TANK GAUGE, OVERFILL ALARM, and LEAK MONITOR
TG-EL-D3-ARF
for use with: HD-A1, TG-EL-LF & TG-EL-VF Sensors

INSTALLATION and OPERATING INSTRUCTIONS

GENERAL
The TG-EL-D3-A Tank Gauging, Overfill Alarm and Leak Monitoring system is intended for use on double wall storage tanks with an annular space sump that is accessible from grade. A complete system consists of: the TG-EL-D3-A remote mounted indicator/alarm, the TG-EL-LF or TG-EL-VF tank level sensors and up to three HD-A1 leak sensors. See Fig. 1 for a typical installation.

Indicator
The TG-EL-D3-A indicator is microprocessor based and provides a continuous indication of the gallons of fluid in the tank. On demand the fluid depth in inches is displayed. The TG-EL-D3-A indicator includes an integral alarm horn that will sound for: "tank empty" (low fluid level), "tank overfill" (high fluid level), water leak, and oil leak. The indicator includes four relay dry contact outputs: common alarm (low fluid, high fluid, water leak, or oil leak), hole alarm (water or oil leak), over-fill warning (for optional outdoor bell at tank fill pipe, silences automatically after 60 sec.), and high tank level. An over-fill alarm silence pushbutton may be mounted at the tank fill pipe, to allow the driver to silence the bell before the 60 sec. period expires.

Level Sensor
The TG-EL-LF level sensor (See Fig. 2) is lever-float actuated, and senses the depth of the fluid in the tank. It is connected to the TG-EL-D3-A indicator via a three wire shielded cable. The fluid depth is translated into gallons and displayed on the TG-EL-D3-A indicator. A chain permanently connected to the float arm is provided for calibration and periodic testing of the level sensor and overfill alarm function. TG-EL-LF is suitable for use in all oils from gasoline thru #6 oil.

The TG-EL-VF level sensor (See Fig. 3) is a magnetically coupled vertical lift float actuated level sensor. All stainless steel and teflon construction makes it suitable for gasoline thru #2 oil, waste oils, waste water and many chemicals.

The TG-EL-D3-A indicator can be used with either the TG-EL-LF or TG-EL-VF. The LF and VF sensors are not field interchangeable.

Leak Sensor
The HD-A1 Leak Sensor (See Fig. 4) is a solid state, optically actuated assembly that responds to the presence of oil or water, and discriminates between the two. When liquid collects in the secondary containment area, the TG-EL-D3-A indicator will alarm and display "H2O" or "OIL". The HD-A1 transmitter module also has a yellow LED for Water and a red LED for Oil. The HD-A1 sensor can be located anywhere that leaking oil might accumulate: at the bottom of the annular space of a double-wall tank, in a tank piping manway, or in a double wall piping sump. Up to three HD-A1 sensors may be wired in series into a single TG-EL-D3-A indicator. Each HD-A1 can be individually tested with a built-in magnetically actuated test switch.

FEATURES

* Intrinsically safe sensor wiring allows sensors to be safely located in Class I, Div. 1, Group C & D hazardous locations.
* Single level sensor for: gallons display, low level (time to refill) overfill (high level), liquid depth.
* Leak Sensor discriminates between water and oil.
* Leak Sensor can be tested from grade.
* Integral door mounted alarm horn and alarm silence pushbutton.
* Self-silencing relay contact output for outdoor tank overfill warning bell.
* Dedicated leak alarm relay contact for connection to remote alarms or building automation systems.
* English language alarm messages on the indicator door for fast diagnostics
* 4-20mA output proportional to gallons for remote indicators, recorders or building automation systems.
* Gallons recall pushbutton allows you to compare tank gallons before and after Leak alarm (to determine leak rate).
# TG-EL-D3-ARF

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SPECIFICATIONS

TG-EL-D3-A Indicator
Power: 120VAC (+15,-20%)/30VA
Non-Volatile Calibration
Microprocessor based
Ambient Temperature:
Operating:+32°F to 125°F (0°C to +55°C)
System Accuracy:
+/-0.4% (field calibrated)
Digital Display: 0.8” characters
Readout: To 100,000 gallons

4-20mA Output:
Max load 550 Ohm. "I"-terminal tied to
building ground (non-isolated).
Intrinsically Safe Sensor Circuits: Class I,
Div. 1, Group C & D locations when installed
in accordance with instructions.
cable length - 800 ft. max
Instrument Housing:
Die cast aluminum for flush and surface mounting
Relay Contacts: SPDT, 120 VAC max. 5A
Resistive

TG-EL-LF Level Sensor
Tank Depth: 12 feet max.
Tank Pressure: 15 psi max.
Fluid Temperature: 180°F max
Assembly head Ambient Temp: -20°F to +120°F max
Tank Contents: gasoline through #6 fuel oil
Wetted Parts: Aluminum, bronze, buna N,
stainless steel
Mounting: 2" tank opening minimum

TG-EL-VF Level Sensor
Tank Depth: 12 feet max.
Tank Pressure: 150 psi max.
Fluid Temperature: 180°F max.
Tank Contents: Light oils, gasoline
Wetted Parts: Stainless steel, teflon
Mounting: 4" tank opening required

HD-A1 Leak Sensor
Water and Oil tight epoxy potted construction
Output: 0-1mA DC - Tristate: dry, oil, water
Reverse polarity protection
Integral Magnetic Test Switch
Mounting: 2" NPT coupling
Wetted Parts: stainless steel and epoxy resin
compatible with gasoline, oil and water.
Gasohol compatible, if special ordered.
Ambient Temp: 0-135°F

Instrument Mounting Dimensions

FIG. 5
OPERATION

Normal
Display on door indicates current gallons in tank. Pressing "Liquid Depth" pushbutton will cause display to indicate liquid depth to tenths of an inch.

