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Section One- Overfill Protection-Tech Talk 26

Tech Talk No: 026

Subject: Overfill Protection

Purpose of Tech Talk: To give brief overview of Overfill Protection. To provide answers to the most common questions, and to dispel the most common misconceptions regarding Overfill Protection.

Scope: This document generally covers specifics, relating to Overfill Protection on road and rail tanks, and although some information is applicable to other areas such as storage tanks, generally this is outside the scope of this document.

What is overfill protection?

Put simply it is a device used to prevent a tank having more liquid put in then the tank is designed to carry safely. It should be used as a means to shut pump or valve off to prevent overfill in an emergency when other devices have not operated.

Why is overfill protection required?

Overfill became an issue with the advent of bottom loading of tankers (closed hatch filling). By the nature of closed hatch filling it became an issue to have overfill protection to prevent accidental overfilling occurring. Without overfill protection by the time the overfill is detected it is already too late and product has been lost. If we lived in a perfect world and there was no such thing as human error, overfill protection would not be required! Alas we do not live in a perfect world and until we develop the technology to create the perfect robot to do the work, overfill will always be required.

What is required in Australia?

The recently published AIP Safe Load Pass System specified the following relating to Overfill Protection as minimum requirements for any vehicle to be passed for loading at any participating oil industry facility. This certification is valid for six months only and can only be given by an approved inspector of which Liquip is one.

- * All vehicles wishing to utilise bottom loading facilities must be equipped with Overfill Protection devices that are 100% compatible with the Scully (or equivalent) bay controller.

In practice the only written code code at present is the English IP code. All Liquip overfill related overfill equipment ie. the probes, truck plug, on the truck side to our PD Series Monitors on the gantry side meet this standard.

- * A wet test of probes operation must be conducted by immersing the probe in a container of liquid (non-flammable) while checking operation of the overfill system ie. using a rack monitoring device to see if it red lights.

This means that anyone who is an approved inspector may be in the market for a portable testing unit. "They may be opposition but we can still make a sale!" Check who are the approved inspectors in each state!

- * Where interlocks are fitted to ensure probes have been installed. Check that interlock is functioning correctly.

For those not familiar with such a system, certain tankers (normally chemical) have probes fitted where they can be removed easily from the tank and stored, yet still be connected to overfill system. Liquip part number TM3-AT. This means that without an interlock to ensure probe is in place vehicles can get a green light to load with no probe actually in the tank

- * Where fitted, the operation of the vapour vent/overfill interlock air pressure switch must be checked to ensure loading is prevented until vapour vents are open.

Note: Only optical and thermistor based probes are to be accepted. Specifically capacitor type probes are not accepted.

Types of probes

Generally there are three types of probes in road and rail tanks. These are; Capacitance, Thermistor and Optic. There are a few others such as float type switches but these are now very uncommon. For general information Aviation tankers use pneumatics.

CAPACITANCE

Capacitance probes are banned in Australia. Still used in some parts of the world but we believe not for much longer. The reason being that they are not guaranteed fail safe.

THERMISTOR

Thermistor probes are assumed by most people to work by measuring sudden drops in temperature. This is not quite correct in fact the thermistor probes measure resistance not temperature. As the temperature drops the resistance increases.

Therefore, thermistor probes are in fact measured for increases in resistance not decreases in temperature.

Advantages: Is that thermistors do fail safe “generally”.

Disadvantages: Unreliable due to being bedded in a glass bead.

On cold mornings it can take over a minute to get a green light.

Can have stop start effect if probe is near a vent or in a draught as the air being pushed out by displacement can cool the thermistor and produce the same effect as cold fuel.

OPTICAL

Optical probes work on the principle that light refracts differently in different substances ie. the refractive index of air allows the light beam to reflect back internally giving a dry signal, yet in liquid the light beam is refracted outwards and no return signal is sent back giving a wet signal.

Advantages: They have proved themselves to be trouble free

Very low maintenance

Disadvantages: A shield is required over the prism to prevent back reflection off any adjacent shiny surfaces eg dip tube. This can trick the system into believing that the probe is dry even though it is wet. This is not a problem for Liquip probes as the main body acts as a shield. Other optic probes have removable shields that are by definition less reliable.

Not good with oils or other viscous products, can get dirtied.

Will not work in white liquids such as milk.

At present there are two types of optic two wire and five wire the pros and cons of both are listed below

FEATURE	RESULT
2 wire probe electronics is simpler	2 wire is cheaper to make
2 wire has less connections	2 wires easier to maintain and install. Requires less skill and less likely to suffer from mistakes
2 wire has one channel per compartment 5 wire has one channel with all probes linked in series.	5 wire monitors are less complex because only one channel is used. therefore cheaper to make.
Each 2 wire channel is independent, in parallel. 5 wire are all in series	2 wire is easier to diagnose 5 wire system cannot diagnose past first fault
2 wire system requires a dummy if less than the maximum allowable number of compartments. 5 wire does any number from one on eight.	2 wire dummy is an extra cost compared with 5 wire.
2 wire systems are available from more suppliers than 5 wire systems are	More competition in 2 wire systems therefore possibly cheaper. Spare parts are more readily available
2 wire probes can be tested with simple effective methods.	2 wire is cheaper to maintain

In general the two-wire system is preferred due to low costs, easy maintenance, simplicity and greater availability.

Some questions most commonly asked regarding overfill

Probes operate by power from the main island monitor, therefore how can we be sure that this will not cause an explosion?

Probes are manufactured to specific standards and must meet specific approvals. Ex ia IIA T6 Class 1 Zone 0. Monitors t Exd (ia) IIB T6 IP65. This sounds good as does the approvals that all our related overfill equipment meets, but what does it really mean?

Let me first explain the differences between the various Class / Zones

Class 1 Zone 0 This describes the environment that is within the confines of the product and is explosive at all times. ie This relates to probes as they are within the confines of the product.

Class 1 Zone 1 This describes the environment that is potentially explosive at all times. For example, this is within the confines of the loading gantry and relates to our range of Island monitors.

Class 1 Zone 2 This describes the environment that may sometimes be explosive and can be described as the area, between zone 1 and the safe (non explosive) boundary.

In answer to the original question we can be sure that the probe will not cause an explosion under any circumstances because it is intrinsically safe. ie the energy is limited which removes the potential for a spark.. See various methods for explosion protection methods and related terms below.

Explosion Protection Techniques and Terms

Type	Description	Method	Typical Application	Aust. Standard For Manufacture
Exi	intrinsic safety	Energy Limitation	Instrumentation & process control equipment	AS2380 part 1 AS2380 part 7
Exd	Flameproof	Containment	Power equipment, High energy switching eg Probe Doctor	AS2380 part 1 AS2380 part 2
Exe	Increased safety	Avoidance of ignition source	Fluorescent lighting, junction boxes, marshalling boxes	AS2380 part 1 AS2380 part 2
Exn	Non-sparking	Avoidance of ignition source	Zone 2 only	AS2380 part 1 AS2380 part 9
Exp	Pressurised enclosure	Exclusion of the hazard	Control cubicles, Instrumentation and electric motors	AS1825
DIP	Dust-excluding ignition proof	Exclusion of dust	All electrical equipment	AS2236

Note: The Australian wiring rules AS3304 applies to all installations. Section 9 of AS3000 specifically refers to AS2381 for the special requirements for hazardous areas.

Why do we have truck plugs with various bayonet pins?

The answer to this is that we manufacture truck and gantry plugs to suit the standard in various countries. Below is a table that identifies general rule of thumb regarding number of bayonet pins.

Number of pins	Governing petroleum body	Type of probes which suit	Country / Background
2	API ie USA	Optic, thermistor & Capacitance	Original TP in Australia
3	API ie USA	Optical 5 wire,	6 contacts
4	AIP ie Australia	2 wire optic, capacitance or Thermistor	New standard in Australia 8 or 10 contacts
4	IP ie Britain Europe	All types of probes	All must be 10 pin contacts

API stands for American Petroleum Institute
AIP stands for Australian Institute of Petroleum
IP stands for Institute of Petroleum (British)

By the time the overflow protection system worked product had overflowed?

This is very simply answered. The setting of the probe height in the tank is incorrect. There is a lag time between when the probe reads wet to when the pumps stop pumping into the tank. ie it is simply a matter of the flow rate of the pump compared to the ullage of the tank. The average lag is equal to 100 litres

Imagine this, if it takes 3 seconds for the pump to stop and it is pumping at about 2000 lpm then we know that 100 litres will flow into the tank even after probe is wet. If we only have 50 litres ullage between probe height and safe fill level then we have a problem!

I am having problems with getting a green light to load, HELP!

For Trouble-shooting guide to overfill protection problems, please refer to Tech Talk no. 21 “*Fault finding, Tanker overfill protection 2 wire system.*” Which is attached.

How can I be sure that the tank is correctly grounded via the truckplug?

Please refer to tech talk no. 13 “*Have You been grounded?*”, which is attached and more than adequately covers vehicle grounding via the truckplug. Briefly, grounding assurance is only obtained if the earth-return is forced to go through the tank structure.

How can I be sure that the Island monitor is in fact earthed ?

If you have any island monitors other than Liquip’s PD100 series or PD500 series than you cannot be 100% sure at all times. If you have a Liquip Island monitor, no worries! All Liquip island monitors have built in Automatic grounding assurance. Without mains earth attached the Liquip island monitor will not work therefore preventing loading if unsafe.

At the time of writing this, we are not aware of any other island monitor manufacturer IN THE WORLD who can make this claim!

Acknowledgments

There are numerous people, departments and previous tech talks that contributed to this document in one way or another.

Special thanks to the Engineering dept. In particular David Gregory, Greg Hamilton and Andrew Smith.

Thanks also to Judy Thomas for assistance in preventing the computer from winning.

Contribution from Jim Bury, Liquip W.A. also greatly appreciated

Have You Been Grounded?

10 August 1995

Tech Talk No: **T013**

Subject: **Tanker grounding and overfill protection.**

Attached are documents detailing the subject of ensuring road tankers are bonded to the loading rack to prevent static electricity sparks while loading.

Why is Liquip writing this? Because a spark at a major terminal is not something to be ignored.

1. A driver reported a large and loud spark jumping from his API coupler to the truck adaptor at a modern Sydney terminal.

This Terminal Is Equipped With A Well-Known American Ground-Assurance System Linked In With The Overfill Protection Monitor.

Liquip were called in to check the vehicle and the loading arms for continuity. No problems were detected in these areas but it was discovered the ground assurance unit was incorrectly wired.

2. It has been noted on several occasions in the past that some tankers will not get a green light on the overfill monitor until either the vapour recovery hose or the loading arm is connected.

