8 August 1996

Tech Talk No: **21**

Subject: **Fault-finding, Tanker overfill 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.

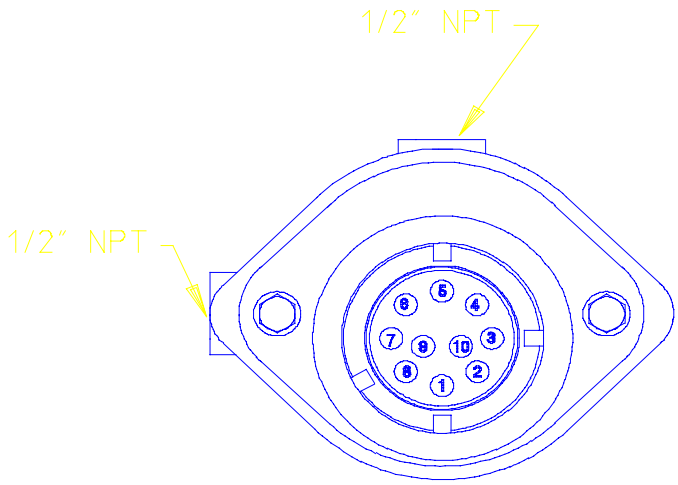
Connect to vehicle according to instruction. If one compartment shows faulty, check and remake the black and white wire connections before replacing probe or dummy if necessary. (The hand-held testers are battery powered and are not as discriminating as rack monitors).

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 (30ºC): Approximately between 1000-1500 Ω.
On a cold day (10º): 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 odd-ball reading, then follow the line of investigating the most likely fault which 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 (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 overfill. 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 Smart^2. 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 which 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 many 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.