4-20mA output constantly transmits a signal proportional to tank gallons.

Low Tank Contents
Door horn sounds, common alarm contacts close (B-BO), and display alternates between "LO" and current gallons.

Press alarm silence pushbutton on indicator door to silence horn, (B-BO) contacts open.

Display will continue to indicate "LO" until tank is filled above low level setpoint.

Tank Over-Fill
When tank gallons exceeds the 'H' (high) setpoint: door horn sounds, common alarm contacts close (B-BO), Over-Fill contacts close (F-FO), high level contacts close (L-LO), and display alternates between "HI" and current gallons.

Press alarm silence pushbutton on indicator door to silence horn ((B-BO) contacts open).

Display will continue to indicate "HI" until tank is emptied below 'H' (high) setpoint.

Over-Fill contacts (F-FO) remain closed for approximately 1 minute after initial over-fill and then automatically open. These contacts are typically used to sound a bell located near the tank fill pipe. The alarm notifies the truck driver that filling should stop immediately. This alarm silences automatically to prevent annoying neighbors and to make it unnecessary for the driver to silence the alarm.

Optionally, an over-fill alarm silence pushbutton may be mounted near the fill pipe. Pressing this pushbutton (hold for 2 seconds min.) allows the driver to silence the over-fill alarm before the 1 minute automatic silencer timer expires.

The High level contacts (L-LO) will remain closed until the tank level drops below the 'H' (high) setpoint level. These contacts may be used to light a 'full tank' warning light at the fill pipe.

The TG-OF-AVS alarm panel combines three Over-fill warning functions in one NEMA 4 outdoor enclosure: Alarm bell, Tank Full light, Alarm Silence pushbutton. The TG-OF-AVS is purchased as a separate accessory.

Leak (Hole)
When an HD-A1 Leak Sensor trips: the horn sounds, common alarm contacts close (B-BO), hole contacts close (H-HO) and the display alternates between "H2O" or "OIL" and the current gallons. When the leak is initially detected, the TG-EL-D3-A saves the current gallons in its memory.

Press the alarm silence pushbutton to silence the horn (and open B-BO contacts).

The display will continue to alternate between gallons and "H2O" or "OIL", and contacts H-HO will remain closed until the sump is drained.

Pressing "Hole Alarm Recall" will cause the display to show the gallons in the tank at the start of the leak. Comparison with the current gallons and usage will show how many gallons leaked.

When multiple HD-A1 sensors are installed, a leak at any of the locations will cause an alarm. Generally the sensors are located in the double-wall piping sump(s) and in the tank double-wall sump. Visually inspect the LED indicators on each HD-A1 transmitter to determine which sensor caused the alarm.
INSTALLATION

ATTENTION

Each TG-EL-D3-A System (indicator and level sensor) is fabricated based on the dimensions of a specific tank. Before proceeding, verify that the tank depth and capacity (engraved on the TG-EL-D3-A door) match the tank dimensions. Do not attempt to install this unit if there is a discrepancy. Each TG-EL-D3-A indicator and level sensor are factory calibrated as a matched set. Verify that the S/N of both pieces are the same.

Read all of the Installation instructions before proceeding.

The phrase "Intrinsically Safe" is used throughout this manual. What does it mean?

"Intrinsically Safe" means that the combination of the design of the TG-EL-D3-A system and proper field installation allows the TG-EL-LF (or TG-EL-VF) Level sensor and HD-A1 Leak sensor(s) to be safely located in Class I, Division 1, Group C & D Hazardous Locations.

If the TG-EL-D3-A system is properly installed, the sensor wiring circuits will be incapable of releasing sufficient energy to cause ignition of the Group C & D Hazardous atmosphere.

WARNING

Failure to follow all procedures in this manual and on drawing TG-D3-A-FM voids the intrinsically safe design and may create a hazardous condition. Only electricians experienced in intrinsically safe wiring should install sensors.

If power is present, accidental shorts to the sensor wiring may cause an explosion. Check each work location and determine if an explosion hazard exists. If an explosion hazard exists do not proceed with installation.

Consult with the National Electric Code (NEC) and local authorities (building inspectors, fire marshall etc...) to determine what locations (if any) are Hazardous at your site.

Installation Overview

Mount TG-EL-D3-A Indicator
Mount Level Sensor (TG-EL-LF or TG-EL-VF)
Mount Accessories
Route Wiring (Do Not Connect)
Test Sensor Wiring
Connect Wiring
Test HD-A1 Leak Sensor(s)
Mount HD-A1 Leak Sensor(s)
Calibrate Level Sensor
Encapsulate wiring splices
Set Over-Fill Alarm Setpoint
Test Over-Fill Alarm
Set Low level Alarm Setpoint
**Mount TG-EL-D3-A Indicator**

* The indicator must be mounted in a location where it is protected from temperature extremes (32°F - 125°F), vibration and moisture.
* The indicator must be mounted in a non-hazardous area. Conduits must be sealed to prevent hazardous gases from entering the non-hazardous area.
* The wiring distance between the Indicator and the Level Sensor should not exceed 800 feet.
* The total wiring distance between the Indicator and all Leak Sensors should not exceed 800 feet.