This Means The Overfill Protection Plug Is Not Ensuring A Grounding Of The Tanker And It Is Likely That Dissipation Of Static Is Occurring In An Area Containing Vapour/Air Mixture.

Further investigation can be summarised as follows:-

- * Ground-assurance systems give assurance only that the component to which the grounding-bolt is fastened is properly bonded. This is frequently **not** the tank.
- eg. LPG tankers have been seen with the ground-bolt on the bumper bar or on the chassis. This gives no assurance of grounding the tanks, to which the pipelines and product connections are attached.
- eg. White-product tankers typically have a grounding wire to a post in the truck plug. This gives no assurance of grounding anything, not even the truck plug.

Grounding assurance is only obtained if the earth-return is forced to go through the **tank** structure.

- * The overfill monitor is quite adequate as a grounding assurance system so long as the wiring on the truck is correctly installed.
- * There appears to be a lack of knowledge on how the USA grounding assurance device works when linked in with the overfill monitor.
- ie. To operate correctly, every vehicle must be equipped with a diode in the wiring that fulfils the same function as the grounding bolt on stand-alone systems such as LPG tankers.

At the terminal where the spark occurred the ground assurance device had been 'fixed' so that a simple short across pins 9 and 10 gave the green light. (Presumably a diode has been inserted in the gantry wiring to simulate all tankers being so equipped). Therefore there is no earth assurance at all.

Recommendations.

- (a) All white product trucks should be wired so that the common earth return wire of the overfill system is forced to pass through the tank structure.

The Liquip 'Ground Boss' attached is one method of achieving this. Also attached is an old Scully instruction which achieves the same purpose but at greater cost due to the conduit requirements.

- (b) A clear method of identifying complying trucks should be agreed upon.
- (c) The terminal with the 'by-passed' earth assurance system may wish to take action so as not to create a false sense of security.

Attachments

David Gregory 10/8/95

LIQUIP TRUCK PLUG

TP100 SERIES

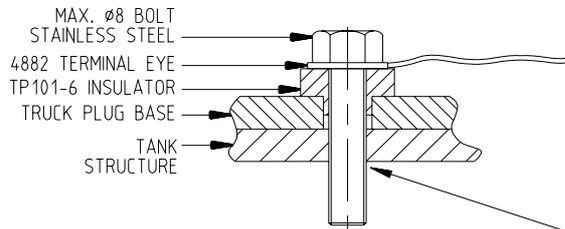
DATA SHEET

TITLE:	Truck plug for overflow protection with added ground assurance.
PURPOSE:	Industry standard 10 pin overflow protection plug interchangeable with others of the same type. However incorporates no-cost wiring connectors that ensure the tanker is bonded to the gantry so long as the plug body is correctly mounted. This dissipates static electricity and prevents sparks due to differences in potential.
OPERATION:	<p>TP series provides standard 10 pin connection for tanker system with room for an electronic dummy should this be required in a 2-wire operation.</p> <p>All of the above is normal.</p> <p>Where TP series differs is in the way it ensures good grounding of the tanker to the gantry and ensures dissipation of static electricity and so eliminates sparks. Hence the name "Ground Boss"</p> <p>It has long been a recommended practice to break the number 10 common earth return and "force" it through the tanker chassis by terminating and bolting the wire through the chassis at a distance apart to ensure grounding of the tank. However the difficulty in doing this cheaply and neatly has meant that few tankers used the technique.</p> <p>"Ground Boss" achieves this at essentially no cost by using the mounting bolts inside the plug. Internal insulating bushes ensure the only electrical path is via the external fastener, i.e. those bolted to the tanker: and the number 10 common earth wire is run from pin 10 to one bolt head and from under the other bolt head out via conduit to the probes. 9 and 10 are simply looped together if required. Therefore the only way the tanker can load is by having its tank in good contact with the rack monitor earth.</p> <p>Caution! The "Ground Boss" truck plug must be bolted to the tanker main structure, not to a potentially-isolated bracket or bolted-on substructure.</p>
SPECIFICATION:	<p>3 and 4 bayonet fixing to industry standard 10 pin as standard.</p> <p>Conduit ports 1/2" NPT (straight) thread, two options.</p> <p>Mounting by 2 stainless steel bolts 8mm dia via acetal insulating bushes.</p>
VARIANTS:	<p>TP103 - 3 pin bayonet fastening</p> <p>TP104 - 4 pin bayonet fastening. Use also for 2 pin.</p>
WEIGHT:	1.3kg.
MATERIALS:	<p>Aluminium nose-cone, hard anodised.</p> <p>Stainless steel pins and terminator.</p> <p>Acetal mounting block.</p> <p>Aluminium body and cover plate.</p> <p>PVC cap. Order separately, see below.</p>
ASSOCIATED: EQUIPMENT	<p>5069Z PVC cap kit.</p> <p>DP250 Dummy for 2-wire system.</p> <p>LC95 / LC99 or AGP102 / AGP105 probes.</p> <p>GP100 Series gantry plugs.</p>

LIQUIP

GROUND BOSS TRUCK PLUG TP SERIES

BOLTING ARRANGEMENT



NOTE :
ENSURE HOLES IN PLUG
BASE ARE $\varnothing 10.5$ IF NOT
DRILL TO SIZE

DRILL 2 OFF $\varnothing 9$ HOLES THROUGH THE TANK STRUCTURE. SUPPLY 2 OFF MAX $\varnothing 8$ STAINLESS STEEL NUTS, BOLTS & WASHERS OF SUITABLE LENGTH. IN SOME CASES IT MAY BE NECESSARY TO TAP THE TANK STRUCTURE. THIS IS CUSTOMER CHOICE. APPLY A SUITABLE WATER PROOFING SEALANT TO THE BOLT HEADS TO WATERPROOF THE ENCLOSURE.

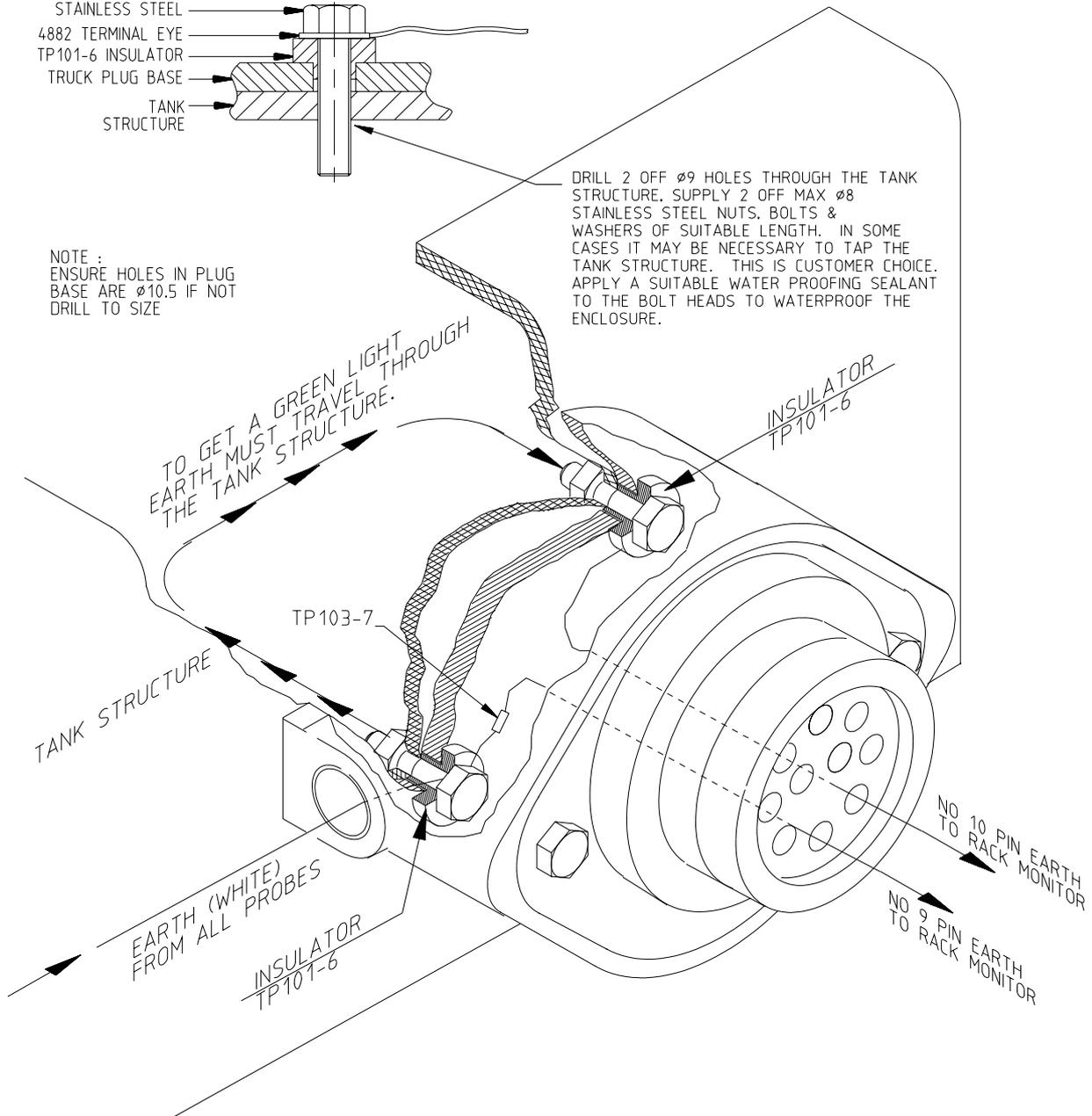
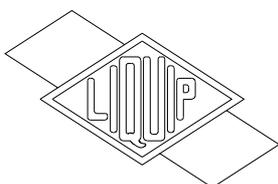


