will show "**XXX.XX**" which is the fluid level in inches using the existing offset programmed into the display, the lower left display shows "**GAU 1**", "**GAU 2**", "**GAU 3**" or "**GAU 4**" indicating which input is selected. The lower right display shows 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 "**too hi**" 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 3/4 up the vertical part of the float. If the tank has fluid in it manually gauge the fluid level. 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 displays, 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, "**StorE**" 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 400.00 or just 400 with no decimal. The display can only have 5 digits, so 400.000 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 9 digits to be entered for the volume per inch, so extra zeros need to be added in front of the number to get 9 digits. For our examples, in the first case we would get 0001.6 6667 and for the second case we would get 00005 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 "**1 Lin CALib**".

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 bottom displays as you enter them.

16. Press **ENTER** to save, the display will show "**StorE**" on the top right 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 linear calibration menu for the next tank, up to 4. After the fourth tank has been calibrated, the

gauge will go to the table calibration menus to allow viewing of the calculated calibration tables for the four tanks.

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 top displays show "**1 CAL tAbLE**". The bottom left display will go to 0.00 inches, and the existing volume calibration for 0 inches will be shown on the bottom 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 bottom 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**.**XXXX, XX**.**XXX, XXX**.**XX or XXXX**.**X, there is no decimal for **.**XXXXX or XXXXX**.**, 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 "**StorE**" 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. Repeat steps 18 to 22 for "**2 CAL tAbLE**", "**3 CAL tAbLE**" and "**4 CAL tAbLE**".

25. **SERIAL CONFIGURATION MENU:** To access the serial configuration menu, press ↑↑ **FAST UP** until the display shows "**SErIAL out tYPE XXXXX**", where "**XXXXX**" is either **rS.485**", "**rS.232**" "**rAdio**", "**CELL1**", "**CELL2**", "**CELL3**", "**CELL4**", "**SAtOn**", or "**SAtOF**" depending on optional modules. <u>This setting is configured at the factory and should not need to be changed</u>.

26. **IP ADDRESS MENU:** To access the menu, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the displays show "**IP 173.255.223.132**". <u>This should only need to be changed under Garnet's request</u>. This is only shown if configured with 901 cellular option.

27. **PORT MENU:** To access the menu, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the displays show "**Port 7778**". <u>This should only need to be changed under Garnet's request</u>. This is only shown if configured with 901 cellular option.

28. **SATELLITE ON/OFF MENU:** Press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the displays show "**SAt dAtA**". Press the ↑ **UP** button to turn the satellite data updates on, or the ↓ **DOWN** button to turn the satellite data updates off. (The GPS updates will continue to be sent.) This is only shown if configured with 904 satellite option.

29. **SATELLITE DIAGNOSTIC:** Press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the displays show "**SAt d**" followed by four numbers which may be used for factory diagnostics. This is only shown if configured with 904 satellite option.

30. **SOFTWARE REVISION:** To access the software revision menu, press ↑↑ **FAST UP** or ↓↓ **FAST DOWN** until the displays show "**900d6 SOFt rEL X.XX**". Where X.XX is the revision number, for example "**3.11**".

31. **EXIT MENU:** To exit the programming mode, press ↑↑ **FAST UP** until the exit menu is accessed, the display will show "**AStEr CodE CALib donE**". Press **ENTER**, "**Prog donE**" will be shown momentarily and the gauge will return to normal operation.

32. 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.

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

⚠ WARNING: All wires and/or cables used for installation must be rated for temperatures between -40°F to +167°F (-40°C to +75°C).

When installing the 902 wireless option, please use the following diagram. (no special operating conditions)

902 Wiring Guide

902 Wireless	Wire Color	902 XSC Wireless Transmitter
PWR	Red	POWER
GND	Black	GROUND
RX	Blue	RX
TX	Orange	TX
DTR	Green	DTR
CTS	White	CTS

When installing the 904 satellite option, please use the following diagram. (no special operating conditions)

904 Wiring Guide

904 Satellite	Wire Color	904 Transmitter
SAT TX	Orange	SAT TX
SAT RX	Blue	SAT RX
SAT DSR	White	SAT DSR
SAT DTR	Green	SAT DTR
SAT POWER	Red	SAT POWER
SAT GND	Black	SAT GND

The wiring colors for the following 903 Modbus options are not included because there is not a standardized system for specific wire colors.