**Mount the Level Sensor**

* The TG-EL-D3-A indicator can be used with either the TG-EL-LF or TG-EL-VF level sensors. The -LF and -VF sensors are not field interchangeable.
* When the tank is underground, manholes large enough to permit removal and servicing of the sensor **MUST** be provided. **DO NOT BURY** the level sensor. Many local codes require easy access for monthly testing of sensors.
* Vertical clearance above the tank must permit installation of the level sensors. Allow approximately one tank diameter plus 1-1/2 feet.
* Although the sensors and wiring are watertight (when properly installed), adequate drainage should be provided. The units should not be submerged under normal operating conditions. Water damage to sensors caused by improper installation will not be covered by the warranty.

**TG-EL-LF Lever Float Level Sensor**

* The float must have an unobstructed swing in a vertical arc to allow it to reach the top and bottom of the tank. Avoid locations where the float will be affected by manual sticking, tank filling and return flows. Make sure that the float will not hit the end of the tank or rub against pipes, ladders or other obstructions (Fig. 1).
* Remove the 2" NPT flange adapter (and gasket) by removing the 4 hex head bolts (see Fig. 6).
* Remove the "WARNING" tag from the level sensor and note the "critical dimension".
* Measure the tank INSIDE diameter. Compare it to the I.D. shown on the tag. If the dimensions are not the same; **DO NOT PROCEED ANY FURTHER**, consult the factory.
* Measure the height from the tank fitting to the tank bottom (Fig. 7). Cut and thread a 2" NPT nipple such that the top of the flange will be at the "Critical Dimension" (+/- 1/8"). The intent is to place the pivot point of the lever arm exactly in the middle of the tank. If it is not, readings will be inaccurate.
* Tighten the flange and nipple (using pipe dope). Make sure that the face of the flange is parallel to the top of the tank. Two of the bolt holes must be in line with the long axis of the tank (See Fig. 8).
* Temporarily set the float aside. Make sure the calibration disk is attached to the lever arm. Attach the float arm to the pivot lever. Connect the chain from the lever arm to the chain on the head, make sure the chain is not wrapped around anything. (See Fig. 9).
* Place the flange gasket on the nipple/flange. Insert the Tank Assembly with the calibration chain hole facing the direction of the float arm swing (See Fig. 10A). When the gear bracket is inside the Tank, use the chain to pull up the float arm to prevent from jamming on the Tank bottom. (See Fig. 10B).
* Hand tighten the 4 flange bolts. (See Fig. 10C).
* Using the chain, slowly raise and lower the float arm from tank bottom to top. It should move freely. Do not force the arm past any obstructions.
FIG. 6
TG-EL-LF LEVEL SENSOR HEAD
FIG. 7
TG-EL-LF
MOUNTING FLANGE CRITICAL DIMENSION

FIG. 8
TG-EL-LF FLANGE ORIENTATION
TG-EL-VF Vertical Lift Level Sensor

* Check the sensor for damage which may have occurred during shipment. The float should move freely from top to bottom. If the float can be rotated on the rod, it is damaged.

* The sensor float assembly should be installed through a 4" NPT half coupling in the top of the tank as shown in Fig. 11. It is recommended that a strike plate be situated directly below the coupling.

* Remove the "WARNING" tag from the sensor and note the "mounting height".

* Measure the tank INSIDE diameter and compare it to the I.D. shown on the tag. If the dimensions are not the same, DO NOT PROCEED ANY FURTHER, consult the factory.

* Screw the mounting bushing 1-1/16" into the proper opening in the top of the tank (See Fig. 11). There should be a clearance of at least 2" between the bottom of the probe and the bottom of the tank (See Fig. 13).

* When using a standpipe, screw the mounting bushing 1-1/16" into the 4" NPT coupling on top of the standpipe (See Fig. 12). There should be a clearance of at least 2" between the bottom of the probe and the bottom of the tank (See Fig. 13).
Mount Accessories (optional)

The FA-S Overfill warning sign, overfill alarm bell and/or warning light and optional overfill alarm silence pushbutton should all be mounted near the tank fill pipe. The tank truck driver must be able to hear (or see) the overfill alarm from the fill pipe location.

However, since the wiring to these devices is not Intrinsically Safe; DO NOT MOUNT ANY OF THE OVERFILL ALARM ACCESSORIES IN A CLASS I HAZARDOUS LOCATION.

Route Wiring

After reading all of the notes below, route conduits and pull wiring.

Pull sensor cabling carefully to prevent nicks or cuts in the cable outer insulation. Use Preferred P/N 21655 cable (or equal).

Water or moisture contacting any of the sensor wiring will cause incorrect readings.

Perform wiring shorts and leakage test in the next step BEFORE MAKING ANY LEVEL OR LEAK SENSOR WIRING CONNECTIONS.

WARNING

Failure to follow all procedures in this manual and on drawing TG-D3-A-FM voids the Intrinsically Safe design, and may create a Hazardous Condition.