FIG 1:1

X11499

Issue: B

METERS - VALVES - VENTS - MANHOLES - PUMPS - HOSEREELS - OVERFILL PROTECTION - LOADING ARMS - ELECTRONIC DIPSTICKS



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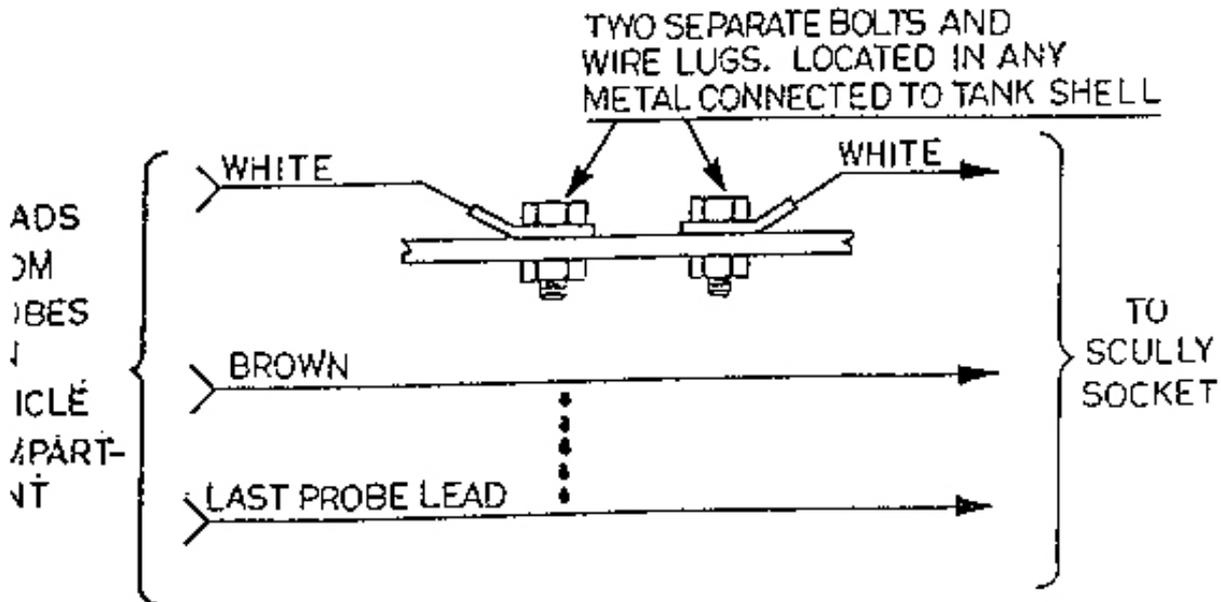
SUBJECT: TANK TRUCKS - SCULLY PLUG GROUNDING

The technique illustrated below may be optionally used to further insure that static grounding of the vehicle to the loading rack ground circuit. This wiring forces the common return current from all vehicle compartment probes to pass through a portion of the tank's metal en route to the socket. Thus, when the Scultrol loading rack system gives permission to load, the ground circuit from the loading rack is proved connected to the tank vehicle.

If this technique is used, the precautions in the general installation instructions regarding adequately grounding the socket box need not be observed.

In order to avoid nuisance shut downs, it is important that the two "ground connections" be made very securely and with hardware which will not loosen or become electrically insulated by corrosion; etc. The use of a conductivity improving antioxidant grease such as "Kopr-Shield" is recommended to maintain a low resistance electrical connection at these points:

WARNING: Note that this ground proving system is only applicable when the Scultrol System is operational, not when the system is operating in a bypassed mode.



CABLE PATH BETWEEN SENSING PROBES AND SCULLY SOCKET

Red by: <i>San L.</i>	Title: <i>Wiring Distribution</i>
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8 August 1996

Tech Talk No: 21

Subject: **Fault-finding, Tanker overflow protection 2 wire system.**

1.0 Purpose of this manual.

To provide a simple step-by-step procedure to isolate a problem on a vehicle and fix it. (2 wire system only).

2.0 Tools.

Best	-	Liquip Probe Doctor with diagnostic display.
Next	-	Scully rack monitor.
Minimum	-	Multimeter.
Spares	-	Optical probes and electronic dummies.

3.0 Safety

Observe all health and safety standards relevant to the area and contents of the vehicle.

Note multi-meters must be approved type if used in Zones 1 or 2. Also permission must be obtained for any work or observations carried out in a gantry or terminal.

If in doubt, consult management.

4.0 Typical Reports of Faults.

Following are separate procedures for the most common problems:-

- * Always gets a red light.
- * Intermittent red light.
- * Turns to red during loading.

4.1 Vehicle gets 'red light' wherever and whenever it loads.

- Most likely cause - Faulty probe.
Other possibilities - Faulty dummy.
Any wire open circuit.
Any wire short circuit.

Note: Some vehicle circuits combine the pneumatics into the system with a pressure switch. Ensure this switch is closed (continuous) before proceeding further.

4.1.1 Diagnosing with Rack Monitor.

- a) With Liquip Probe Doctor the diagnostic panel immediately shows up the faulty compartment.
Then check and remake black wiring connections and white wiring connections before replacing probe/dummy if necessary.
Verification is shown on the diagnostics.

- b) With Scully monitor there is normally no diagnostic panel. Therefore make the vehicle and area safe, plug in the monitor and measure voltages across each probe. (See details Tables 1 & 2).
Any compartment which is significantly different from the values shown for that type of probe is suspect. Check and remake black and white wire connections before replacing probe or dummy if necessary.

4.1.2 Diagnosing with hand-held tester.

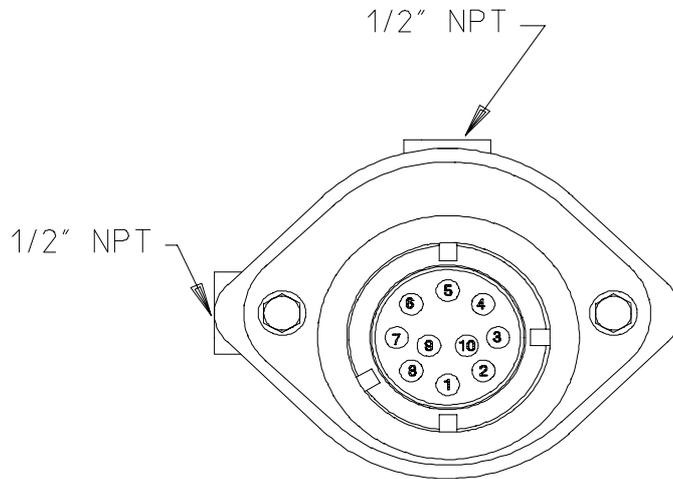
Connect to vehicle according to instruction. If one compartment shows faulty, check and remake the black and white wire connections before replacing probe or dummy if necessary.
(The hand-held testers are battery powered and are not as discriminating as rack monitors).

4.1.3 Diagnosing with Multimeter.

- a) If probes/dummies are thermistor: Measure resistance across each probe from the truck plug pins and compare with the reference values given.

Method is:-

Truck Socket - View from front on a 5 compartment tank should be:



- a)** Set multimeter to read resistance, range up to 4,000.00 Ω .
Hold red lead on No.10 contact and in turn hold the black lead onto contacts numbers 3, 4, 5, 6, etc in turn (assuming all compartments have thermistor probes). The meter should read on average 2000 Ω .
On a hot day (30°C): Approximately between 1000-1500 Ω .
On a cold day (10°): Approximately 2500-3500 Ω .

Look for one or more compartments with resistance values significantly different from the others.

Make and remake connections on black and white wires from truck plug to probe before replacing probe if necessary.

- b)** If probes or dummies are other than thermistor eg capacitive or optical, the Multimeter alone cannot test the probes.
See later section on checking earth and wiring.

4.2 Vehicle gets intermittent Red Light or loads at some gantries but not others.

- Most likely cause - Faulty wiring connection in earth (white wire) wiring.
Other possibilities - Intermittently faulty probe.
Faulty wiring on 'black' side.
Worn truck plug.

Note: With any intermittent fault, try and obtain a history before commencing a physical investigation. Then duplicate the circumstances to give the best chance of producing the fault.

4.2.1 Diagnosing with Rack Monitor.

a) If the fault can be produced, follow checks as in 4.1.1 above. IF the fault cannot be produced, check the voltage across each probe black and white wires and pick out the uncommon or 'jumpy' voltage. Follow previous procedures to rectify.

b) If there is no obvious fault or oddball reading, then follow the line of investigating the most likely fault that we have defined as being in the white wire system. Go through the whole black and white wire system from truck plug to each probe, breaking and remaking every connection to ensure it is good.

Lightly tap each probe and dummy to check for a blink on the monitor to indicate an internal fault.

4.2.2 Diagnosing with hand-held tester.

The tester will either show a fault or not show a fault. If the latter, then move on to testing with Multi-meter.

4.2.3 Diagnosing with Multi-meter.

The first line of attack as noted above is the white earth wiring system.

To check EARTH between truck plug pin No10 and tank shell:-

Set Multi-meter to read resistance (continuity), ensuring it is a safe area. Set range to 30 Ω .

Hold red lead to No.10 contact and black lead to tank shell. Multi-meter should read approximately 1 Ω and stay fairly constant.

A faulty earth at this point indicates the main earth (Big white) wire running from the truck plug that (pin No.10) is broken. You will have to re-run this main earth wire.

A bad earth connection joint between the main earth and the probe's white wire can also create intermittent shut down. Making sure all connections are free of rust and secure.

Repeat this test on all compartments.

4.2.4 Other possibilities.

Worn truck plug; inspect and fix as necessary. (All Australian tankers should now have 4-slot truck plugs and it should no longer be possible to break contact to the monitor by physical waggling of the gantry and truck plug connection).

The other possibilities to be considered here are chemical attack or heat-effect on the probe.

- * Does the tanker ever carry chemicals?
- * Does the tanker every carry hot products or has it been steamed out recently?
- * It is possibly a gantry problem.

From each gantry point view, the Scully monitor has separate adjustment on each channel and it is not unusual for a particular channel to allow loading of some vehicles but not others. This is where an intermittent fault is much easier to locate if a reliable 'event' history is available.

4.3 Vehicle shuts down during loading.

Most likely causes are draught (if thermistor), incorrect setting (if occurs at nearly full) and poor plug connection if at random and can be fixed by waggling.

No electrical tools are required for these problems.

4.3.1 Thermistor probes in draught.

If thermistor probe is sited near a vapour vent (vapour valve) the symptoms are very clear.

- * Always gives green light.
- * Always starts to load and continues to load well after high-flow start.
- * Shuts down.
- * If left alone, starts again within a minute.
- * May shut down again or may complete load.

The cause is air being pushed out of the vent system as liquid is pumped in the bottom. The draught can build up sufficiently to cool the thermistor and simulate an overflow. When loading stops, the draught stops, the thermistor heats up and the green light comes back on.

4.3.2 Incorrect height setting.

This causes shut-off within a few hundred litres of safe-fill level. It may normally not be a problem but occur occasionally if waves are set up in the compartment.

4.3.3 Poor gantry-to-truck connection.

This is a common reason for failure to load.

- * Always fit a cap to the truck plug.
- * Keep both sides of the contacts clean and free of corrosion.
- * Ensure the 4-slot system is now fitted.
- * Ensure neither truck plug slots nor gantry pins are worn or loose.

A quick waggle while connected is a simple test.

TABLE.1.