When installing the 903 Modbus option using RS232, please use the following diagram. (no special operating conditions)

903 Wiring Guide

903 Modbus	RS232 Connector
RS422 TX POS/RS232 TX	TXD
RS422 TX NEG/RS232 RX	RXD
RS422/485/232 GROUND	GND

When installing the 903 Modbus option using RS485, please use the following diagram. (no special operating conditions)
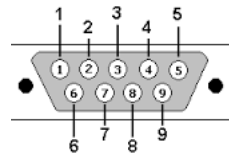
903 Wiring Guide

903 Modbus	RS485 Connector
RS422 RX POS/485 POS	D+
RS422 RX NEG/485 NEG	D-
RS422/485/232 GROUND	GND

When installing the 903 Modbus option using RS422, please use the following diagram. (no special operating conditions)

903 Wiring Guide

903 Modbus	RS422 Connector
RS422 RX POS/485 POS	RX+
RS422 RX NEG/485 NEG	RX-
RS422 TX POS/RS232 TX	TX+
RS422 TX NEG/RS232 RX	TX-
RS422/485/232 GROUND	GND

Pin:	Mode:	RS232	RS422	RS485
1		DCD	DCD+	-
2		RXD	RX -	-
3		TXD	TX +	D+
4		DTR	DTR+	-
5		GND	GND	GND
6		DSR	RX +	-
7		RTS	TX -	D-
8		CTS	DCD-	-
9		-	DTR-	-

When installing the 905 WITS option, please use the following diagram. (no special operating conditions)

905 Wiring Guide

905 WITS	Wire Color	WITS Connector	Pin
RS422 RX POS/485 POS	Yellow	RX+	D
RS422 RX NEG/485 NEG	White/Yellow	RX-	E
RS422 TX POS/RS232 TX	Blue	TX+	A
RS422 TX NEG/RS232 RX	White/Blue	TX-	B
RS422/485/232 GROUND	Black	GND	J

The RS422 port uses a female Amphenol PT00E-12-10S receptacle which accepts an Amphenol PT06E12-10P male plug.
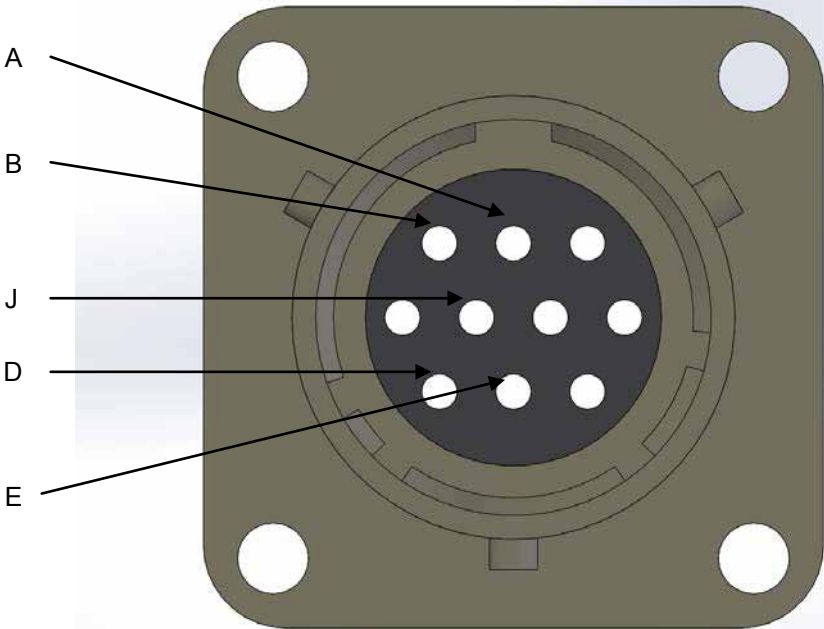
There are only 5 serviceable components in the system: the float, the sender bar, the interconnecting fiber optic cable, the display, and the batteries. If the float is sunk, the display will read the bottom tank reading all the time. If the float is partially sunk, the reading may rise and then fall as the tank is filled.

If the fiber 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 fiber, or if the fiber is not fully inserted, the display may show bad light as "**bL:xx**" where xx is the number of bits received. If the fiber optic cable is disconnected from the display, a flashing red light should be visible from the end of the fiber.

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 fiber into the sender optical connector and the other end of the fiber into either the optical input of a 900D6 display that is known to be good or a 917 Display & Sender Bar Tester to verify correct operations. The 900D6 display or the 917 Display & Sender Bar Tester should show a volume value. Please see the 917 Display & Sender Bar Tester manual for more testing details.