* The combination of the design of the TG-EL-D3-A indicator and proper field installation allows the TG-EL-LF or TG-EL-VF level sensor and HD-A1 Leak Sensor to be safely used in Class I, Division 1, Group C & D Hazardous Location.
* All wiring must comply with local codes. Use copper wire.
* Use only the conduit entries provided on the TG-EL-D3-A Indicator case. Do not make any new openings in the case.
* The Intrinsically Safe wiring must remain physically separated from Non-Intrinsically Safe wiring by means of conduit, raceways, partitions or tie-down (if a 2" minimum separation is maintained).
* The Non-Intrinsically safe wiring (alarm bells, overfill alarm, remote displays, etc...) MUST NOT PASS THRU THE CLASS I HAZARDOUS AREA.
* Equipment connected to the TG-EL-D3 indicator must not use or generate voltages greater than 125VAC.
* Conduits that enter the Hazardous Area must have a conduit seal to prevent the passage of fumes.
* The Integrity of the Intrinsically Safe design of the TG-EL-D3-A depends on effective shunting of electrical current to ground. Connect the "G" terminal (TB2-1) to local power system ground ("green wire"). Run a separate dedicated conductor from the Intrinsically Safe (I.S.) ground screw to a grounding electrode. 1 Ohm maximum from indicator to ground. 12 A.W.G. minimum. Protect the I.S. ground wire from damage, mark it with "INTRINSICALLY SAFE" labels.
* Multiple TG-EL-D3-A indicators may be wired to the same ground, provided that failure of one ground wire will not affect the grounds to the other indicators.
* Intrinsically Safe sensor wiring from multiple TG-EL-D3-A indicators may be run in the same conduit provided that all indicators share the same ground.
* See ANSI/ISA RP-12.6, "Installation of Intrinsically Safe Instrument Systems for Hazardous (classified) Location", for further installation guidelines.
* Do not apply power to the TG-EL-D3-A indicator unless the metal safety partition is covering the sensor terminal strip. Do not remove the partition unless all sources of power are removed first.
* Identify the Intrinsically Safe sensor wiring with light blue (if no other wires are blue) or "INTRINSICALLY SAFE" tags.
* Use minimum 20 A.W.G. shielded cable for sensor wiring. Tape all exposed shields. Connect shields only where shown. If other than Preferred P/N 21655 cable is used; cable run must have less than .15 uf total capacitance and less than 100 mH total inductance; and insulation must be greater than .01 inches in thickness.

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Test Sensor Wiring

* After routing the shielded cable to the sensors, but before making any connections, check resistance from each conductor (including shield) to ground. All conductors must measure greater than 2 Meg Ohms to ground. This checks for damaged insulation and water infiltration. Do not hold the Ohm meter probe tips or bare wires with your fingers, this will give false readings.

Connect the Wiring

WARNING

DO NOT APPLY POWER to the TG-EL-D3-A indicator or to any of the auxiliary circuits (alarm relay contacts, etc.) UNTIL AFTER the sensor wiring (terminals I-6) have been connected AND the metal safety partition is in place in the indicator.

Do not remove the metal safety partition unless all sources of power have been removed (this may involve multiple disconnects).

See drawing TG-D3-A-FM for all field wiring connections. Note that all terminals are shown figuratively on these drawings, the physical terminal layout is labeled in the indicator and shown below: (Fig. 14).

Intrinsically Safe Circuits

Power: L1-N 120VAC, 30VA
Recorder Output: 1+ - I-
4-20mA/550 ohms
Relays: 5 Amp Res. @120VAC
High Level LC-L-LQ
Hole Alarm HC-H-HO
Fill Alarm PC-F-FO
Common Bell BC-B-BO

Power off or alarm makes 'X' - 'XO'
Power on and no alarm makes 'X' - 'XC'

FIG. 14
TG-EL-D3 TERMINAL BLOCK LAYOUT

* Use connectors provided in splice kit (P/N 190271) at this time.
* The TG-EL-LF and HD-A1 sensors have a color coded cable. Follow color code on drawing TG-D3-A-FM.
* The TG-EL-VF sensor has a numbered terminal strip: 1,2,3. Wire 1-1, 2-2, 3-3, shield-4.
* AFTER the system has been fully tested and calibrated, field splices will be encapsulated in an epoxy resin to seal against moisture. DO NOT ENCAPSULATE SPLICES UNTIL AFTER TESTING.
* To permit easy withdrawal of the sensors from the tank for future service and testing, leave sufficient cable coiled around each sensor head (approx. 10-15 ft.).
TRIPLE UNIT HD-A1 HOOKUP

DOUBLE UNIT HD-A1 HOOKUP

SINGLE UNIT HD-A1 HOOKUP

NOTES:
1. ONLY ONE OF THESE ARRANGEMENTS MAY BE CONNECTED TO TERMINALS 4, 5, 6.
2. CUT OUT ONLY SHIELDED WIRES THAT ARE NOT SHOWN IN THESE CONNECTION DIAGRAMS.

LEVEL SENSOR MODEL | TANK DIAMETER | RANGE JUMPER
--- | --- | ---
TG-EL-WF-7 | 33-41 | YEL-DRG-BRN
| 41-57 | YEL-DRG-BRN
| 57-71 | YEL-DRG-BRN
| 71-84 | NONE

TG-EL-WF-12 | 84-94 | YEL-DRG-BRN
| 94-117 | YEL-DRG-BRN
| 117-144 | NONE

WARNING: THIS DRAWING IS FOR WIRING DETAIL ONLY. SEE DRAWING TG-D3-A-FM, SHT 1 OF 5, FOR INTRINSIC SAFETY PHYSICAL LAYOUT AND WIRING REQUIREMENTS.
AUX PIPING
SUMP HD-A1
LEAK SENSOR

MANHOLE
HD-A1
LEAK SENSOR

TANK
HD-A1
LEAK SENSOR

FOR A TWO UNIT INSTALLATION -
DO NOT PROCEED BEYOND THIS SPLICE

NOTES:
1. FOR 2 LEAK SENSORS, USE HD-TB-2.
2. FOR 3 LEAK SENSORS, USE HD-TB-3.
3. LEAK SENSORS MAY BE WIRING IN ANY
MASTER SENSOR BOX, SIMPLIFY MAINTENANCE.

INSULATE UNUSED WIRES:
FOR TG-EL-VF ONLY
SEE TABLE ON
TG-D3-A-FM,
SHEET 2 OF 5

WARNING:
THIS DRAWING IS FOR WIRING DETAIL ONLY.
SEE DRAWING TG-D3-A-FM, SHEET 3 OF 5, FOR
INTRINSIC SAFETY PHYSICAL LAYOUT AND
WIRING REQUIREMENTS.

