GARNET
INSTRUMENTS LTD.

SeeLevel Special™
Gauge For Trucks

MODEL 808P2 MANUAL

REVISION H

IMPORTANT OPERATOR INFORMATION

DATE INSTALLED:_____

UNIT NUMBER:_____

COMPARTMENT:_____

DISPLAY CALIBRATION UNITS (e.g. inches, gallons):_____

MINIMUM TANK READOUT:_____

MAXIMUM TANK READOUT:_____

ALARM POINT (IF APPLICABLE):_____

SPILLSTOP EMPTY POINT (IF APPLICABLE):_____

SPILLSTOP HORN POINT (IF APPLICABLE):_____

SPILLSTOP SHUTDOWN POINT (IF APPLICABLE):_____

AUTOMATIC ALARM: WARNING LEVEL:_____

EMPTY LEVEL:_____

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CHAPTER 1
OVERVIEW

Congratulations on purchasing the Garnet Instruments Model 808P2 SeeLeveL Special™ Gauge for Trucks. The SeeLeveL represents the state of the art in liquid level measurement equipment for transport applications. The SeeLeveL is designed for reliable, accurate level measurement of sour or sweet crude oil, chemicals, acids, water, condensate, gasoline, or diesel fuel. 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 SeeLeveL has been designed to withstand the vibration and shock encountered in mobile applications. The components are weatherproof, and the sender bar in the tank can withstand steaming temperatures. The 808P2 operates entirely on internal batteries, with 12 volt truck power only being used to operate the back light (external alarms will require truck power).

The SeeLeveL can display in any units, such as inches of level, gallons, barrels, or cubic metres of volume. It has one alarm point which can be used to operate horns, isolation valves, or a Garnet MultiRack driver. It also has an additional automatic, self resetting alarm output to operate a high level warning horn or light, and can operate the Garnet SpillStop to shut down loading of the truck in an overfill situation.

The 817 Truck Gauge Programmer is used to program the SeeLeveL to read the desired calibration units, and to set the alarm points. The programmer is designed to be easily operated by people unfamiliar with electronics or computers.

CHAPTER 2
NEW FEATURES OF THE 808P2

The 808P2 has some enhancements over the 808PA series. It uses new technology in the display to provide a number of new features:

1) The calibration memory has been changed to a flash memory device which is much more secure and does not require power to maintain the memory contents. This should result in a much more reliable operation, with less chance of a lost or corrupted calibration.
2) The display can be programmed with a magnet for 8 or 11 bit operation, to work with bars in either 1/3, 1/4, or 1/6 inch mode. If a sender bar ends up in the wrong mode, then the display will show bad light and the number of bits received. The previous displays would not accept bars in 11 bit (1/6 inch) mode. The mode is stored in the display in the same secure memory as the calibration.
3) The display has improved diagnostics:
   a) If the wrong number of bits are received, then the display shows “bL:xx” where xx is the number of bits actually received.
   b) By connecting together two end pins on the right hand side of the programming plug (looking at the back of the display), the display will show a basic inch calibration, which aids in troubleshooting to determine if the sender bar or display calibration is at fault.
   c) If there is a fault during programming or if the memory is not functioning correctly, the display shows “Err”.
   d) If the memory does not have a valid value for the number of received bits (either 8 or 11) then the display shows “Prob”.
   e) If the display has no fiber connected and is exposed to strong light the display will show “Sun” indicating that sunlight is affecting the display. If a flickering light gets into the display opto then the display may show either “Sun” or “bL:xx” depending on the exact nature of the light getting in.
4) The optical receiver has been improved so it cannot be overloaded with too much light from the sender bar.
5) The display backlight has been changed for improved brightness and evenness of illumination. The color has been changed to green to make it easier to see.

6) The fiber optic connector is field replaceable, so if it is broken or fails, the display can be quickly returned to service.
7) The entire display has been miniaturized to fit into the lid of the enclosure. This greatly eases installation and servicing, since the gauge can be removed without having to unbolt the base of the enclosure. To remove the display, simply pop the lid off, undo the fiber, and disconnect the wires.
8) The display has a new alarm output. The purple wire is an automatic, self resetting alarm output for overfill warning. A switch must be wired from the white wire to ground, and a horn or warning light is connected to the purple wire. When the product level rises to the warning point, the warning device will turn on. Pressing the switch momentarily will turn the warning off. When the tank is emptied, the warning is reset to that the next time the tank is filled the warning will turn on again. This way the operator cannot forget to re-arm the warning system.
9) The display has the ability to drive a remote transmitter for applications which require the transfer of the data from the gauge to another piece of equipment.
10) The density of the product can be entered into the gauge to enhance measurement accuracy. The amount that the float sinks into the product is dependent on the density of the product, so by entering the density the accuracy of the gauge can be maintained as the density varies from load to load.

CHAPTER 3
GAUGE DESCRIPTION

The SeeLeveL gauge 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 information via fiber optic cable to the display, which displays the level in appropriate units and operates the alarms, Spill Stop transmitter, and remote data transmitter.

The float contains magnets which activate reed switches inside the stainless steel sender bar to indicate the level of the fluid. The activated switches are detected by the microprocessor at the top of the bar. The microprocessor operates from a long life lithium battery giving about 10 years of life. The level information is relayed through the fiber optic cable to the display, the fiber being used to maintain electrical isolation between the sender bar and the display, allowing operation in flammable liquids.

The display converts the level information to volume according to the calibration programmed into it with the 817 Truck Gauge Programmer. The calibration can be in inches or volumetric units such as cubic metres or barrels. The tank level is shown on a backlit LCD (Liquid Crystal Display) giving good visibility in all lighting conditions. The display circuitry and LCD operate from a lithium battery giving nominally 8-10 years of life. The LCD back light is powered by 12 volt truck power. The entire display is enclosed in a Valox Betts box with a clear cover, which is durable enough to withstand indirect road spray.

The display contains four alarms which are programmed using the 817 Truck Gauge Programmer. They can be set to turn on or off at any point in the tank. Alarm 4 is available as an output transistor which completes a circuit to ground and can handle 1 amp of DC current at 24 volts.

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.

Alarm 4 also has an extra transistor output on the purple wire. With this purple wire connected to a warning horn, and the white wire connected to a momentary switch to ground, alarm 4 functions as a self resetting high level warning alarm. Alarm 4 is programmed as the warning point, and alarm 3 is programmed near the tank empty point. When the product level rises in the tank and hits the warning point, the horn will sound. Momentarily pressing the switch will silence the horn. When the tank is unloaded below the empty point, the alarm is reset so that it will sound again when the tank is filled to the warning point. This way the operator cannot forget to turn on the horn. The horn will sound at the warning point even if the switch is pressed prior to the product level hitting the warning point.