To Check Voltage when connected to rack monitor.

i) Choice of multimeter.

Any type of multimeter can be used for checking continuity or measuring thermistor resistance.

However when measuring voltage across electronic probe you need a “fast sampling digital multimeter”.

This is because the monitor output is a square wave and we want to be able to read the voltage at the top of the wave and the bottom (max & min shown below).

A recommended type is Hewlett Packard Smart². Set to range 30 volts D.C.

(ii) Typical readings, given as a guide only, are:-

PROBE	Minimum Vdc	Maximum Vdc
Thermistor Thermistor dummy	2.0	3.5
Capacitive SP27 (obsolete)	4.5	5.0
Monitor, Open Circuit	13.4	13.8
Liquip electronic dummy DP250	5.0	6.5
Scully Electronic dummy	4.5	7.0
Scully Optical	6.5	9.5
Liquip Optical LC99	5.5	9.5

Fault finding is by comparing readings **of the same type of probe only**. Look for a probe that occasionally or always shows a distinctively different minimum or maximum reading.

TABLE.2.

Examples of diagnosis by checking probe voltage while connected to monitor.

i) The tanker is a 5 compartment and worked OK with Scully monitors in various terminals but would not load with another Scully Monitor at one terminal. All probes and dummies are then individually tested to be OK.

Open truck plug with the monitor being connected, the voltage reading are recorded as follows:-

		ACTUAL	TYPICAL	COMMENTS
Compt	Probe	Voltage Reading	Voltage Reading	
1	Liquip Optical	6.5 to 9.0	5.5 to 9.5	
2	Scully Optical	6.5 to 9.5	6.5 to 9.5	
3	Scully Optical	6.5 to 9.5	6.5 to 9.5	Occasionally jumps to 10V
4	Scully Optical	6.5 to 9.5	6.5 to 9.5	
5	Scully Elec. Dummy	4.5 to 7.0	4.5 to 7.0	

Compartment 3 has the higher voltage reading out of the three (3) Scully optical probes, so it is replaced and that fixes the problem. The probe is not necessarily faulty, the monitor channel may need an adjustment or there was a poor wiring connection in the tanker.

(ii)

		ACTUAL	TYPICAL	COMMENTS
Compt	Probe	Voltage Reading	Voltage Reading	
1	Liquip Optical	6.5 to 7.5	5.5 to 9.5	
2	Capacitive	4.6 to 5.0	4.5 to 5.0	
3	Liquip Optical	6.5 to 7.5	5.5 to 9.5	
4	Capacitive	6.5 to 7.0	4.5 to 5.0	Higher than normal
5	Capacitive	4.6 to 5.0	4.5 to 5.0	
6	Electronic dummy	4.6 to 5.0	4.5 to 6.5	

Compt 4 has the higher voltage readings out of the three (3) SP27 probes and after replacing it, the tanker loads OK.

TP100 SERIES TRUCK PLUG

INSTALLATION INSTRUCTIONS IMPORTANT : PLEASE READ BEFORE INSTALLING

1. Liquip Truck Plug . Supplied as standard with 10 pins to allow 6 channel or 8 channel 2 wire or 5 wire systems. TP103 for 3 pin bayonet sites and TP104 for 4 pin bayonet sites.
 The following items are supplied separately:
 10 off 4844 screws M3 x 6 long
 10 off 5238 washers M3 shakeproof
 2 off 4882 terminal eyes M8
 2 off TP101-6 insulating spacer
 1 off 5637 plug conduit 1/2" NPT
 2 off 3234 self tapping screws
 Replacement nose cone sub-assemblies:
 TP103-8 (3 Pin) & TP104-8 (4 Pin)
 Optional
 1 off TP103-7 Earthing wire requirement for scully ground hog
2. See installation fig 1:1. Ensure tank is clean and the truck plug is fitted to bare metal.
 Fit 10 off 4844 & 5238 to secure wires 1 to 10 on the socket (see fig 1:2). 2 off 4951 to truck plug body, 2 off terminal eyes and 2 off insulating spacers as shown in fig 1:1. 1 off conduit plug to be fitted to the vacant conduit entry after insulation, 1 off diode wire (if supplied) is connected between white wire and pin no 9 (see fig 1:2).
3. Mount truck plug assembly using the holes located on the underside of the truck body.
 Ensure $\varnothing 8$ bolts pass through items in this order from the inside of the body:
 - terminal eye
 - insulated spacer
 - base body
 then screw onto tank structure with stainless steel bolts or bolt through with stainless steel bolts, nuts & spring washers. Apply sealant around mounting holes to prevent moisture entering. (Refer fig 1:1 on the back of this page).