P/N 21674 CABLE
P/N 21655 CABLE

EPoxy FILLED
SPLICE KIT
#196271

WHT RED BLK SHLD BLK WHT RED GRN BLU YEL GRN BRN
HD-TB LEAK ALARM TESTER (NOTE 13)
Drawing TG-D3-A-FM, Sheet 5 of 5 is peculiar to the TG-EL-D3-S*F, and the HD-S. It has therefore been omitted in this manual.
**Test HD-A1 Leak Sensor(s)**

**BEFORE** installing the HD-A1 Leak sensor(s) in the containment sumps, and **BEFORE** encapsulating the wiring splices in epoxy, **TEST** each HD-A1 sensor as follows:

- Obtain a sample of the fluid to be stored in the tank (#2 oil, gasoline, etc...).
- Obtain some water.
- Obtain a small container to place the fluid and the sensor in. The container must be opaque (i.e.: Paint can, coffee mug,...) to prevent ambient light from entering.
- Put the fluid (oil,...) into the container, and then lay the HD-A1 Sensor horizontally in the bottom of the container. Place an opaque cover or your hand over the container to keep out ambient light.
- Confirm that the red OIL LED comes on, that the TG-EL-D3-A indicator horn sounds and that the indicator displays "OIL".
- If the HD-A1 does not indicate "OIL"; see the trouble shooting section.
- Repeat for water.
- Confirm that the yellow WATER LED comes on, that the TG-EL-D3-A indicator horn sounds and the indicator displays "H2O".
- Place the magnet (attached to the transmitter) over the black test area, outlined on the HD-A1 transmitter.
- If the sensor tip was dry initially, the red "OIL" LED should light on the transmitter and the "OIL" alarm should trigger on the TG-EL-D3-A indicator.
- Press the Alarm Silence pushbutton on the indicator.
- Repeat for each HD-A1 sensor in the system.
- It is strongly recommended that the installer invites the owner to witness these tests and that the installer make a written record of the tests. (Formal records of alarms and test results are mandatory in some localities. Check State and Local Codes).

**Mount the HD-A1 Leak Sensor(s)**

One HD-A1 sensor is typically mounted in between the two walls of the double-wall tank at the low point of the tank. Additional sensors may be mounted in double-wall piping sumps or manways to detect piping leaks.

- **DO NOT BURY** the HD-A1 sensor or transmitter. Provide access for periodic testing via an easily removable 18" street box or manhole assembly (See Fig. 18).
- The thru-tank wiring fitting is not designed for prolonged immersion in water. Drainage must be provided.

- Fiberglass Tank Annular Space installations:
  - Starting from the opening where the HD-A1 will be inserted into the space between the tank walls, (normally a 4" NPT half coupling), work an electricians fish tape completely around the inner wall of the tank and back out the opening. NOTE: Some tanks are supplied with a length of nylon string in place, for pulling the HD-A1 into position.
  - Loosen the cap nut on the feed-through fitting and slide the two reducing bushings, riser pipe and coupling (if used) and feed-through fitting towards the transmitter and away from the sensor itself.
  - Carefully unroll the pull cable and clear any tangles.
  - Hook the fish tape (or string) to the loop and pull cable, and pull the probe into the tank.
  - Pull the pull cable completely around the tank and back out the opening in the outer wall.
  - When shipped, the pull cable and the electrical cable are cut to exactly the same length. Therefore, when the remaining electrical cable between the HD-A1 sensor and transmitter is exactly the same length as the pull cable that has been pulled out of the tank opening, the sensor is directly opposite the tank opening and on the bottom of the tank. Stop pulling when the lengths match.
  - Using a pipe joint compound; screw the 4 X 2 reducing bushing into the tank and the riser pipe and coupling (if used) into the 4 X 2 bushing.
  - Carefully roll up the excess pull cable, secure the roll with a tie-wrap and carefully stuff it into the riser pipe (if used) or into the tank opening in such a way that it may be fished out later if need be.
Figure 1 - Liquid Sensor positioned in the annular space.

**FIG. 17**

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**FIG. 18**

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Again using a thread compound, thread the 2 X 1/2 reducer into the coupling on the riser (or directly into the 4 X 2 bushing if no riser is used), and thread the feed-through fitting into the 2 X 1/2 bushing. Take care to hold the electrical cable firmly while sliding the feed through to prevent the probe from moving on the bottom of the tank.

Tighten the feed-through fitting cap nut securely to hold the cable and to seal the opening.

Secure the transmitter near grade level to provide easy access for future testing of troubleshooting.

Steel Tank annular space access pipe installation:

Steel double-wall tanks typically have a 2" vertical pipe at one end of the tank that connects to the sump at the bottom of the tank.

Remove the pull cable from the HD-A1 cone.

Attach a weight to the electrical cable just behind the sensor with tie wraps.

Using a thread compound, thread the 2 X 1/2 reducer into the coupling on the riser.

Lower the sensor into the sump access pipe until it touches the bottom, then withdraw it 1".

Thread the feed-through fitting into the 2 X 1/2 bushing. Take care to hold the electrical cable firmly while sliding the feed-through to prevent the probe from moving on the bottom of the tank.

Tighten the feed-through fitting cap nut securely to hold the cable and to seal the opening.

Secure the transmitter near grade level to provide easy access for future testing or trouble shooting.

Double-Wall piping sumps and manways:

Remove the pull cable.