The display has a Spill Stop transmitter for direct connection to a Garnet 815 SpillStop or 815U SpillStop Ultra controller. The transmitter operates in accordance with the programmed alarm points 1, 2, and 3. This provides the user with automated horn warnings and automated control of PTO loading to prevent product spills due to inadvertent overfilling of the tank.

Installation of the gauge consists of cutting a hole in the top of the tank and welding in a 1 inch coupler, and welding an anchor assembly to the bottom of the tank. The sender bar is cut to length, the end is sealed, and it is inserted from the top of the tank and fastened at the top with a compression fitting. The display is mounted at a convenient point on the truck, and Synflex air brake hose is connected from the sender head to the display to house the fiber optic cable. The cable is connected at each end, and the gauge is programmed. Snapping on the covers for the head and display completes the installation. The bar can be removed later for service by disconnecting the fiber, unscrewing the compression fitting, and pulling it out.

CHAPTER 4
UNIQUE FEATURES

The SeeLeveL gauge has been designed for maximum ease of installation and servicing, and for best operational features. The anchor at the bottom of the tank provides a shock mount for the float, and holds the float in place while the bar is removed so no tank entry is required for sender bar replacement. If the new sender bar is cut to the same length as the old, no re-calibration is required.

The float is molded from polyethylene for high chemical resistance, good esthetic appearance, and high durability due to the "give" in the plastic. The light weight of the polyethylene allows the float size to be minimized while allowing it to float on the lowest density products.

The sender bar has no moving parts and is completely filled with potting material to enhance reliability. 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. To accommodate different tank sizes, the bar is simply cut to length with a hacksaw, and the cut end sealed with a cap to prevent moisture or product contamination. This way only one size needs to be stocked, and a perfect fit is ensured. The sender head is very low in profile to satisfy rollover requirements; the maximum height is less than 5 inches above the top of the tank so that it will not protrude above the spillway. The bar is programmed for 1/3” or 1/6” resolution by holding an ordinary magnet (included with the operator’s manual) under the head for a specific period of time; this can be done in the field if necessary. The resolution information is stored in three separate memories for security, but if for some reason this information is lost, the sender bar automatically defaults to 1/3”.

The single fiber optic cable connecting the sender head to the display can be disconnected at both ends. There is approximately 10 times as much light as is required for operation available for the fiber, so no special fiber end preparation is required. The fiber ensures that even with faulty wiring into the display, no explosion hazard can exist.

The 808P2 display enclosure used is waterproof and the internal circuitry is also protected against moisture by an internal panel and a coating on the circuit board. By being battery operated and not requiring truck power to operate (other than the LCD backlight), installation is simplified and reliability enhanced. The small size of the display box also makes it easy to find an appropriate mounting location. The backlit LCD display ensures that the gauge display is always visible, regardless of ambient lighting conditions.

The use of an on-site programmer eliminates downtime waiting for factory calibration parts, and allows easy reprogramming should the need arise. The entire display, including decimal point, is completely programmable to whatever units are desired. In addition to numbers, the letters F, U, L, and E can be programmed to provide displays such as FULL, E, etc. The alarm can be programmed to turn either on or off to save terminals and wiring, and uses a transistor rather than a relay to increase current capability, eliminate sparking, and eliminate gauge battery power drain.

CHAPTER 5
SENDER BAR LIMITS OF RESISTIVITY

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

The tube used in the manufacturing of the sender bar is seamless 316 stainless steel. **It should be noted that certain corrosive products, as well as high concentrations of acid products, may attack the stainless steel 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 Loctite products used to secure the end cap can be attacked by certain chemicals as well. For reference, a chemical resistance chart from Loctite showing product compatibility with various chemicals can be found in the center of the manual.

The 680 retaining compound we specify is similar to Loctite #592, 567, 565, 569, 545, 580, 571, 242, 577, 572, 542, 565, 545, 243. If you require more information, please call the Loctite Corporation, in Canada, 1-800-263-5043, in USA, 1-800-562-8483.

CHAPTER 6
808P2 INSTALLATION GUIDE

1. Pick a spot in the tank for the sender bar to be mounted. It should be as close to the middle of the tank as possible. Allow room for the head at the top of the sender bar. Make sure that the float will not contact any baffles or other obstructions in the tank. It is preferable if the float can be accessed from the hatch, to make any future service work easier. For this reason **do not** mount the float behind a baffle where it can't be reached from the hatch.

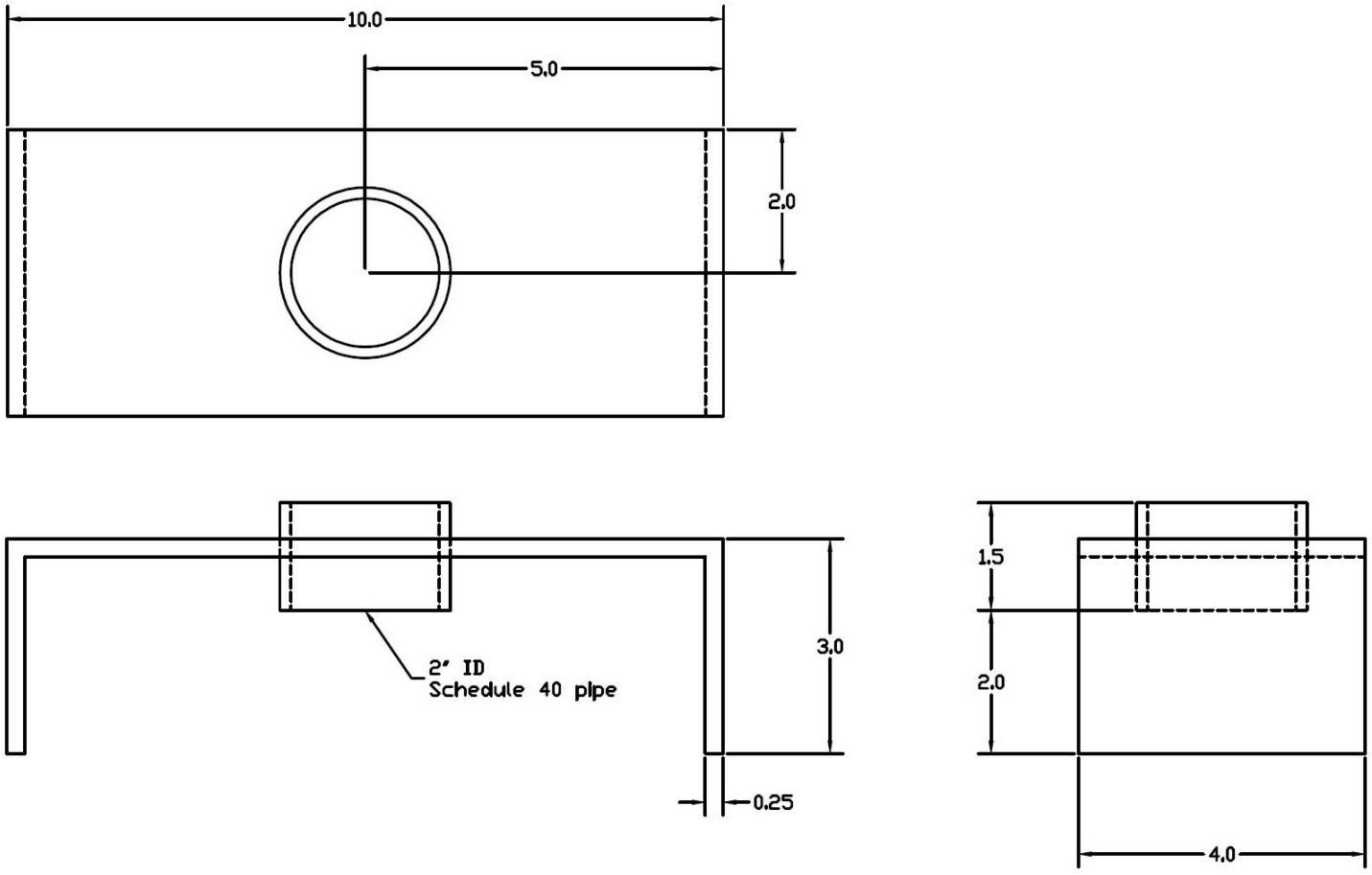
2. Drill or cut a hole in the top of the tank to mount a 1 inch NPT coupler (not provided). Weld the top coupler in place.

