ULTRAMAGIC MAINTENANCE MANUAL SUPPLEMENT Nº19

'FUELTek' FUEL CONTROL SYSTEM

Section 1 - General

This supplement defines the maintenance and inspection requirements for the Ultramagic "FuelTek" Electronic Fuel Gauge, as a response to the requirements established in EASA CS 31HB.82 and FAR 31 Amdt. 31-7 section 31.82.

Sections 1 to 5 detail the maintenance procedures and the parts used. Section 6 details the annual / 100 hour inspection and test requirements. The numbering of sections is kept from the main Ultramagic Maintenance Manual, its content being substituted or appended by the content of this supplement.

The electronic fuel gauge is an optional fit designed for use with the standard range of Ultramagic fuel cylinders. The gauge provides some significant features not available with the mechanical gauge such as zero to 120% fuel monitoring, digital electronic readout and audio warnings at 20% and 10% fuel levels.

The information contained in this supplement applies to the following Ultramagic range of standard fuel cylinders, when fitted with FuelTek sensor:

Ultramagic Cylinder Type	Propane Capacity
M-20 / M-20D	20 kg
M-30 / M-30D	30 kg
M-40 / M-40D	40 kg

1.1.4 Preventative maintenance: Fuel Cylinders

(Add the following)

- External cleaning of the 'FuelTek' readout
- Re-charge / Replacement of the 'FuelTek' readout internal battery
- Removal / Replacement of 'FuelTek' jack lead
- Removal / Replacement of 'FuelTek' readout unit
- When not in use, cover the jack sockets to prevent the ingress of contamination.
- Monitor the functionality of the gauge display for a smooth and continuous change in readout as the cylinder fuel content varies.
- To prevent the further ingress of magnetic particle contamination to the cylinder, use a filter when refuelling.

Section 2 – Envelope Repairs

Not applicable.

Section 3 – Basket Repairs

Not applicable.

Section 4 – Fuel Systems

4.2.13 Contents Gauge: FuelTek system

(Replace with the following)
When fitted, the standard mechanical fuel gauge is completely removed from the fuel cylinder and is replaced with a special Dip Sensor Assembly and float. A small cable fitted with 2.5mm jack plugs at each end links the Dip Sensor Assembly to a special Readout Assembly.

The dip sensor assembly consists of a long stainless steel tube welded to a machined head. The head is attached to the cylinder mounting using the same seal as for the standard gauge. The tube contains a long printed circuit board fitted with electronic sensing devices. A magnetic float is fitted to the outside of the tube and is free to rise and fall with the fuel level.

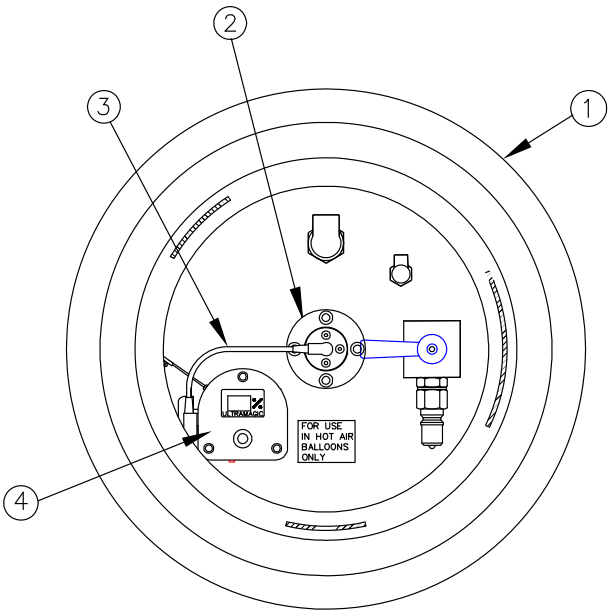
When the fuel level in the cylinder varies, the float triggers special sensors fitted inside the dip sensor tube. This in turn provides the change in electrical signal which is detected by the electronics in the Readout Assembly. A digital indication of the remaining fuel contents is then provided on the Readout display.