Locate the sensor at the lowest point of the chamber. The sensor must not be exposed to daylight.

Lay the sensor horizontally and secure it to the chamber wall to prevent movement. The two stainless steel rings must not be electrically connected together or to ground. Fluid must be free to enter the nose cone.

Secure the transmitter near grade level to provide easy access for future testing or trouble shooting.

Calibrate the Level Sensor

The TG-EL-D3 may be ordered with either the TG-EL-LF Lever Float Level Sensor or the TG-EL-VF Vertical Lift Float Level Sensor. Follow the appropriate procedure.

TG-EL-LF Calibration

In order to start the calibration procedure, the sensor should be mounted in the tank with the steel calibration disk attached. If it is not, see the section: "Mount the Level Sensor".

Power the instrument. The display should light up. Permit a two minute warm up time.

Station one person at the Indicator to observe the readings and perform any necessary calibration adjustments. A second person at the Tank will stroke the Tank Assembly. The two should be able to communicate.

With the float arm resting on the bottom of the Tank (chain completely slack) depress and hold-in the "Liquid Depth" pushbutton on the Indicator door. The display should read 0.9. If the reading is LLLL or less than 0.8, slowly rotate clockwise the LEVEL "Z" adjustment screw (See Fig. 19) until the reading is 0.9. If the reading is above 0.9, slowly rotate the "Z" adjustment screw counter-clockwise until the reading is 0.9.

Using the test chain, slowly raise the float arm and hold gently against the top of the Tank. Press and hold the "Liquid Depth" pushbutton, the gauge should indicate: (Tank depth - .9°). The tank depth for which the gauge was built is engraved on the instrument door.

For example: for tank depth of 120°, the reading should be 119.1; for a 72° Tank, 71.1.
If the reading is HHHH or too high, slowly rotate the LEVEL "S" adjustment screw counter-clockwise; if too low, rotate clockwise, until the reading is correct.

Adjustment of the Span (S) screw will affect the Zero (Z) reading. Repeat Zero and Span steps several times until both readings are correct.

Withdraw the Tank Assembly from the Tank by removing the four flange bolts.

Remove the calibration disk and screw from the end of the float arm (Fig. 9). These are only used during calibration and not required for normal gauging system operation.

Install the float on the float arm as per instructions attached to the float.

Re-install the Level Sensor.

ATTENTION

To install the Assembly with the float attached, the Tank must be less than half full of liquid. Otherwise, as the float is forced into the liquid the float arm could be bent and damaged. Reduce liquid level if required.

Replace the four flange bolts and tighten evenly to assure a watertight seal.

Replace the Hex Plug (with O ring) in the calibration chain hole so that water cannot enter the Tank (See Fig. 6).

TG-EL-VF Calibration

The LEVEL S adjustment is preset at the factory to match the Tank Depth (I.D.) on the sensor WARNING tag and engraved on the indicator door. It should not be adjusted in the field.

Stick the tank. Note the liquid depth. The level must be greater than 12" and less than 'FULL' minus 12" for proper calibration.

Press the 'Liquid Depth' pushbutton on the indicator door. Adjust the LEVEL "Z" trimpot (Fig. 19) on the main PC board until the display reads the same depth as the stick reading. (a correction of 2-3" from the factory setting is not uncommon).

If the tank is empty, lay the sensor on the ground and position the float at approximately half stroke. Measuring from the mid-point of the float, determine the liquid depth that this position simulates.

Encapsulate the Sensor Wiring Splices

* Reference Fig 20 on previous page.
* Read all steps before starting.
* Clean and scuff the cable outer insulation with sandpaper in the area that will be inside the splice. This insures good resin adhesion.
* Depending on the installation, use either a butt connector to join two wires or a wire joint for three wires, provided in the splice kit (included).
* Do not wrap the wires and butt connectors in electrical tape. This will prevent the resin from sealing the connections.
* Snap the two halves of the plastic splice mold over the completed connection. If necessary enlarge the opening at the end of the mold.
* Wrap the ends of the mold with the tape provided (or putty) to prevent the resin from leaking out. Insert the two funnels into the mold.
* Prop up the mold at a slight angle. Hold it with a clamp so that both hands will be free to work with the resin pouch.
* Mix the epoxy resin according to the instructions on the resin pouch. Note the caution about cold weather. It may be necessary to heat the pouch before going outdoors.
* Fill the mold (from the low end) very slowly to prevent air bubbles from forming.
* Allow the splice to harden and cool
* Coil the cable and splice in the sensor head access chamber.
* Additional splice encapsulation kits can be ordered by Preferred P/N 190271.

Set the Over-Fill Alarm Setpoint

* Determine the gallons that should trip the Over-Fill Warning Alarm. The Over-Fill setpoint should comply with all codes (Federal EPA, local EPA, fire codes, etc.) and must be sufficiently below tank full capacity to give the tank truck operator enough time to prevent an over-fill spill.
* For regulated tanks that rely on Over-Fill alarm as the only means of overfill prevention, the Federal EPA requires that the alarm trips before the tank is 90% full (by volume).
* If time-to-overfill is the main criteria, the tank fill rate must be known. Some sample fill rates for light oils with gravity fill are:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>450 gal/min.</td>
</tr>
<tr>
<td>3&quot;</td>
<td>350 gal/min.</td>
</tr>
<tr>
<td>2&quot;</td>
<td>250 gal/min.</td>
</tr>
</tbody>
</table>

These are approximate figures and must be verified for the actual fluid and piping arrangement.
- Determine desired time before over-fill (in seconds)
- Calculate: (full tank gallons - (gpm fill rate x seconds)/60)
- Example: 3 minute warning 19,890 full capacity, 450 gpm fill rate,
  \[
  (19890 - ((450 \times 180)/60)) = 18540
  \]
  NOTE: 18540 is greater than 90% full (17901), this would not satisfy EPA requirements.
* Open indicator door. Press H pushbutton (Fig. 19), view current trip point (in gallons) on door. Changer setpoint by adjusting screw next to H pushbutton.