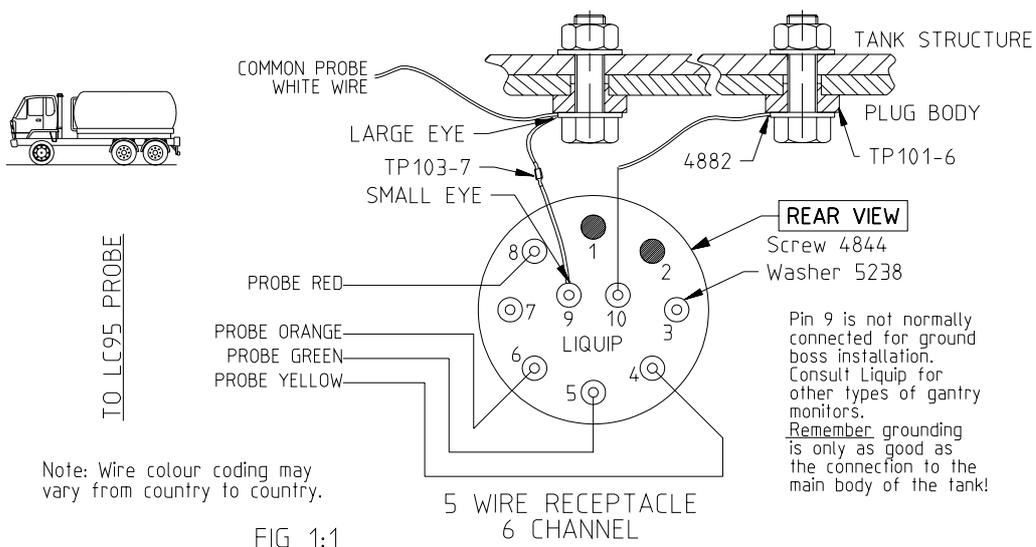


FIG 1:1

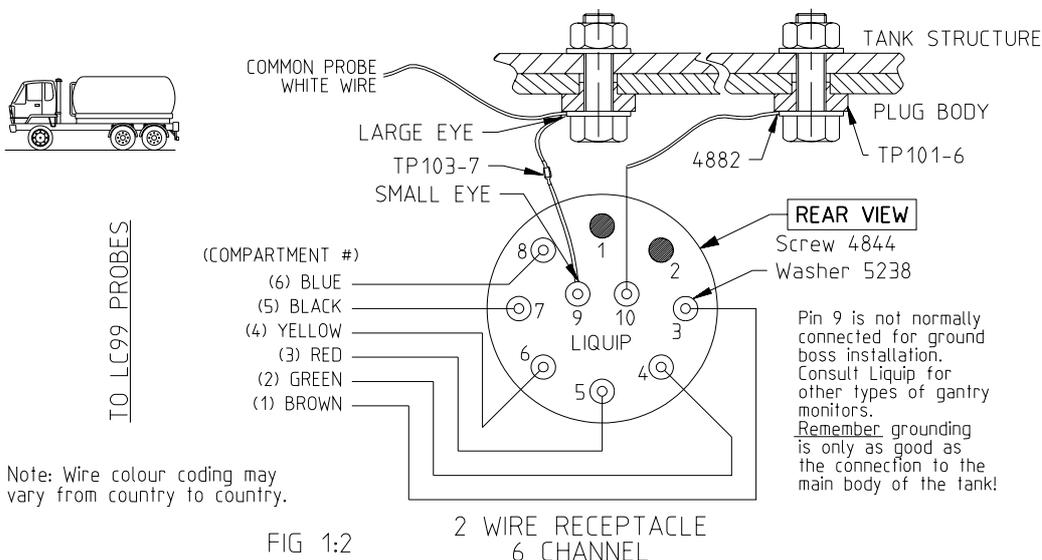


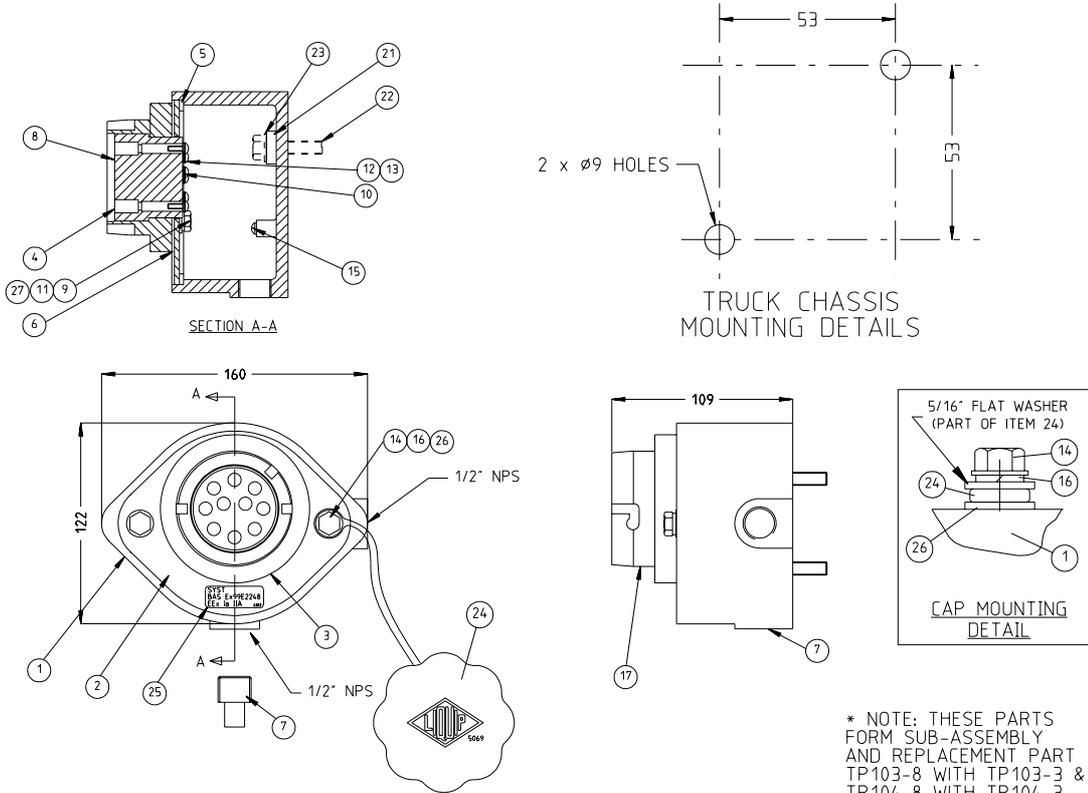
FIG 1:2

P4729

Issue: G

LIQUIP

TP103 & TP104

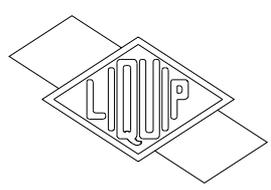


ITEM	PART NO	DESCRIPTION	MATERIAL	QTY TP103	QTY TP104	
1	TP101-1	BODY	ALUMINIUM	1	1	
*	2	TP100-2	COVER PLATE	ALUMINIUM	1	1
*	3	TP103-3	PLUG 3 SLOT	ALUMINIUM	1	-
*	TP104-3	PLUG 4 SLOT	ALUMINIUM	-	1	
*	4	TP100-4	PIN CONTACT	STAINLESS STEEL	10	10
	4258	GASKET	NITRILE	1	1	
*	6	4259	GASKET	FIBRE	1	1
	5637	PLUG CONDUIT	NYLON	1	1	
*	8	TP100-5	SOCKET	ACETAL	1	1
*	9	4843	SET SCREW HEX. HD.	Z/P STEEL	2	2
	4728	LABEL FOR PIN I.D.	PLASTIC	1	1	
*	11	0114	WASHER SHAKEPROOF	Z/P STEEL	2	2
	4844	SCREW METAL THREAD	STAINLESS STEEL	10	10	
	5238	WASHER SHAKEPROOF	STAINLESS STEEL	10	10	
	0011	SET SCREW HEX. HD.	Z/P STEEL	2	2	
	3234	SCREW SELF/TAP	STAINLESS STEEL	2	2	
	0108	WASHER SPRING	Z/P STEEL	2	2	
	4845	SCREW METAL THREAD	STAINLESS STEEL	1	1	
18						
	40021	CARTON STOCK SIZE (NOT SHOWN)	CARDBOARD	1	1	
	4729	INSTRUCTION LEAFLET (NOT SHOWN)	PAPER	1	1	
	21	TP101-6	INSULATING SPACER	ACETAL	2	2
	22	HEX HEAD BOLT MAX $\varnothing 8\text{mm}$ TO REQUIRED LENGTH	STAINLESS STEEL	NOT SUPPLIED	NOT SUPPLIED	
	23	4882	EYE TERMINAL	ELECTRICAL	2	2
	24	5069Z	TRUCK PLUG CAP KIT	PVC	NOT SUPPLIED	NOT SUPPLIED
	25	6382	LABEL - BASEEFA APPROVAL	PVC	1	1
	26	0101	WASHER FLAT	Z/P STEEL	2	2
	27	0100	WASHER FLAT	Z/P STEEL	2	2
	28	4666	SIGN: WARNING - WELDING & PLASMA CUTTING	PLASTIC	1	1

X11494

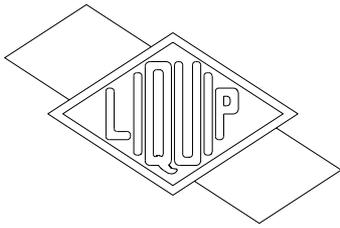
Issue: L

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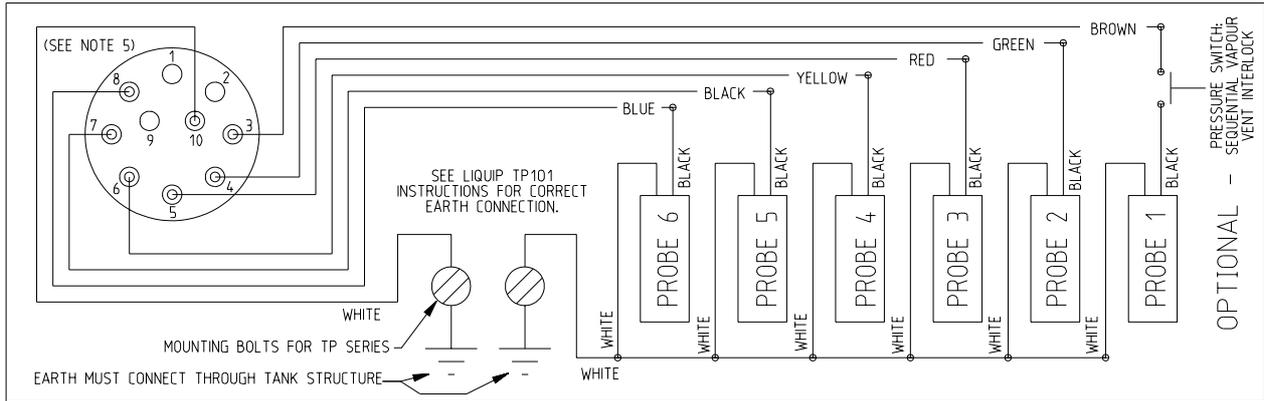
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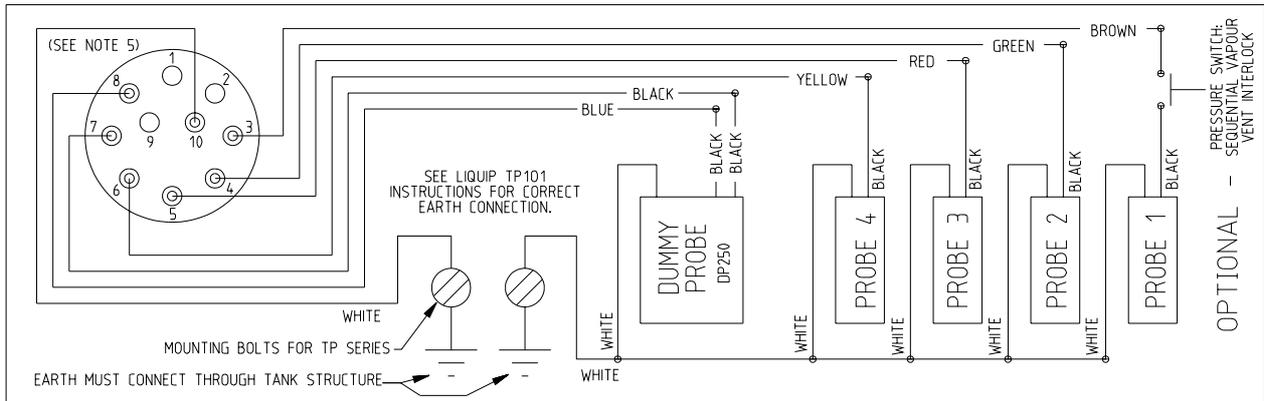
OVERFILL PROTECTION

2 - WIRE SYSTEM, 6 CHANNEL, ILLUSTRATED

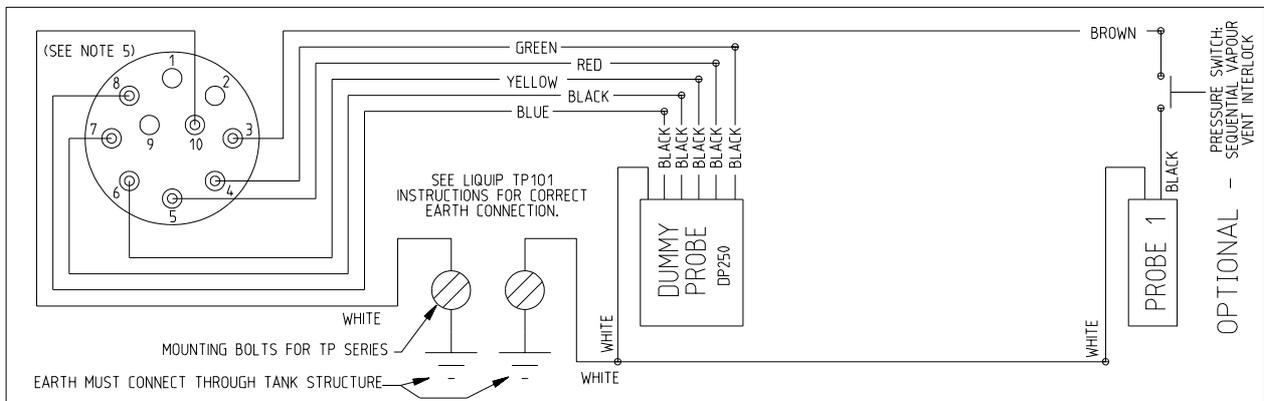
6 COMPARTMENTS



4 COMPARTMENTS



1 COMPARTMENT



- NOTE:
- 1 -
 - 2 - ADDITIONAL WIRING INFORMATION ON DUMMY PROBE REFER TO DATA SHEET P4786
 - 3 - INDUSTRY COLOR CODING STANDARD FOR 6-COMPARTMENT TANKER IS SHOWN
 - 4 - CHECK YOUR LOCAL COLOR CODING STANDARD FOR 8-COMPARTMENT TANKER AND COMPATIBILITY
 - 5 - CHECK YOUR LOCAL STANDARD ON 'TRUCK PLUG' & 'GANTRY SOCKET' FOR NUMBER OF BAYONET PINS
- TP103 & GP103 HAVE 3-PIN BAYONETS AND
 TP104 & GP104 HAVE 4-PIN BAYONETS.