3. Slide the compression fitting over the sender bar, threads facing down, and insert the bar through the coupler and align it vertically in the tank. Determine how much length needs to be cut off the bottom of the bar. At a minimum the bar should be mounted 1 inch off the bottom of the tank to allow for tank expansion and contraction. For tanks greater than 75 inches in height, increase the gap to 1.5 inches. Cut the bar with a hack saw and trim exposed circuit board with a sharp knife. **Do not use a disk type cutoff saw since the heat generated will short circuit the internal circuit board.**

4. **Ensure that the compression fitting is on the bar** and clean the end of the bar and the inside of the end cap with Loctite 7070 Cleaner. Spray Loctite T7471 Primer onto both the end of the bar and the inside of the end cap. Allow the primer to dry for a few minutes. Apply a bead of Loctite 680 Retaining Compound around the bottom of the tube and around the top of the end cap. Place the cap onto the end of the tube with a twisting motion so that the retaining compound is smeared completely on the portion of the bar where the end cap is. To remove entrapped air, place the end on the floor and rock the bar until excess air has escaped. Keep the end cap in position by gently clamping the bar in a vise with the end against a solid object. Avoid setting the end cap against a cold floor, as this will slow the curing process. The curing time should be about an hour at room temperature. **The Loctite must be set before the tank is put into service. Bar failure due to a leaking end cap is NOT covered by**

warranty. Note that a kit with all the required Loctite products is available from Garnet. For further details on the Loctite products see Technical Service Bulletin #17 on our web site, www.garnetinstruments.com.

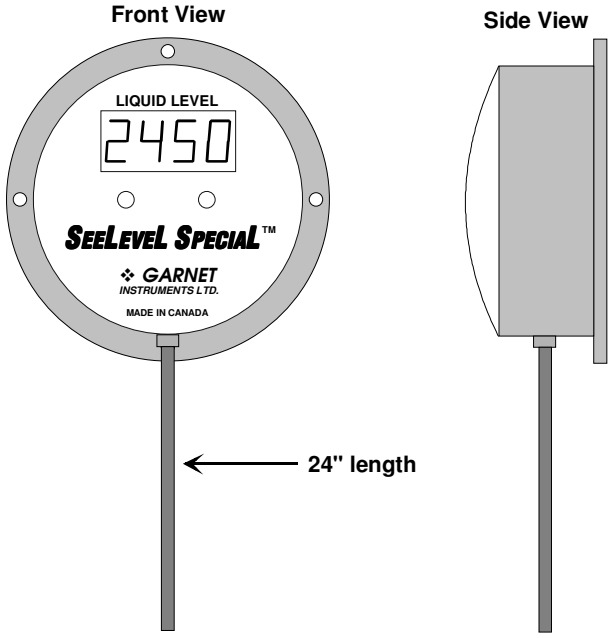
5. Make up an anchor by cutting a 4" X 16" piece of 1/4" thick material. Bend each end down at 90 degrees (see the diagram below), so the resulting flat piece is about 4" X 10" inches with 3" sides. Drill a hole to insert a 2"ID schedule 40 pipe in the center of the plate, weld tube to plate. Insert the bar into the tank and slide the anchor assembly over the sensor bar with the "**U**" facing down. Align the sensor bar vertically and weld the anchor in place to the bottom of the tank. Pull the sensor bar up a bit and slide the float (cone side up) over the bar. Lower the bar back into the anchor.



6. Tighten the base of the compression fitting into the coupler. Lift the bar 2" off the bottom of the tank, and tighten down the compression fitting nut. Raise and lower the float a few inches to set the bottom reading.

7. Pick a spot for the display. It should be easy to see and out of direct road spray and protected from driving rain. Mount the display enclosure using the mounting flange holes, being certain to shim the enclosure away from the mounting surface with the spacers provided to allow water drainage. **Broken display enclosures caused by water freezing behind the enclosure are NOT covered by warranty.**

8. Route 1/4" Nylon air brake hose from the sender head to the display and fasten with **brass inserts** and **compression fittings** at each end (the brass inserts may be part of the fitting). If the holes are not pre-drilled in the display enclosure, drill holes into the Valox box close enough to the base of the box to avoid contacting the lid flange. Never drill holes into the top of the box since water will leak in. If the hole has been tapped too large, Teflon tape can be used on the fitting to ensure a proper seal. Make sure that the lid is not on the box when drilling to avoid damaging the display electronics. **At the lowest point in the air line insert a T fitting with approximately two feet of Synflex hanging down to provide a drain for any water than may get into the system. If a T fitting is not feasible, put a fitting into the bottom of the display enclosure and route the 2 feet of Synflex from there (see diagram below).** If wiring is to be connected, drill and tap extra holes as needed into the enclosure. Feed the fiber optic cable through the hose, leaving about 12 inches extra at each end.



9. Cut the fiber ends square with a sharp knife and insert the fiber into the connectors at each end and tighten the connector lock nuts. Make sure that the fiber is loosely coiled inside the enclosure and is not pulled tight or bent sharp. The display should change from reading "no L" to some inch value as soon as the fiber is connected. If not, check that the fiber ends are clean and cut square, and that the fiber is fully inserted into the connectors at each end. If the display shows “bL: 8” or “bL:11” reprogram the sender bar or display for the correct mode (1/3 or 1/6 inch).

10. Inspect the head cap for casting flash, lightly sand or scrape off any casting protrusions. Make sure that there is grease on the rubber O-ring and snap on the head cap.