Test Over-Fill Alarm

* Press and hold the Over-Fill Test pushbutton on the indicator door. The gallons display on the door should ramp up to 90-95% of tank volume.
* When the gallons exceeds the Over-Fill alarm Setpoint: door horn sounds, display alternates between "HI" and current gallons, Over-Fill remote bell contacts close (F-FO), high level contacts close (L-LO), and common alarm contacts close (B-BO).
* Release the Over-Fill Test pushbutton.

Adjust the Low Level Setpoint

* Open the Indicator door. Press L pushbutton (See Fig. 19). View the current trip point on the door (in gallons). Change setpoint by adjusting screw adjacent to L pushbutton.
PERIODIC TESTING

It is very important to test this equipment on a regular basis. Preferred Instruments recommends annual testing (as a minimum). Some state and local codes require monthly testing with the results of the test recorded in a log book (check with local of officials).

**Leak Alarm Test**

* Go to the street box/manhole where the first HD-A1 Leak Sensor is located.
* The space being monitored should be dry before starting the test (the OIL and WATER lights on the HD-A1 transmitter should both be OFF)
* Place the magnet (attached to the transmitter) over the black test area that is outlined on the HD-A1 transmitter.
* The red "OIL" light on the transmitter will turn ON, "OIL" will be displayed on the TG-EL-D3-A indicator, the horn on the indicator will sound, and the H-HO leak alarm contacts will close.
* Remove the magnet. The OIL light on the transmitter will turn off. The Indicator will remain in Alarm.
* Press the Alarm Silence* pushbutton on the door of the indicator. the horn will silence, the display will return to displaying gallons, and the H-HO contacts will open
* If the system does not perform as described, retain a qualified field service person to inspect the system.
* Repeat the above procedure for any additional HD-A1 Leak Sensors.

**Over-Fill Alarm Test**

* Stick the tank. Note the fluid depth. Press the "Liquid Depth" pushbutton on the TG-EL-D3-A indicator door. The depths should agree.
* Press and hold the "Overfill Alarm Test" pushbutton on the Indicator door. The gallons display should ramp up to 90-95% of the tank capacity. When the gallons exceed the setpoint, the horn on the Indicator door will sound; the display will blink "HI", and the F-FO contacts will make.
* Release the Test pushbutton.
* If an outdoor alarm is connected to the F-FO contacts, it will sound for 60-90 seconds.
TROUBLE SHOOTING

WARNING

If power is present, accidental shorts to the sensor wiring may cause an explosion. Check each of the sensor locations (up to 3 HD-A1 and 1 Level Sensor), and determine if an explosion hazard exists. If all sensor areas are safe, proceed with the testing. If any area is unsafe, remove sensor and continue test in a safe area or REMOVE the explosion hazard and keep it removed for the duration of the test. IF EXPLOSION HAZARD CANNOT BE REMOVED, DO NOT PERFORM ANY TESTS!!!

WARNING

Install Intrinsic Safety metal partition over terminals 1-6 BEFORE re-applying any power to the indicator.

SYMPTOM: Display indicates "LLLL" or "HHHH"

This means that the level sensor is indicating a level below 0" (LLLL) or above max. tank height (HHHH). Possible causes are: incorrect calibration, field wiring error, bad field wiring, water or moisture contacting wiring, bad level sensor. NOTE: the TG-EL-LF level transmitting element is a 20K Ohm pot, TG-EL-VF uses a 2K pot.

1) Determine if the indicator is operating properly. Press 'H' pushbutton and adjust high alarm setpoint slightly. If this is possible, indicator is probably functioning properly.

2) Remove all sources of power from the indicator. Independent sources may power alarm contacts. Remove these sources also.

3) Remove intrinsic safety metal cover from terminals 1-6.

4) Remove wires from terminals 1,2,3,4. Measure from sensor wire 1 (wht) to 3 (blk); correct reading is 20K Ohms for TG-EL-LF, 2K for TG-EL-VF. Measure from 1 (wht) to 2 (red) and then from 2 (red) to 3 (blk), add these two measurements together. For TG-EL-LF the sum should be the same as the 1 to 3 reading. For TG-EL-VF these readings should not be open circuits (they will not add to 2k).

If any reading is bad, disconnect wiring at sensor splice and repeat the measurements to determine if the sensor is bad or if the field wiring has a short/open.

I splices are already in place, and wiring needs inspection, do so by completely cutting out a splice. Later, replace the entire splice by re-ordering P/N 190271.

5) Measure resistance from each field wire to earth ground (TB2-1). Each must measure greater than 2 Meg Ohms. Do not hold the Ohm meter probe tips or the bare wires with your fingers, this will give false readings.

If any wire shows a partial short to ground; disconnect wiring at level sensor. Measure sensor and field wiring independently to determine which is causing the short. Shorts less than 1K Ohms are typically damaged insulation. High resistance readings are typically caused by water infiltrating the cable, cable splices, or the level sensor head.

6) Level Sensor and Field Wiring OK: Either the indicator is improperly calibrated, the indicator is malfunctioning, or the lever arm/float is physically damaged (bent, fell off, etc.).
Follow level sensor calibration procedure above. The tank must be less than half full to extract the TG-EL-LF for calibration purposes.