X7505

Issue: D

Liquip Overfill Probes

DATA SHEET

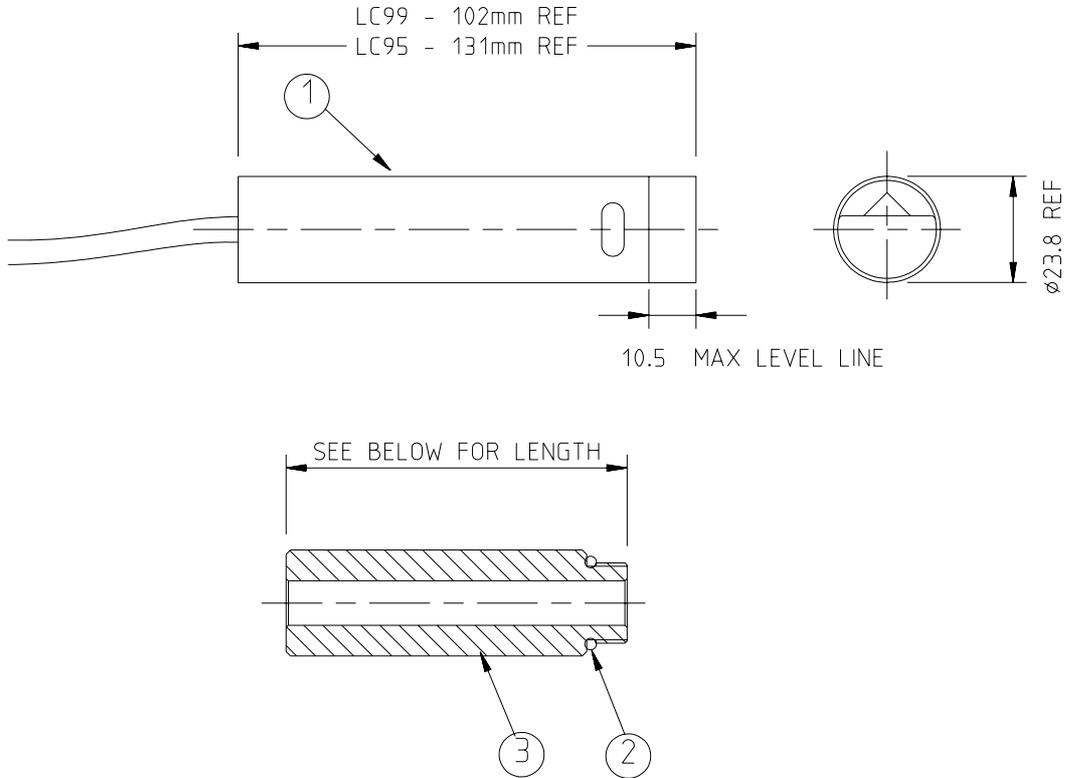
PART N°: LC99A
LC95D

- TITLE:** Liquid-sensing probes for use as overfill protection on road tankers and in storage tanks.
- PURPOSE:** To provide a probe that is compatible with existing monitors and interchangeable with current probes.
- To improve safety by making the main body act as a light labyrinth. (Optical probes can be fooled by external light sources impinging on the receiver or by it's own light reflecting back off a bright surface. Removable shields are by definition less reliable than integral shields).
- OPERATION:** Sensing mechanism used is the different behaviour of a light beam in a glass prism when the prism is wet instead of dry. There is a very large difference in refractive index of air compared with petroleum liquids and this difference provides a very well defined and reliable switching point. In air, the light beam reflects back internally, in liquid the beam is refracted out into the liquid and "lost". Electronics in the probe are designed to create the light beam, detect its return or disappearance and pass that message to the "Probe Doctor" or other rack monitor for appropriate response.
- SPECIFICATION:** Glass prism potted in epoxy. Solid state electronics in potting compound. Stainless steel tip. Matt black acetal body.
Extension bars of acetal or stainless steel to suit. Various applications in various lengths. Trigger point $\pm 0.5\text{mm}$ repeatability. Light-shield (hood) is actually the body. Probe can be removed from tank top without having to access interior to remove a hood.
- VARIANTS:** LC99A - Acetal 2 wire.
LC95D - Acetal 5 wire. (used overseas, not generally in Australia).
- MATERIALS:** Acetal probe body, Stainless steel tip, Glass prism, and epoxy
Acetal extension bar, Viton "O"-ring
- WEIGHT:** 120g.
- MOUNTING:** Liquip VOH 200-5 junction box mounting is minimal weight and cost.
Bolts on to Liquip manhole covers. Alternatively, any industry-standard probe holder as probe is interchangeable.
- ASSOCIATED EQUIPMENT:** AGP102 2 wire glass probe
AGP105 5 wire glass probe
PD100 Series "Probe Doctor" overfill monitor.
TP Series "Ground Boss" truck plug.

Overall dimensions shown on the drawing overleaf.

LIQUIP

OPTICAL SENSING PROBE

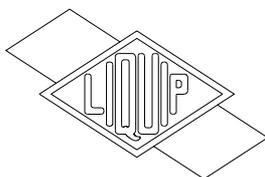


ITEM	PART NO	DESCRIPTION	MATERIAL	
	1	LC99A	OPTIC PROBE ASSEMBLY 2 WIRE	ACETAL
		1	LC95D	OPTIC PROBE ASSEMBLY 5 WIRE
(OPTIONAL)	2	0293	O-RING	VITON
(OPTIONAL)	3	LC99-3	EXTENSION 98mm	ACETAL
		SP27-3S	EXTENSION 107mm	ST STEEL
		OP25-300	EXTENSION 207mm	ALUMINIUM
		OP25-300+	SPECIAL EXTENSION 207mm	ALUMINIUM

X7502

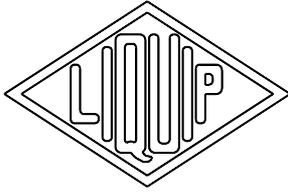
Issue: D

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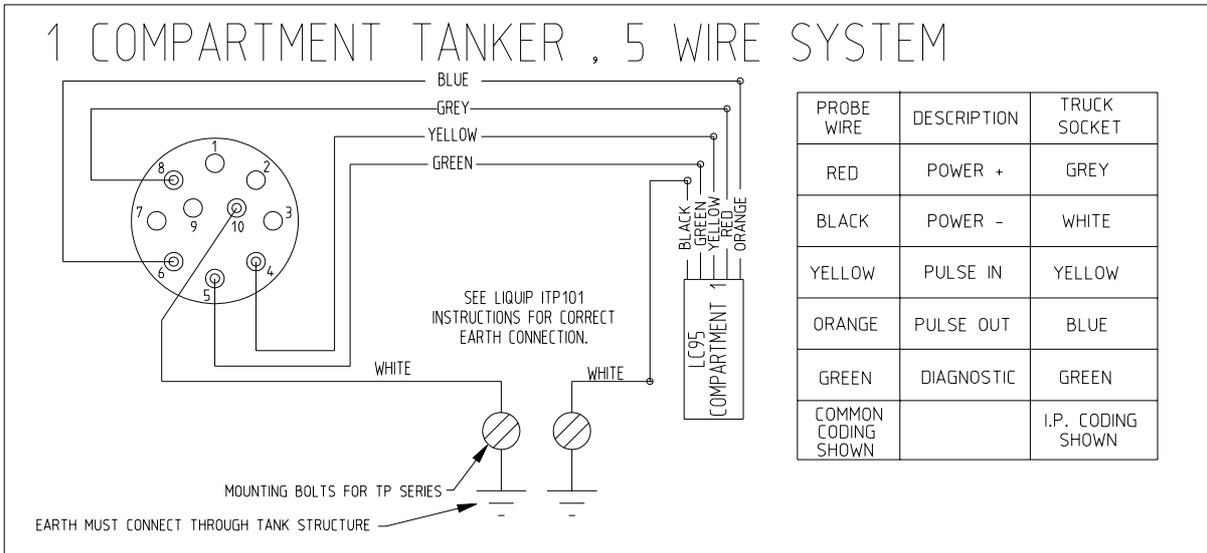
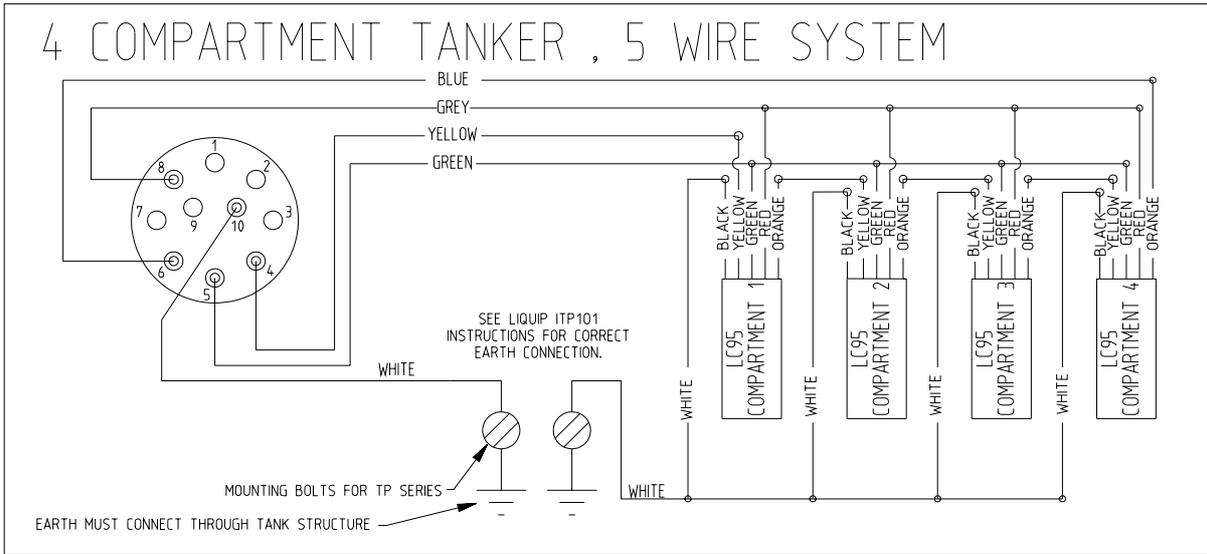
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OVERFILL PROTECTION

LC95



NOTES :

1. IF GREEN BECOMES DISCONNECTED , "PROBE DOCTOR" OPERATES CORRECTLY EXCEPT DIAGNOSTIC LIGHTS ALL "BLINK".
2. CHECK YOUR LOCAL STANDARD ON "TRUCK PLUG" & "GANTRY SOCKET" FOR NUMBER OF BAYONET PINS.
 TP103 & GP103 HAVE THREE-PIN BAYONETS AND
 TP104 & GP104 HAVE FOUR-PIN BAYONETS