The sensors fitted inside the dip sensor assembly are mounted on a special printed circuit board. In addition, the circuit board is provided with electrical “jumper links”, resistors and a 2.5mm jack socket. The circuit board is completely contained within a heat-shrink jacket. The jacket provides a degree of mechanical protection and prevents electrical contact between the circuit board and the dip sensor metalwork.

The dip sensor circuit boards are provided in three lengths. The different lengths are required to accommodate the 20kg, 30kg and 40kg fuel cylinders. Since the printed circuit boards are in all respects identical except for their lengths, they are configured electrically in the factory by setting the “jumper links” so that any Readout Assembly may be used with any cylinder size without the need for re-calibration.

The ‘FuelTek’ Readout Assembly consists of a bespoke five-part plastic-moulded box. The box contains a rechargeable PP3 battery, and an advanced electronic circuit board fitted with the electronic sensing circuitry, a digital display, a multi-function pushbutton, an audio alarm, an on/off switch, low battery warning indication and a 3.5mm jack socket to allow the connection of a remote power supply.

The ‘FuelTek’ Readout Assembly is designed to be attached to an existing boss mounted on the top of the standard range of Ultramagic cylinders using a simple thumb-screw arrangement. In this arrangement, one Readout Assembly is dedicated to an individual cylinder. However, a single Readout may be dedicated to more than one cylinder using a simple switching arrangement which may be supplied by Ultramagic.



ITEM	DESCRIPTION	DWG / PART NUMBER
1	20kg FUEL CYLINDER ASSEMBLY	4002-0100
1	30kg FUEL CYLINDER ASSEMBLY	4003-0100
1	40kg FUEL CYLINDER ASSEMBLY	4004-0100
2	20kg FUELTEK DIP SENSOR ASSEMBLY	BO-NE-0200
2	30kg FUELTEK DIP SENSOR ASSEMBLY	BO-NE-0300
2	40kg FUELTEK DIP SENSOR ASSEMBLY	BO-NE-0400
3	2.5mm JACK LEAD ASSEMBLY	BO-NE-0040
4	FUELTEK READOUT ASSEMBLY	BO-NE-0500

Figure 1
Plan View On Fuel Cylinder Showing 'FuelTek' Electronic Gauge Installation

4.2.13.1 General

This section describes the procedures necessary to enable the removal, repair, cleaning and replacement of the components used in the electronic gauge equipment.

Maintenance other than that detailed in Section 1.1.4 (Preventative Maintenance) and Section 6 (Annual / 100 Hour Inspection), should not be carried out unless it is clear that there is a fault or there is a noticeable deterioration in the performance of any part of the equipment function.

Unless otherwise stated, maintenance specified in this section may only be carried out by Ultramagic or by a maintenance organisation approved by the airworthiness authority in the country of registration.