11. Program the gauge as directed in the programming section. To determine the bottom reading of the gauge, measure from the bottom of the tank to the middle of the straight vertical part of the float when the float is resting on the anchor. Do **NOT** set the gauge to read "0" at the bottom since this will not result in a correct reading when the float is actually floating on the product. In addition, if the gauge ever goes below "0" due to tank expansion, it will read some nonsensical value since this region has not been programmed.

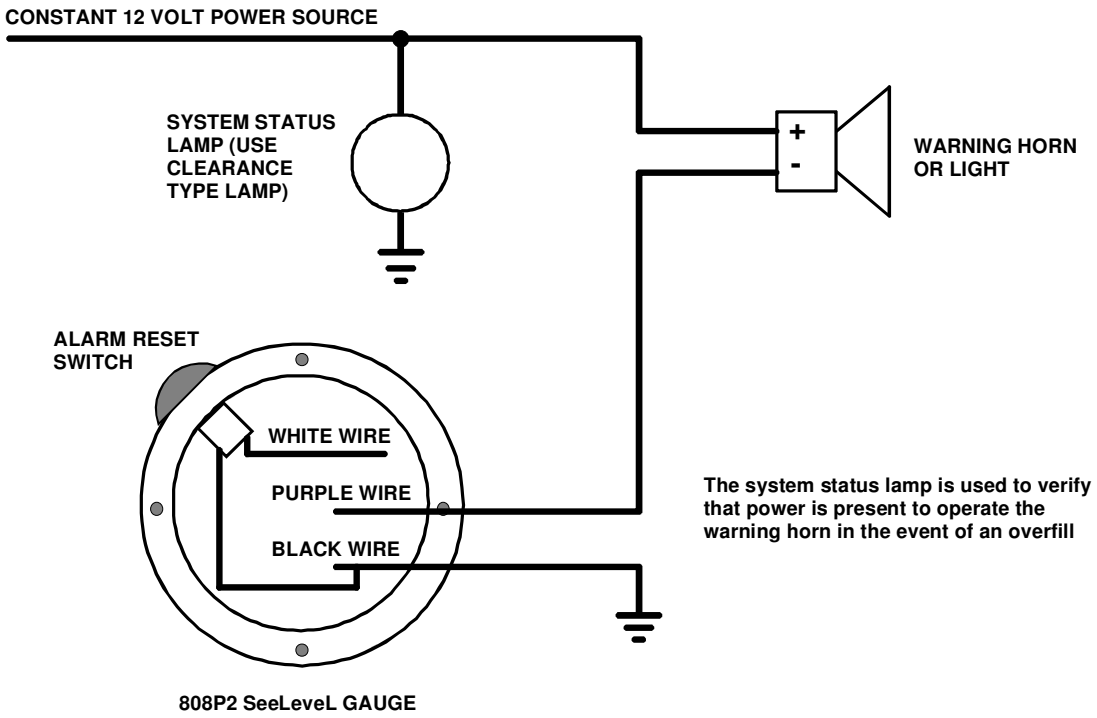
12. If wiring is used, route the wires into the display box using Synflex, compression fittings, and inserts like was used with the fiber cable. Connect the **BLACK** wire to ground, the **RED** wire to a 12 volt clearance light circuit (this operates the LCD back light), and the **YELLOW** alarm wire to the alarm circuit (if used). The alarm wire completes a circuit to ground when active, so the other end of the circuit needs provide power. The **PURPLE** automatic alarm wire is connected to the negative side of a relay coil, with the positive side connecting to +12 volts. The relay contacts control power to the warning horn or light, this should be "PTO sensed" power. This means that the power is only supplied to the warning device when the PTO is engaged. The **GREEN** SpillStop wire goes to the compartment terminal on the 815, or to the Yellow wire of the 815U. The **WHITE** switch wire goes to the white wire on the automatic alarm reset switch, with the black switch wire going to ground. To program the alarms and the SpillStop see the alarm programming section. Contact Garnet for information concerning the connection of the **GREEN/YELLOW** remote

wire. Note that the **GREEN/YELLOW** wire may not be installed on all displays.

13. Inspect the display cap for casting flash, lightly sand or scrape off any casting protrusions. Make sure that there is grease on the rubber O-ring and snap on the display cap.

14. Verify gauge operation by lifting the float. Record the unit number, calibration units, minimum and maximum readout values, and any alarm points programmed in the IMPORTANT OPERATOR INFORMATION area on the front page of the owner's manual. **The truck operator must be given the owners manual upon delivery with all front page data filled in.**

AUTOMATIC ALARM WIRING DIAGRAM



THE RELAY IS NEEDED IF THE HORN OR LIGHT DRAWS MORE THAN 1 AMP

CHAPTER 7
SENDER BAR PROGRAMMING

The 808P2 sender bar is identified by an “X” in the serial number, for example 810X-9999. It can be programmed for either 1/3” 8 bit operation or 1/6” 11 bit operation. The reason that the bar sends more bits for 1/6” operation is that there are twice as many points to send. The 808P2 display must be programmed to match the mode of the bar, so if the bar is in 1/3” mode the display must be in 1/3” mode, and if the bar is in 1/6” mode the display must be in 1/6” mode. If the modes do not match, the display will show bL:8 or bL:11.

CAUTION: If the bar is being used with a display other than an 808P2, contact your dealer or Garnet Instruments before attempting to operate the bar in 1/6” mode with the different display.

For security, the bar holds its mode information in three different memory locations and continually takes the best two out of three as being the correct mode. If any one location is corrupted it is automatically repaired. If the bar ever loses its mode information completely, it will default to 1/3” operation.

The bars are always shipped in 1/3” mode, so they only need to be programmed if the 1/6” mode is desired. If a bar is in 1/6” mode it can be programmed back to 1/3” mode. A bar can be reprogrammed any number of times. The bar mode is programmed by holding a magnet underneath the head for a specific period of time. The magnet can either be one you have, or a float can be used – slide it right up against the head (this can only be done before the compression fitting is on). The magnet is in the correct position when the opto appears to flicker continuously instead of flashing.

To program a bar to 1/6” mode, hold the magnet under the head for 12 seconds. The LED should appear to flicker continually during this time. Remove the magnet after the 12 seconds, the LED will respond with 6 long flashes (1 second on, 1 second off, 1 second on, etc.). After the 6 long flashes, the bar will resume normal operation. If desired, the bar can be plugged into the 817 **OPTICAL INPUT**, the # BITS should show 11. Note that the timing window is from 9 to 15 seconds, so you don’t have to be exact.

To program a bar to 1/3" mode, hold the magnet under the head for 6 seconds. The LED should appear to flicker continually during this time. Remove the magnet after the 6 seconds, the LED will respond with 3 long flashes (1 second on, 1 second off, 1 second on, etc.). After the 3 long flashes, the bar will resume normal operation. If desired, the bar can be plugged into the 817 **OPTICAL INPUT**, the # BITS should show 8. Note that the timing window is from 3 to 9 seconds, so you don't have to be exact.