X7506-B

LIQUIP - PROBE DOCTOR

DATA SHEET

Part No: PD100 series

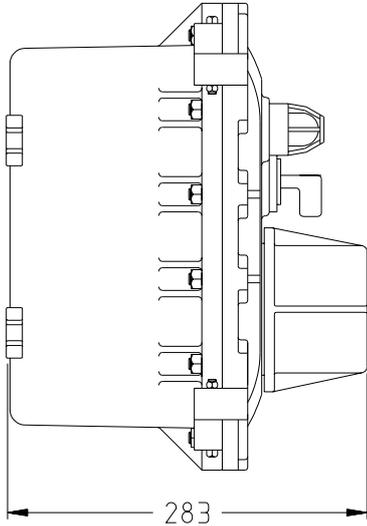
- TITLE:** Overfill protection monitor for use with electronic probes in road tankers and storage tanks.
- PURPOSE:** To provide a truly universal monitor for any common probe and automatic operation with 2-wire and 5-wire systems.
- OPERATION:** The output from the monitor is a go or no-go signal used to control the loading operation in a gantry or tank farm. The signal changes state if the monitor detects a signal due to a probe going from a dry to a wet state.
- SPECIFICATION:** Explosion proof-housing for Class 1 Zone 1.
Signals to probes intrinsically safe Class 1 Zone 0.
Power supply may be 240Vac or 110Vac.
Output switching triple-ganged relay for greater reliability, normally open, volt-free rated 240v 5amp (if power output is required, contact Liquip).
Lockable by-pass switch to enable loading of tankers in an emergency.
Cables entries 3/4" NPS. An adaptor to metric conduit threads is also available.
Shutdown response time less than 0.5 seconds.
Weight 15kg. Dimensions - see overleaf.
- FEATURES:** Automatic sensing and switching to 2-wire or 5-wire systems. Just connect "Probe Doctor" to the tanker and it not only switches, it shows you the result.
Automatic grounding of the vehicle at no cost when used with Liquip "Ground Boss" truck plug.
Compatible with all common electronic probes. Provides 8 channels for 2-wire probe tankers.
Diagnostic box on monitor shows driver the condition of each compartment, the output relay position and whether 2-wire or 5-wire.
Pad-lockable by-pass switch allows for emergency loading. However clearly visible as both green and red lights are illuminated when on by-pass as a warning signal.
May be used solely as a 2-wire or a 5-wire monitor with local-standard plug and socket connectors. However for maximum flexibility use common industry 4-bayonet and 10-pin system.
For no-cost truck grounding assurance use Liquip "Ground Boss" truck plug.
- VARIANTS:** PD108-240 8 channel 240Vac
PD108-110 8 channel 110Vac
PD106-240 6 channel 240Vac
PD106-110 6 channel 110Vac
PXD100 Series – Grounding Assurance (with Liquip ground-boss truck plug)
- MATERIALS:** Aluminium boxes.
Polycarbonate window.
- SERVICE:** Self-calibrating. No adjustments required.

2 solid state boards with plug connectors for quick site change-over.

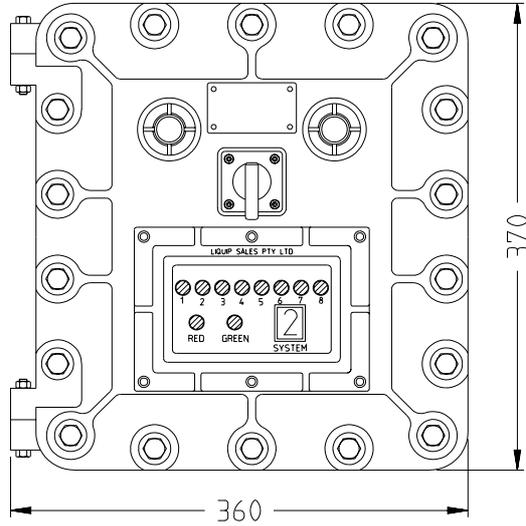
See overleaf for mounting details.

LIQUIP

PROBE DOCTOR PD100 SERIES



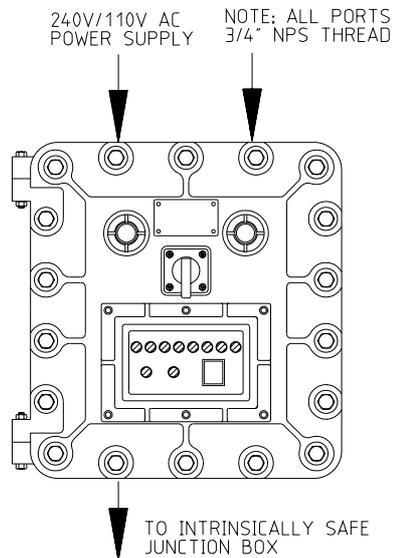
END VIEW



FRONT VIEW



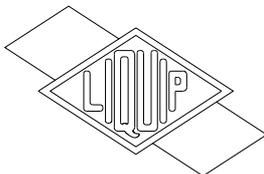
MOUNTING DIMENSIONS



X9503

Issue: D

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LIQUIP MONITOR FOR OVERFILL AND GROUNDING

DATA SHEET

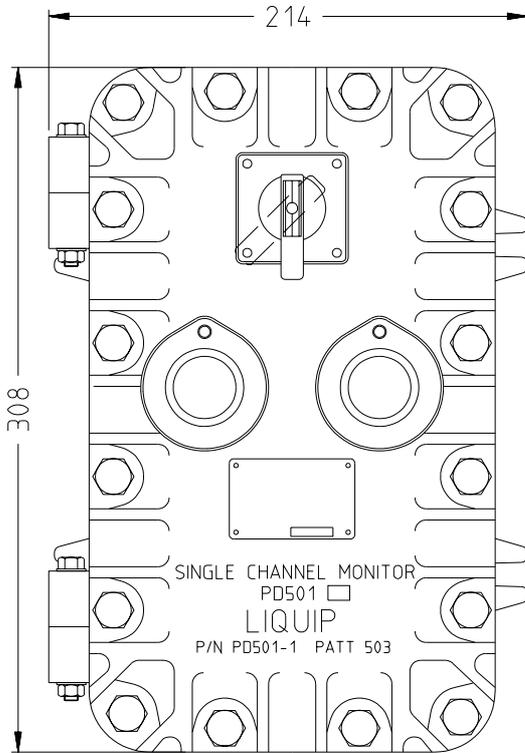
PART N°: PD501 SERIES

- TITLE:** Multi-purpose monitor. Use for 5-wire probe overfill protection: also use for ground assurance: also incorporates a single channel for 2-wire probes for railcar filling: or combination of these.
- PURPOSE:** A single monitor per gantry now provides overfill protection combined with ground assurance to offer lowest capital cost with simple and cheap installation wiring. Compatible with all common probes.
- OPERATION:** Output from the monitor is a single triple-ganged relay signal to provide a go or no-go control for operation of the gantry or tank farm. Indication is by red or green lamp and a lockable by-pass switch is standard. Truck plugs may be standard or optic style. Ground assurance connector may be via truck plug, or ground ball socket, or 'crocodile' clamp.
- SPECIFICATION:** Explosion proof housing for Class 1 Zone 1, monitoring signals intrinsically safe Class 1 Zone 0. Power supply 240v AC or 110v AC. Output (control) relay triple-ganged for reliability, normally open, volt-free rated at 5 amp 240v (if power output is required, contact Liquip). Lockable by-pass switch to enable loading in emergency. Cable entries 3/4" NPS, adaptors to 25mm conduit thread available. Shutdown response time 0.5 seconds for all fault conditions. All model variants are factory set and tested, however site changes are easily carried out as it is controlled by wiring changes on output terminal strip. Therefore only one monitor design is required throughout the terminal and tank farm. SAA approved to Exd (ia) IIB T6 IP65. Approval Number 3385X.
- VARIANTS:** Simple linkages provide the following variations of the same monitor:
5-wire probe overfill monitor
2-wire probe overfill monitor single channel
Ground assurance monitor with crocodile clamp
Overfill monitor with ground assurance wired through truck plug
Overfill monitor with separate cable (clamp or ball type) for ground assurance
All the above in 110v AC or 240v AC power supply
- MOUNTING:** See attached diagram.
- SERVICE:** Self-calibrating, no adjustments required. One solid-state board with plug-connector for quick site change-over.
- MATERIAL OF CONSTRUCTION:** Aluminium housing. Explosion proof polycarbonate lights and switch.
- WEIGHT:** 8 kg.
- ASSOCIATED EQUIPMENT:** See data sheet for accessories for monitors. Includes junction box for intrinsically safe cabling. Optic and standard gantry plugs and self-store cable. Crocodile clamp and self-store cable for grounding. Ball socket and self-store cable for grounding.

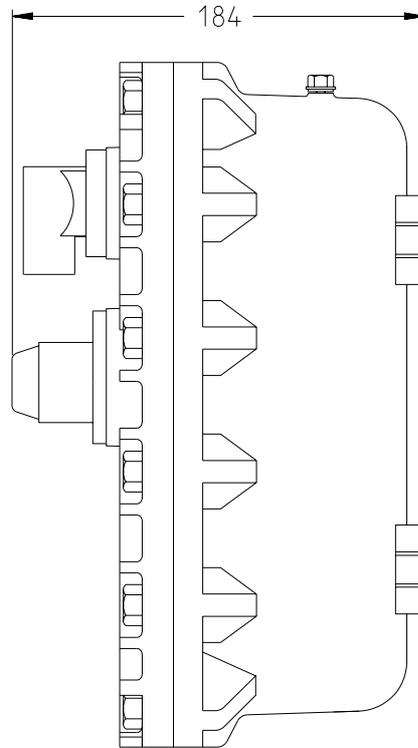
Overall dimensions shown on the drawing overleaf.

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PD501 SERIES

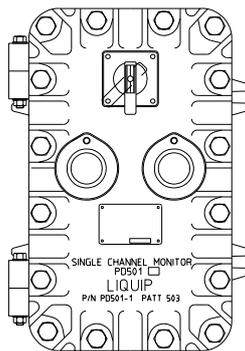


ELEVATION



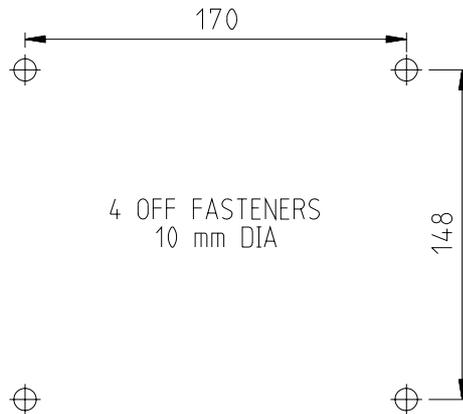
END ELEVATION

240V/110V AC POWER SUPPLY ↓ ↑ TO OUTPUT RELAY



NOTE:
ALL PORTS
3/4" NPS

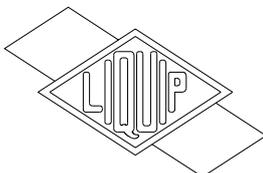
↓ INTRINSICALLY SAFE
SIGNAL TO TRUCK PLUG



X952296

Issue: C

METERS - VALVES - VENTS - MANHOLES - PUMPS - HOSEREELS - OVERFILL PROTECTION - LOADING ARMS - ELECTRONIC DIPSTICKS



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LIQUIP ACCESSORIES FOR OVERFILL MONITOR JB10x JUNCTION BOX, GP SERIES GANTRY PLUGS & CABLE