7) If tests 4 & 5 show no problem, and the unit will not calibrate correctly; check indicator S/N and Level Sensor S/N. S/N's should be identical, check capacity and depth engraved on door against actual tank data.

If all S/N's and dimensions are correct, indicator may be programmed incorrectly, or defective.

**SYMPTOM: Poor Accuracy**

If indicator can be calibrated correctly at empty and full but readings at other points appear to be inaccurate (greater than 1% of capacity deviation), several factors could apply:

1) Tank not level. Depth measurements at the stick hole and level sensor location will not agree.

2) Worn dip stick. After years of dropping a stick into a tank, the wear can alter the true length of the stick.

3) Dip Stick doesn't allow for strike plate thickness.

4) Incorrect fabrication data. Capacity and depth engraved on door (and in the program) MUST match actual tank data.

5) Pivot Point Not Centered. (TG-EL-LF only). Lever pivot point MUST be at the vertical and horizontal center of the tank. Incorrect I.D., stand pipe, manhole, or height data could cause the level sensor to be fabricated incorrectly. Make sure sensor S/N and indicator S/N match.

6) Misaligned Sweep of Float Arm (TG-EL-LF only). The float swing arm assembly must be lined up with the centerline of the tank, to allow full swing from true full to true empty of tank. See Fig. 8.

**SYMPTOM: 4-20mA Output not Calibrated**

1) See Fig. 19 for component layout.

2) Intrinsically Safe metal barrier MUST be in place.

3) Remove wire on Terminal I+. Connect mA meter across terminals I+, I-.

4) Short across capacitor C30. Adjust 4-20 "Z" trimpot until output = 4.00mA. Remove C30 short.

5) Short across U13 pins 3 & 4. SHORTING PINS OTHER THAN 3 & 4 COULD CAUSE PERMANENT DAMAGE. Adjust 4-20 "S" trimpot until output = 20.00mA.

6) Repeat steps 4 & 5 until both readings do not require adjustment.

7) Note that terminal "I-" is connected to terminal G. If ground loops occur, an external isolator may be required.

**WARNING**

Oil leaks are a very serious matter. ALL ALARMS SHOULD BE INVESTIGATED THOROUGHLY. Do not assume an alarm is "False" until liquid samples have been withdrawn from each of the sensor tip locations. Report all leaks to the local authorities promptly.

**SYMPTOM: Always displays OIL or H2O Alarms:**

- Fluid in sump. Inspect each sump.
- One of the field wires or splices is an open circuit. Continuity test field wiring. Re-splice wiring.
- One of the red or green wires is shorted to a black wire. See dwg TG-D3-A-FM

**WARNING:** Read all "warnings" on Pg. 27, BEFORE starting trouble shooting.
- The HD-A1 farthest from the indicator is wired wrong, green wire not jumpered to black wire.
- Bad HD-A1. If more than one HD-A1 is installed, isolate as follows:
  Start at HD-A1 closest to indicator. Jumper green to black.
  Re-test first HD-A1
  If bad, replace.
  If ok; remove jumper, repeat on HD-A1 next farthest away.

**SYMPTOM:** OIL alarm, should be OIL alarm:
- Sensor conductivity rings shorted together or to earth ground. Inspect each sensor.
- Cable from transmitter to sensor is shorted or wet. Inspect each cable for damage.
- HD-A1 is bad. Isolate "Bad HD-A1" (see "Bad HD-A1" above). Replace

**SYMPTOM:** H20 alarm, should be H20 alarm:
- Distilled water or low conductivity water. Add salt to water, test again.
- Grease or dirt covering the sensor rings and insulating the rings. Inspect each sensor.
- HD-A1 is bad. Isolate bad HD-A1 (see above). Replace

**SYMPTOM:** Sensor wet, but no alarm:
- Sensor optical detector is exposed to excessive ambient light. Shield from light.
- Is the sensor fully submerged?

**OIL/H20 INDICATOR TEST:**

- Remove all power from unit, including any separate lines which might energize relay circuits.
- Remove intrinsic safety metal cover from terminals 1-6.
- Remove field wires from terminals 4,5 & 6. Apply electrical tape to each exposed conductor.
  Leave the wires within the confines of the metal cover.
- Re-install metal cover over terminals 1-6 and the wires removed from terminals 4,5, & 6.
- Re-apply power.
- Indicator should display "OIL" leak alarm; if not, indicator is bad and should be returned for repair.
- Remove Power Sources
- Remove intrinsic safety cover from terminals 1-6
- Obtain a 15K Ohm resistor (Bn, Grn, Org, 5%, 1/4W minimum) - Preferred Utilities #22153C-1/2CF.
- Put 15K resistor across terminals 5 & 6 to simulate DRY condition
- Re-install metal cover
- Power indicator
- Indicator should not display OIL leak alarm. If OIL leak display occurs return indicator for repair.
  If H20 alarm or no leak alarm occurs, indicator is functioning properly.

**GENERAL INDICATOR TEST**

1) Check fuse (just above terminal strip). CAUTION 120 VAC!

2) Check door cable. Re-seat plug in socket J3 (top-middle of PC board). White dot should be toward top. If cable is multicolored, brown should be on top. If grey cable, red stripe should be on top.

3) Check U1 for proper seating. I.C. Notch should be toward top. DO NOT UNPLUG with power on. Use anti-static discharge procedures to avoid damaging chip. Chip should be marked with the same S/N as the Indicator door.

4) Press H pushbutton and adjust Over-Fill alarm setpoint slightly.

**WARNING:** Read all "warnings" on Pg. 27, BEFORE starting trouble shooting.