If the magnet is held in position for less than 3 seconds or more than 15 seconds, the bar mode will not change. The bar can be programmed to either mode regardless of the mode it is currently in, so if in doubt about the mode feel free to reprogram.

CHAPTER 8
SETTING DISPLAY DENSITY

When the gauge is calibrated with the correct offset, it is assumed that the density of the product is 0.90 (specific gravity is 90% of pure water). The amount that the float sinks into the product will vary somewhat with the density of the product, and hence the gauge reading will change slightly. For lower density product, the float will sink more, and so the gauge will read a bit low. For higher density product, the float will sink less (it will float higher), so the gauge will read a bit high. The following tables summarize float levels as they relate to the type of float and product density.

Plastic Truck Float Buoyancy

Product Specific Gravity	Amount Float Sinks (Inches)	Level Error (Inches)	Correction (inches) 1/3" Mode	Correction (inches) 1/6" Mode
0.60	1.88	0.63	2/3	4/6
0.65	1.73	0.48	1/3	3/6
0.70	1.61	0.36	1/3	2/6
0.75	1.50	0.25	1/3	2/6
0.80	1.41	0.16	0	1/6
0.85	1.32	0.07	0	0
0.90	*1.25*	*0.00*	*0*	*0*
0.95	1.18	-0.07	0	0
1.00	**1.13**	**-0.13**	**0**	**0**
1.05	1.07	-0.18	0	-1/6
1.10	1.02	-0.23	0	-1/6
1.15	0.98	-0.27	-1/3	-2/6
1.20	0.94	-0.31	-1/3	-2/6

Nominal calibration is 1/2 way up straight side of float.
Bold indicates density of water

Stainless Steel Truck Float Buoyancy

Product Specific Gravity	Amount Float Sinks (Inches)	Level Error (Inches)	Correction (inches) 1/3" Mode	1/6" Mode
0.60	2.92	0.97	3/3	6/6
0.65	2.69	0.75	2/3	4/6
0.70	2.50	0.56	2/3	3/6
0.75	2.33	0.39	1/3	2/6
0.80	2.19	0.24	0	1/6
0.85	2.06	0.11	0	0
0.90	*1.94*	*0.00*	*0*	*0*
0.95	1.84	-0.10	0	0
1.00	**1.75**	**-0.19**	**0**	**-1/6**
1.05	1.67	-0.28	-1/3	-2/6
1.10	1.59	-0.35	-1/3	-2/6
1.15	1.52	-0.42	-1/3	-2/6
1.20	1.46	-0.49	-1/3	-3/6

Nominal calibration is at the weld in center of float.
Bold indicates density of water

To compensate for density variations, the display can be set for the product density. When this is done, it will change the reading by the amount shown in the “Correction” column so that the gauge will read correctly. Note that the amount of variation with density is not large. The density correction will only be needed if the range of product densities is very wide.

If the gauge is put into raw inch mode by jumping pins 1 and 2 on the programming plug, the density correction has no effect. The density correction also has no effect on the calibration during programming or copying.

To set the density:

1. The display must be showing a valid reading in order to set the density. If "no L" or some other error message is showing, repair or connect the gauge before proceeding.
2. Press and hold the alarm reset button. After about 7 seconds the display will show the current density setting, for example, "C .90" indicates a current density setting of 0.90 which is the default. Release the button at this point.
3. If no further action is taken, the display will revert to normal operation after about 5 seconds with no change in the density setting. This is useful if you just want to check the current density setting.
4. To change the density setting, press and release the button repeatedly until the correct density is shown. This must be started before the 5 second time expires, otherwise start again at step 2. The "C" for "current density" on the display will change to "P" for "Program density" and the density will increase from the current setting in 0.05 increments for each button press. For example, if the current density is 0.90, then the display will show "P .95", "P1.00", "P1.05", "P1.10", "P1.15", "P1.20", then it will start over at "P .60", "P .65", and so on.
5. When the correct density is shown, stop pressing the button. After 5 seconds the display will show "Stor" for 2 seconds, indicating that the new density value has been stored.
6. The display will then return to normal operation

To program which float is being used:

1. Since the plastic and stainless steel floats have different buoyancies, the display must be programmed with the type of float used so the density correction will be accurate. This only needs to be done once during installation.
2. The display must be showing a valid reading in order to program the float type. If "no L" or some other error message is showing, repair or connect the gauge before proceeding.
3. Press and hold the alarm reset button. After about 7 seconds the display will show the current density setting, for example, "C .90" indicates a current density setting of 0.90 which is the default. Continue to hold down the button.

4. Put a magnet next to the display face by the “G” in Garnet, with the hole in the magnet facing left and right, not up and down.
5. The display will change to “PL F” or “SS F” depending on whether the display is currently programmed for a plastic or stainless steel float. When this happens, remove the magnet and release the button.
6. If no further action is taken, the display will revert to normal operation after about 5 seconds with no change in the float programming. This is useful if you just want to check the current float programming.
7. To change the float programming, press and release the button before the 5 second time expires, otherwise start again at step 3. Each time the button is pressed the float type will change.
8. When the correct float type is shown, programming is complete. After 5 seconds of no button activity, the display will show “Stor” for 2 seconds if the float type has been changed, indicating that the new float type has been stored.
9. The display will then return to normal operation

CHAPTER 9
808P2 PROGRAMMING INSTRUCTIONS

The 808P2 provides an interactive programming experience. When the programming plug is connected to the gauge, the gauge display will show “prog” within a couple of seconds. Do not start programming the gauge until “prog” is shown. After the plug has been removed, the gauge display will show “donE” for a moment.

Note: it is not possible to directly copy the calibration from an 808, 808i, 808A or old style 810 to an 808P2. The calibration will have to be re-entered using the procedure to calibrate a gauge from a table of calibration values.

Program the 808P2 for the correct mode (1/3”, 1/4", or 1/6”) or check the software revision:

1. The 808P2 display can be used with the 808, 810, or 908 bars, which requires the installer to make sure that the display is programmed for the correct mode so that it will operate correctly with the sender bar used.
2. The 817 Truck Gauge Programmer is not needed for this operation. Only a magnet is required to change the mode.
3. Disconnect the fiber from the display and make sure that no ambient light is getting into the optical connector. The display must be showing “no L” in order to set the mode.
4. Hold the magnet next to the display face by the “G” in Garnet, with the hole in the magnet facing left and right, not up and down.
5. The display will show “C1-3”, “C1-4” or “C1-6” within a couple of seconds, indicating the current mode that the display is set for (the “C” means “current”). Continue to hold the magnet by the face.
6. After 3 seconds of showing the current mode, the display will show “P1-3” for 3 seconds, then it will show “P1-6” for three seconds, then it will show “P1-4” for three seconds (the “P” means “program”). Removing the magnet during the time that “P1-3” is shown will program the mode at 1/3”, removing the magnet during the time that “P1-6” is shown will program the mode at 1/6”, and removing the magnet during the time that “P1-4” is shown will program the mode at 1/4”. To confirm that the new mode has been stored in memory, the display will show “Stor” for one second after

removing the magnet. (Some early models may not show the P1-4 mode; in this case use the P1-6 mode if a ¼" resolution bar is being used).