DATA SHEET

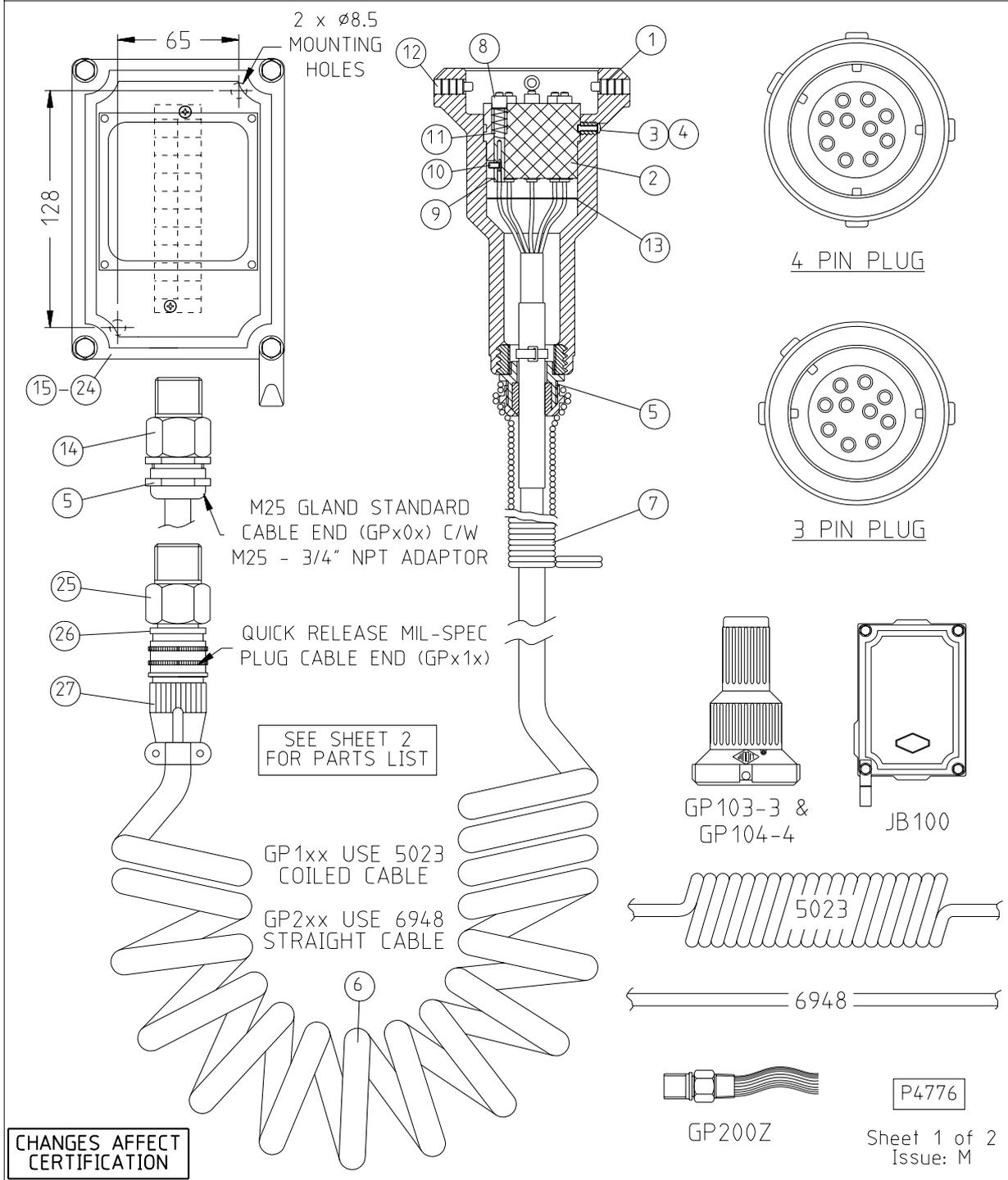
PART N^o: 4791

- TITLE:** Junction Box, gantry plug and cable to suit overfill monitors for loading gantries.
- PURPOSE:** Connects gantry system to tanker via industry standard 3 or 4 bayonet 10 pin plugs for intrinsically safe signals.
- OPERATION:** Designed for use with common industry monitors and vehicles as well as Liquip "Probe Doctor" PD100 Series. Current European I.P. recommendation is to use 4 pin bayonet, 10 pin connectors with automatic monitor switching between 2-wire and 5-wire. However Liquip manufacture 3 pin and 4 pin bayonet connectors for all applications.
- SPECIFICATIONS:** Connect pattern is 10-pin to industry standard and can cater for up to 8 compartments with 2-wire probes. The Liquip gantry plug also accommodates 5-wire probes. Cable entries into junction box are tapped 3/4" NPS thread, while gantry plugs have M25 cable gland connection & are supplied with an M25 to 3/4" NPT adaptor. This allows interchangeability for spare parts.
Customer to supply gantry-side connection to suit local requirement.
- FEATURES:** All materials are non-static producing.
Junction box includes hanger for cable loop-spring.
Socket is heavily ribbed for better grip and bayonet positions clearly visible by being mounted on bosses.
- VARIANTS:** GP103: 3 pin gantry plug with self coiling cable
GP104: 4 pin gantry plug with self coiling cables to modern European standard
GP203: 3 pin gantry plug with uncoiled cable
GP204: 4 pin gantry plug with uncoiled cable
Quick release style gantry plugs & cables are also available
5023: Self-store coiled cable
6948: Uncoiled cable – 8m long
Gantry plugs are available as spare part, order as GP103-3 or GP104-4.
- MATERIALS OF CONSTRUCTION:** Aluminium box.
Polyurethane plug body.
Stainless steel pins and fittings.
10 core cable, outer polyurethane.
- MOUNTING:** Junction box has two pre-drilled internal mounting holes for 6mm diameter bolts.
- WEIGHT:** 4kg for total including junction box.
- ASSOCIATED EQUIPMENT:** PD Series "Probe Doctor" overfill monitors.
TP Series "Ground Boss" truck plugs.

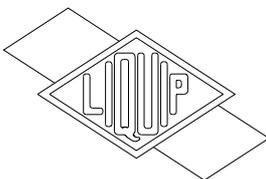
Overall dimensions shown on the drawing overleaf.

LIQUIP

GANTRY PLUGS & COMPONENTS



METERS - VALVES - VENTS - MANHOLES - PUMPS - HOSEREELS - OVERFILL PROTECTION - LOADING ARMS - ELECTRONIC DIPSTICKS



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PARTS LIST & WIRING INSTRUCTIONS FOR ALL 3 & 4 PIN GANTRY PLUGS

ITEM	PART NO	DESCRIPTION	MATERIAL	GP103	GP104	GP203	GP204	GP113	GP114	GP213	GP214	GP103-3	GP104-4	GP200Z	JB100	5023	6948
1	GP104-1	PLUG BODY 4 PIN	POLYURETHANE	1	1	1	1	1	1	1	1	1	1				
2	GP103-1	PLUG BODY 3 PIN	POLYURETHANE	1	1	1	1	1	1	1	1	1	1				
3	GP100-2	SOCKET	POLYURETHANE	1	1	1	1	1	1	1	1	1	1				
3	6526	SETSCREW PAN/PH HEAD	ST STEEL	1	1	1	1	1	1	1	1	1	1				
4	6527	WASHER SHAKEPROOF	ST STEEL	1	1	1	1	1	1	1	1	1	1				
5	6885	CABLE GLAND	N/P BRASS	2	2	2	2	2	2	2	2	2	2				
6	5023	CABLE - COILED (SELF STORE)	POLYURETHANE	1	1	1	1	1	1	1	1	1	1		1		
6	6948	CABLE - UNCOILED 8m (NOT SHOWN)	POLYURETHANE	1	1	1	1	1	1	1	1	1	1				
7	4477	SPRING WIRE SUPPORT	ST STEEL	1	1	1	1	1	1	1	1	1	1				
8	5713	PIN CONTACT	ST STEEL	10	10	10	10	10	10	10	10	10	10				
9	4517	E CLIP	ST STEEL	10	10	10	10	10	10	10	10	10	10				
10	4874	GRUBSCREW	ST STEEL	10	10	10	10	10	10	10	10	10	10				
11	4478	SPRING RETURN	ST STEEL	10	10	10	10	10	10	10	10	10	10				
12	5714	LOCKING PIN	ST STEEL	3	4	3	4	3	4	3	4	3	4				
13	4755	CABLES IDENTIFICATION LABEL	POLYCARBONATE	1	1	1	1	1	1	1	1	1	1				
14	7191	ADAPTOR	BRASS	1	1	1	1	1	1	1	1	1	1				
15	JB100-1	JUNCTION BOX BODY	ALUMINIUM												1		
16	JB100-2	JUNCTION BOX COVER	ALUMINIUM												1		
17	JB100-4	JUNCTION BOX HOOK	ALUMINIUM												1		
18	0100	WASHER FLAT	Z/P M/S												4		
19	4279	GASKET	NEO-CORK												1		
20	4753	LABEL	PLASTIC												1		
21	4920	SETSCREW HEX HD	Z/P M/S												4		
22	4885	SCREW HAMMER DRIVE	STEEL												4		
23	4960	SCREW THREAD CUTTING PAN HD	Z/P M/S												2		
24	5026	BLOCK STRIP TERMINAL	P/E PLASTIC												1		
25	GP200-1	ADAPTOR	BRASS												1		
26	5125	MILITARY PLUG (MALE)	ALUMINIUM						1	1	1	1	1				
27		MILITARY PLUG (FEMALE)	ALUMINIUM						1	1	1	1	1				

NOTES: Wiring colour codes may vary from country to country. In 1996 Liquip Sales Pty Limited adopted the I.P. code of practice in the general interest of compatibility.

CHANGES AFFECT CERTIFICATION

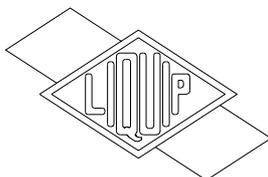
CABLE CONNECTIONS FOR BOTH 3 & 4 BAYONET PIN LIQUIP GANTRY PLUGS

WIRE COLOUR	GANTRY PLUG (3-BAYONET) PIN No	GANTRY PLUG (4-BAYONET) PIN No
BROWN	1	1
PINK	2	8
BLUE	3	6
YELLOW	4	4
GREEN	5	5
ORANGE	6	3
VIOLET	7	7
RED	8	2
WHITE	9	10
BLACK	10	9

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Issue: D

METERS - VALVES - VENTS - MANHOLES - PUMPS - HOSEREELS - OVERFILL PROTECTION - LOADING ARMS - ELECTRONIC DIPSTICKS



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