To test a display:

1. The display should show "**no L**" with no fiber 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**". 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 900D6 display into a bar that is known to be good or simulate a bar using the 917 Display & Sender Bar Tester to see if it is operating properly. Please see the 917 Display & Sender Bar Tester manual for more testing details.

CHAPTER 6 - MASTER CODE

The Master code is available upon request.

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

Sender materials:	Sender bar is polyethylene or 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 display can show up to 99999, 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 power: ⎓	Display will be either powered by an external 12-24 VDC Class 2 power supply or by batteries. Use the table on the next page to determine what is appropriate for your product. NOTE: 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.
Alarms:	4 alarms, each consisting of a transistor conducting to ground with a rating of 1mA @ 24VDC. An external alarm manager is recommended to operate alarm devices.
Fuse(s): (if installed)	If the fuse is activated it may be replaced by field personnel, provided that it is replaced with a Bussmann/Eaton AGC-2 in a non-hazardous area.

Resolution:	1/4 inch (6 mm)
Accuracy:	+/- 1/8 inch (3 mm)
Display temp. range:	-40°F to +140°F (-40°C to + 60°C)
Product temp. range:	-40°F to +194°F (-40°C to + 90°C)
Display temp. drift:	0
Alarm temp. drift:	0

Display Boards	Current Rating		
	Continuous Current	Peak Opto Receive Current	Backlight Current
900D6S		200 uA	
900D6D	33 - 38 uA	400 uA	100 mA
900D6Q		800 uA	

Communication Option Boards	Current Rating		
	Continuous	Peak Receive	Peak Transmit
901 CELL	70 - 82 uA	554 mA	554 mA
902 WIR	150 uA	26 mA	215 mA
903 MOD	3.9 - 4.3 mA		
904 SAT	45 - 60 uA	85 mA	800 mA
905 WITS	3.9 - 4.3 mA		

Option Board	16x AA Cell L91	4x D Cell MN1300	8x D Cell MN1300	12-24VDC Class 2
900NO		√		√
901 CELL			√	
902 WIR		√		√
903 MOD				√
904 SAT	√		√	√
905 WITS		**		√ *

* A 12-24 VDC, Class 2 power source is required to power the communication board.
** A 4x D Cell (MN1300) battery pack is used to power the 900D6 display, but will not power the 905 WITS communication board.

CHAPTER 8 - SERVICE & WARRANTY INFORMATION

The warranty will only apply only if the warranty card that is shipped with the equipment has been returned to Garnet Instruments Ltd.

DISCLAIMER OF WARRANTY ON HARDWARE

Garnet Instruments Ltd. 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 Ltd, 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 Ltd.
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

Maintenance

With regards to maintenance the field personnel are permitted to use the following to maintain their 900-series product:

- Clean the outside of the display enclosure, provided they use a damp cloth.

- Replace batteries, provided this is done in a non-hazardous area.

- Replace the fuse (if installed), provided this is done in a non-hazardous area, and is done with a Bussmann/Eaton AGC-2.

Any additional maintenance or service must be done by qualified Garnet technician or under the advisement of qualified Garnet technician. Not following these guidelines may result in the warranty being voided.

GARNET

LIMITED WARRANTY REGISTRATION

MODEL NO._____ SERIAL NO._____

DATE PURCHASED_____ DATE INSTALLED_____
                    YR/MO/DAY   YR/MO/DAY

COMPANY NAME_____

PRINCIPAL CONTACT_____

ADDRESS_____

TELEPHONE_____ FAX_____

IN CANADA RETURN TO:

Garnet Instruments Ltd.
286 Kaska Road
Sherwood Park, AB T8A 4G7
CANADA

SENDER BAR SERIAL NO._____ (if applicable)

IMPORTANT: WITHOUT THE SERIAL NUMBER OF EACH UNIT IT IS
                   DIFFICULT TO DETERMINE WARRANTY VALIDITY

DEALERS NAME_____

WARRANTY CONTACT_____

ADDRESS_____

TELEPHONE_____ FAX_____

IN UNITED STATES RETURN TO:

Garnet US Inc.
5360 Old Granbury Road
Granbury, TX 76049
USA

IMPORTANT: RETURNING THIS CARD WILL ENABLE US TO NOTIFY YOU IN THE EVENT OF A PRODUCT RECALL OR TO SUPPLY YOU WITH REQUIRED PRODUCT SAFETY INFORMATION.

GARNET

Liquid management solutions, your way.