7. If the magnet is held past the setting time for the 1/4" mode, the display will show the software revision number, which is useful for checking the generation of display. Remove the magnet to resume normal operation. Removing the magnet at any time other than when "P1-X" is shown will result in no change to the mode.
8. Double check the mode by holding the magnet in place until "C1-X" is shown, and then immediately remove the magnet.

Program the 808P2 gauge display into inches:

1. Press the **Power On & Reset** button to turn on the programmer.
2. Press for one second the **810P-1/3"** or **810P-1/6"** button to set the mode.
3. Select a memory location with **MEM LOC**.
4. Press for one second the **INCH MEM** button to put inches into the memory. (the Calibration Display will show "Inch") If the inches are already in memory from a previous calibration, it is not necessary to do it again, but make sure that they are the correct inches (1/3 or 1/6).
5. To program the alarm points, determine the level that they should be set at and whether they should be start up or shut down. The start up ⊓ mode turns the alarm ***on*** as the tank level rises past the alarm point (i.e., the alarm is on at the top of the tank, and off at the bottom). The shut down ⊔ mode turns the alarm ***off*** as the tank level rises past the alarm point (i.e., the alarm is on at the bottom of the tank, and off at the top).
6. If the automatic alarm (the purple wire) is to be used, program A4 as shutdown at the point where the horn is to come on, and program A3 as shutdown a few inches above where the float will sit at the bottom of the tank. The automatic alarm is a special output so that even though A4 is programmed as shutdown, the horn will be turned on when the level rises above the A4 point, and then will turn off when the lid is closed and opened. When the fluid level goes below the A3 point, the alarm will be re-armed so it will sound the next time the level goes above A4.
7. To set alarm point one, use the **INCH** buttons to obtain the desired point on the Calibration Display, then press for one second the **A1** ⊔ or **A1** ⊓ button. The Alarm 1 Display will show "prog", and then it will show the alarm setting. Repeat this procedure for the other alarms. If an alarm is not used it does not need to be programmed.

8. Make sure that the fiber from the sender bar is connected to the gauge display, and plug the small programmer plug into the gauge display. Press the **BAR** button. The inch display should show some inch reading, if it shows “no L” or “bd L’ check the fiber connection and the bar mode (1/3 or 1/6 inch). NOTE: The black fiber optic cable connector MUST be shaded from direct sunlight. See the information in the General Notes section for further information.
9. Measure the distance from the bottom of the tank to the middle of the float, this is the bottom reading. Use the **OFFSET** buttons to obtain this reading on the Calibration Display.
10. Press for one second the **PROG** button (the Calibration Display will show “prog”).
11. When “prog” is done, unplug the programmer from the gauge and verify gauge operation.

Copy one 808P2 gauge display to another (can also copy from an 808PA, 810P2, or an 810PS/810PS2):

1. Press the **Power On & Reset** button to turn on the programmer.
2. Press for one second the **810P-1/3”** or **810P-1/6”** button to set the mode.
3. Select a memory location with **MEM LOC**.
4. Plug the small programmer plug into the gauge display to be copied ***from***. Press for one second the **COPY** button to copy the gauge calibration into memory. (the calibration display will show “copy”)
5. When “copy” is done, unplug the programmer plug from the first gauge and plug it into the gauge display to be copied ***to***. Press for one second the **PROG** button (the calibration display will show “prog”).
6. When “prog” is done, unplug the programmer from the gauge and verify gauge operation.

Program an 808P2 gauge display from a table of calibration values:

1. Obtain a table of inches versus volume
2. Press the **Power On & Reset** button to turn on the programmer.
3. Press for one second the **810P-1/3”** or **810P-1/6”** button to set the mode.
4. Select a memory location with **MEM LOC**.
5. Press for one second the **CLR MEM** button to erase any previous calibration. (the calibration display will show “CLr”)

6. Use the buttons on the middle keypad to enter the desired calibration. Press the **ENTR** button to store the value in memory. When **ENTR** is pressed, the inches will go to the next value. If you make a mistake, press **ENTR**, then **INCH ↓**, then re-enter the correct value, or just continue to enter the correct numbers, the previous ones will scroll off the left of the display (you will need to enter leading blanks if less than 4 digits are entered). If the current point is the same as the last one, simply press **ENTR** again to store the same calibration value as the last point.
7. After the table has been entered, use the **INCH** buttons to review the table to make sure it is correct. If a calibration value is incorrect, simply re-enter it and press **ENTR**.
8. To program the alarm points, determine the level that they should be set at and whether they should be start up or shut down. The start up ⊓ mode turns the alarm ***on*** as the tank level rises past the alarm point (i.e., the alarm is on at the top of the tank, and off at the bottom). The shut down ⊔ mode turns the alarm ***off*** as the tank level rises past the alarm point (i.e., the alarm is on at the bottom of the tank, and off at the top).
9. If the automatic alarm (the purple wire) is to be used, program A4 as shutdown at the point where the horn is to come on, and program A3 as shutdown a few inches above where the float will sit at the bottom of the tank. The automatic alarm is a special output so that even though A4 is programmed as shutdown, the horn will be turned on when the level rises above the A4 point, and then will turn off when the lid is closed and opened. When the fluid level goes below the A3 point, the alarm will be re-armed so it will sound the next time the level goes above A4.
10. To set alarm point one, use the **INCH** buttons to obtain the desired point on the Calibration Display, then press for one second the **A1** ⊔ or **A1** ⊓ button. The Alarm 1 Display will show “prog”, and then it will show the alarm setting. Repeat this procedure for the other alarms. If an alarm is not used it does not need to be programmed.
11. Make sure that the fiber from the sender bar is connected to the gauge display, and plug the small programmer plug into the gauge display. Press the **BAR** button. The inch display should show some inch reading, if it shows “no L” or “bd L’ check the fiber connection and the bar mode (1/3 or 1/6 inch). NOTE: The black fiber optic cable connector MUST be shaded from direct sunlight. See the information in the General Notes section for further information.

12. Measure the distance from the bottom of the tank to the middle of the float, and then look up this value in the calibration table to obtain the correct volume for the bottom reading. Use the **OFFSET** buttons to obtain this reading on the Calibration Display.
13. Press for one second the **PROG** button (the Calibration Display will show "prog").
14. When "prog" is done, unplug the programmer from the gauge and verify gauge operation.

Program an 808P2 gauge display from a table stored in memory:

1. Press the **Power On & Reset** button to turn on the programmer.
2. Press for one second the **810P-1/3"** or **810P-1/6"** button to set the mode.
3. Select the correct memory location with **MEM LOC**.
4. Use the **INCH** buttons to review the table to make sure it is correct. If a calibration value is incorrect, simply re-enter it and press **ENTR**.
5. To program the alarm points, determine the level that they should be set at and whether they should be start up or shut down. The start up ⊓ mode turns the alarm ***on*** as the tank level rises past the alarm point (i.e., the alarm is on at the top of the tank, and off at the bottom). The shut down ⊔ mode turns the alarm ***off*** as the tank level rises past the alarm point (i.e., the alarm is on at the bottom of the tank, and off at the top).
6. If the automatic alarm (the purple wire) is to be used, program A4 as shutdown at the point where the horn is to come on, and program A3 as shutdown a few inches above where the float will sit at the bottom of the tank. The automatic alarm is a special output so that even though A4 is programmed as shutdown, the horn will be turned on when the level rises above the A4 point, and then will turn off when the lid is closed and opened. When the fluid level goes below the A3 point, the alarm will be re-armed so it will sound the next time the level goes above A4.
7. To set alarm point one, use the **INCH** buttons to obtain the desired point on the Calibration Display, then press for one second the **A1** ⊔ or **A1** ⊓ button. The Alarm 1 Display will show "prog", and then it will show the alarm setting. Repeat this procedure for the other alarms. If an alarm is not used it does not need to be programmed.
8. Make sure that the fiber from the sender bar is connected to the gauge display, and plug the small programmer plug into the gauge display. Press the **BAR** button. The inch display should show some inch reading, if it

shows “no L” or “bd L’ check the fiber connection and the bar mode (1/3 or 1/6 inch). NOTE: The black fiber optic cable connector MUST be shaded from direct sunlight. See the information in the General Notes section for further information.

9. Measure the distance from the bottom of the tank to the middle of the float, and then look up this value in the calibration table to obtain the correct volume for the bottom reading. Use the **OFFSET** buttons to obtain this reading on the Calibration Display.
10. Press for one second the **PROG** button (the Calibration Display will show “prog”).
11. When “prog” is done, unplug the programmer from the gauge and verify gauge operation.

Program an 808P2 gauge display for a tank with straight vertical sides:

1. If the tank has a constant cross section so that the volume increases linearly with depth, the programmer can calculate the calibration points so that only one value needs to be entered. Examples of these types of tanks would be upright cylindrical tanks (NOT on their side) and rectangular tanks.
2. Determine the gauge increment, that is, the resolution of the gauge. This will be 1/3” for a low resolution truck gauge or 1/6” for a high resolution truck gauge.
3. Calculate the tank volume for the gauge increment. This is done by calculating the area of the tank and multiplying by the gauge increment. The area will be 3.14159 X radius X radius for an upright cylindrical tank, or length X width for a rectangular tank. For example, for a 12 foot diameter tank with a high resolution truck gauge: radius = 6 feet = 182.88 cm, so the area is 105,070.86 square cm. 1/6” of depth is 0.4233 cm, so the volume per increment is 44,480 cubic cm, which is 0.04 480 cubic metres. (1 inch=2.54 cm, 1,000,000 cubic cm= 1 cubic metre)
4. Determine how many decimal places are to be displayed. For example, if the tank capacity is 22 cubic metres, two decimals could be displayed since there are four digits available. The user may only want one decimal, so it is best to check with the customer.
5. The number calculated in step 3 consists of two parts: the display digits and the guard digits. The display digits are the ones which will be shown, in our example with two decimal places the display digits will be 00.04 so

the display will increase by 0.04 per increment. The guard digits are the next three digits which prevent round off error when the programmer calculates the calibration. In our example they would be 480. (if one decimal place were to be used, display digits would be 000.0 and the guard digits would be 448)

6. Press the **Power On & Reset** button to turn on the programmer.
7. Press for one second the **810P-1/3"** or **810P-1/6"** button to set the mode.
8. Select a memory location with **MEM LOC**.
9. Use the buttons on the middle keypad to enter the increment, guard digits first. In our example, press **4 8 0 0 0. 0 4** which is the three guard digits followed by the four display digits. It is very important to enter all four digits for the display digits, even if some are zeros.
10. Press the **INCR** button for one second, the calibration display will show Incr while the programmer calculates all the points.
11. When the points have been calculated, the inch display will be at zero and the calibration display will show the display increment, in our example **.04** will be shown. A volume of zero is not shown due to the way that the programmer calculates the calibration.
12. To program the alarm points, determine the level that they should be set at and whether they should be start up or shut down. The start up ⊓ mode turns the alarm ***on*** as the tank level rises past the alarm point (i.e., the alarm is on at the top of the tank, and off at the bottom). The shut down ⊔ mode turns the alarm ***off*** as the tank level rises past the alarm point (i.e., the alarm is on at the bottom of the tank, and off at the top).
13. If the automatic alarm (the purple wire) is to be used, program A4 as shutdown at the point where the horn is to come on, and program A3 as shutdown a few inches above where the float will sit at the bottom of the tank. The automatic alarm is a special output so that even though A4 is programmed as shutdown, the horn will be turned on when the level rises above the A4 point, and then will turn off when the lid is closed and opened. When the fluid level goes below the A3 point, the alarm will be re-armed so it will sound the next time the level goes above A4.
14. To set alarm point one, use the **INCH** buttons to obtain the desired point on the Calibration Display, then press for one second the **A1** ⊔ or **A1** ⊓ button. The Alarm 1 Display will show "prog", and then it will show the alarm setting. Repeat this procedure for the other alarms. If an alarm is not used it does not need to be programmed.

15. Make sure that the fiber from the sender bar is connected to the gauge display, and plug the small programmer plug into the gauge display. Press the **BAR** button. The inch display should show some inch reading, if it shows “no L” or “bd L’ check the fiber connection and the bar mode (1/3 or 1/6 inch). NOTE: The black fiber optic cable connector MUST be shaded from direct sunlight. See the information in the General Notes section for further information.
16. Measure the distance from the bottom of the tank to the middle of the float, then calculate the correct volume for the bottom reading (distance X volume increment / gauge increment, for our example if the distance was 4 inches, it would be 4 X 0.04480 / 1/6=1.06 cubic metres). Use the **OFFSET** buttons to obtain this reading on the Calibration Display.
17. Press for one second the **PROG** button (the Calibration Display will show “prog”).
18. When “prog” is done, unplug the programmer from the gauge and verify gauge operation.

Programming the alarms for use with the 815 or 815U Spill Stop:

1. Press the **Power On & Reset** button to turn on the programmer. Make sure you have the correct volume calibration showing in the Calibration Display.
2. For Spill Stop applications, alarm 1 is the overfill point, alarm 2 is the warning point, and alarm 3 is the tank empty point. Alarm 1 must be higher than alarm 2, and alarm 2 must be higher than alarm 3. All three of the alarms are programmed as shutdown.
3. Select the point in the tank where the loading must be stopped to prevent an overfill. Use the **INCH** buttons to obtain this point on the Calibration Display.
4. Press for one second the **A1** ⌴ button. The Alarm 1 Display will show “prog”, and then it will show the alarm setting. This programs alarm 1 as a shutdown with the overfill value.
5. Select the point in the tank where the horn warning should sound. Use the **INCH** buttons to obtain this point on the Calibration Display.
6. Press for one second the **A2** ⌴ button. The Alarm 2 Display will show “prog”, and then it will show the alarm setting. This programs alarm 2 as a shutdown with the horn warning value.

7. Select a point in the tank which is a few inches off the bottom. The product level must go below this point when unloading, but once the tank has been even partially filled the product level should be above this point. Use the **INCH** buttons to obtain this point on the Calibration Display.
8. Press for one second the **A3** ⌴ button. The Alarm 3 Display will show “prog”, and then it will show the alarm setting. This programs alarm 3 as a shutdown with the tank empty value. When the product level drops below this point all of the bypasses on the 815 Spill Stop Controller are reset.
9. This completes the alarm programming. Alarm 4 is not used for Spill Stop applications. Program the gauge according to the appropriate instructions above.

Programming the alarms to use the self resetting high level warning alarm (the purple wire automatic alarm):

1. Press the **Power On & Reset** button to turn on the programmer. Make sure you have the correct volume calibration showing in the Calibration Display.
2. For this application, alarm 4 is the warning point and alarm 3 is the tank empty point. Alarm 4 must be higher than alarm 3. Both of the alarms are programmed as shutdown.
3. Select the point in the tank where the warning should sound. Use the **INCH** buttons to obtain this point on the Calibration Display.
4. Press for one second the **A4** ⌴ button. The Alarm 4 Display will show “prog”, and then it will show the alarm setting. This programs alarm 4 as a shutdown with the warning value.
5. Select a point in the tank which is a few inches off the bottom. The product level must go below this point when unloading, but once the tank has been even partially filled the product level should be above this point. Use the **INCH** buttons to obtain this point on the Calibration Display.
6. Press for one second the **A3** ⌴ button. The Alarm 3 Display will show “prog”, and then it will show the alarm setting. This programs alarm 3 as a shutdown with the tank empty value. When the product level drops below this point the warning bypass is reset.
7. This completes the alarm programming. Alarms 1 and 2 are not used for the self resetting high level warning alarm. Program the gauge according to the appropriate instructions above.

CHAPTER 10
TROUBLESHOOTING GUIDE

There are only 4 serviceable components in the gauge: the float, the sender bar, the interconnecting fiber optic cable, and the display.

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 stay the same as the fluid level changes, or the reading may appear to stick at one value then suddenly jump to a much different value.

If the fiber is damaged or the sender bar is dead, the display will read "no L" on the display. If the light level is poor due to a damaged or excessively bent fiber, or if the fiber is not fully inserted, or if the display is not programmed for the same resolution as the sender, the display will show “bL:xx”, where xx is the number of bits being 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 reads erratically, check for water inside the head or display, and for a poor end cap seal. If no problem can be seen, the display will require factory servicing.

To test a sender bar:

1. Make sure the sender is flashing about once a second from the optical connector. If it is not, 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 the **OPTICAL INPUT** on the 817 Truck Gauge Programmer. The top left display shows the number of bits the bar is sending and the optical power. If the optical power is poor (less than 70), then check the fiber, if it is good and fully inserted then the bar output is defective and the bar must be replaced. Ensure that the number of bits is correct (1/3” is 8 bits and 1/6” is 11 bits). If necessary reprogram the bar with a magnet (see the bar programming section) to put it into the correct mode. If the number of bits is not 8 or 11 then the bar is defective and must be replaced.

3. Press and hold for one second the appropriate mode button on the programmer to match the mode of the bar (**810PS 1/3”** or **810PS 1/6”**). Now press and hold for one second the **BAR TEST** button to put the programmer into the bar test mode. The inch display will now show what the bar is putting out. Slowly run a float up the bar while watching the inch display to verify bar operation. If the bar does not operate correctly then it must be replaced. Note that it is faster to test the bar in 1/3” resolution, if it works for 1/3” it will work for 1/6”. To return the programmer to normal operation press the **Power On & Reset** button.
4. If a programmer is not available, a quick test can be made of the bar by jumpering the two top pins on the programming plug in the display. This converts the display into reading raw inches only, the calibration is ignored. Run the float up and down on the bar to see if the inches change in a consistent manner. The bar should read around 80 to 85 inches when the float is near the top. The bottom reading will vary depending on the length of the bar.

Note: If the programmer or display is being used to test a bar outside in bright sunlight, the sunlight may penetrate right through the black **OPTICAL INPUT** housing and overwhelm the optical input. If this happens the programmer will appear to not respond to pressing the **BAR** or **BAR TEST** button. It will be necessary to shade the connector with your hand to ensure proper operation.

To test a display:

1. The display should show “no L” with no fiber connected. Note that if the optical connector on the display is exposed to ambient light the display may read “bd L” or “Sun”. If neither of these is the case then the display is defective and must be replaced. Note that it is possible for the display to “hang up” and freeze its display if it is exposed to excessive static shock or strong radio signals. If this is the case it should automatically reset itself within a few seconds.
2. Press the appropriate mode button to match what the display should be. Plug a piece of fiber from the **OPTICAL OUTPUT** of the 817 Truck Gauge Programmer to the optical connector on the display. If the display shows “no L” then it is defective and must be replaced (make sure the end of the fiber going into the display is flashing!). If the display shows “bd L” then it may be in the wrong mode. Reprogram the mode according to the

instructions in the programming section. If it does not respond then it is defective and must be replaced.

3. If the display shows some strange reading when the fiber is plugged in, it may need reprogramming. Copy the existing programming into an unused memory on the 817 (just in case) and then program the display in inches or a known good program. The display should show “prog” within a couple of seconds of plugging in the 817 plug, if not it is defective. After the 817 plug is removed the display should match the reading on the 817 calibration display, if it does not then the display is defective.
4. If only the alarms do not work then copy the calibration into the 817 to check if the points are programmed. If they are then connect a fiber from the 817 **OPTICAL OUTPUT** to the display optical connector. Connect the positive terminal of an ohm meter to the alarm wire, and the negative terminal of the ohm meter to the ground (green) wire. Use the inch up/down buttons on the 817 to run the display up to test the alarms. If the purple wire is being tested then make sure that both A3 and A4 are correctly programmed and run the display from below A3 to make sure that previous bypassing is cleared.

Troubleshooting block diagrams are available on our website, www.garnetinstruments.com

CHAPTER 11
SERVICE AND WARRANTY INFORMATION

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

Garnet Instruments Ltd.
286 Kaska Road
Sherwood Park, Alberta
Canada T8A 4G7
E-mail: tstalker@garnetinstruments.com