4.2.13.2 Dip Sensor Assembly

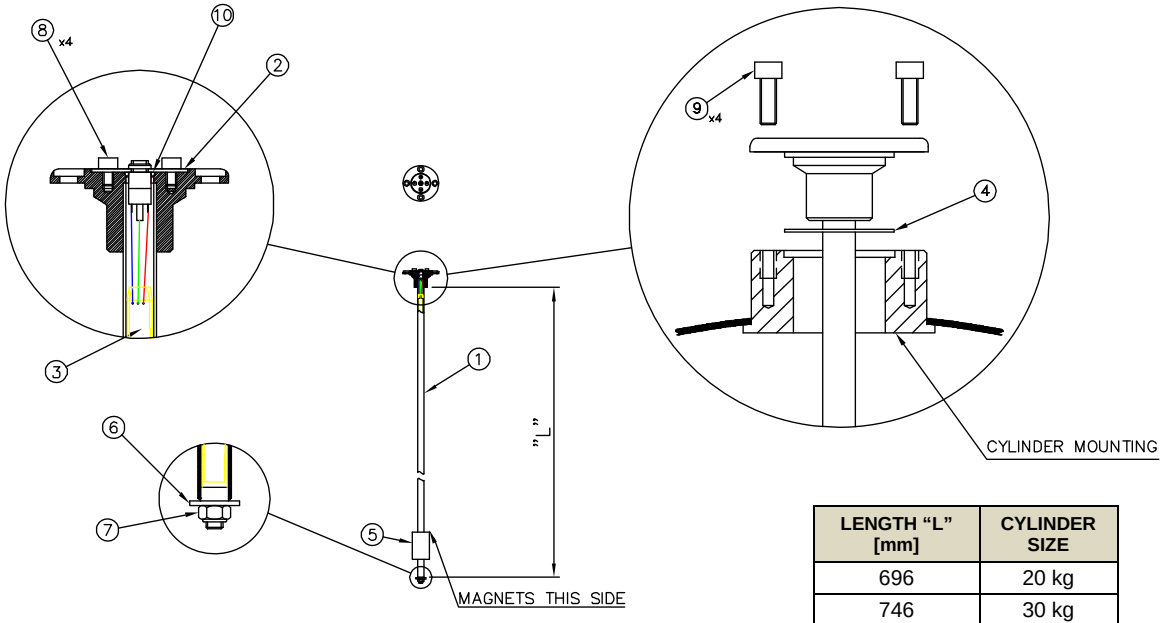
The Dip Sensor Assembly is available in three different sizes and is designed to fit the standard Ultramagic 20kg, 30kg and 40kg fuel cylinders. Note that it is important to ensure that the correct assembly is fitted to the cylinder. Use of the incorrect Dip Sensor Assembly will result in erroneous fuel quantity measurement. Note also that the Dip Sensor Assemblies contain a long printed circuit board fitted with the magnetically-activated electronic sensors. There are three different circuit board lengths designed to accommodate the 20kg, 30kg and 40kg cylinders. Fitting the wrong circuit board will result in eventual damage to the circuit board wired connections and incorrect fuel quantity measurement.

The bottom of the Dip Sensor tube is closed off by a welded screw fitting. This welded joint forms part of the cylinder pressure seal. The screw fitting is provided with a nut and washer for the purposes of retaining the magnetic float. The upper end of the tube is welded to the Dip Sensor Head and again, this joint forms part of the cylinder pressure seal. The Dip Sensor Head is secured to the cylinder in the usual fashion using the same gasket seal as for the standard mechanical fuel gauge.

The top of the Dip Sensor Head is provided with a small plate secured using four screws. This plate provides mounting for the jack socket and allows access to the circuit board. Note that the jack connector is provided with "O" seal. This seal maintain the cylinder pressure integrity in the unlikely event that either of the two welded joints on the tube should fail. In addition, the bottom of the jack socket is fitted with a coating of resin to prevent the possibility of fuel flow through the connector body in the unlikely event of a welded joint failure. Therefore the system is fail-safe.

WARNING: Only parts obtained from Ultramagic are to be fitted in these locations

To remove and strip down the Dip Sensor Assembly, refer to Figure 2 and proceed as follows.



LENGTH "L" [mm]	CYLINDER SIZE
696	20 kg
746	30 kg
885	40 kg

ITEM	DESCRIPTION	DWG / PART NUMBER
1	20kg SENSOR TUBE ASSEMBLY	BO-NE-0210
1	30kg SENSOR TUBE ASSEMBLY	BO-NE-0310
1	40kg SENSOR TUBE ASSEMBLY	BO-NE-0410
2	CONNECTOR PLATE	BO-NE-0070
3	20kg PCB SENSOR ASSEMBLY	BO-NE-0250
3	30kg PCB SENSOR ASSEMBLY	BO-NE-0350
3	40kg PCB SENSOR ASSEMBLY	BO-NE-0450
4	GAUGE SEAL GASKET	BO-C-0135
5	MAGNETIC FLOAT	BO-NE-0030
6	ST STEEL DIP TUBE END WASHER	CR-03-0010
7	ST STEEL DIP TUBE END LOCK NUT	VE-C-0250
8	ST STEEL CONNECTOR PLATE SCREW	MA-FE-0544
9	M6 SENSOR TUBE ASSEMBLING SCREW	BO-C-0080
10	CONNECTOR PLATE NBR O-RING	CR-09-0155

Figure 2
'FuelTek' Dip Sensor Assembly

Before removal of any components, switch off and disconnect the Readout Assembly from the Dip Sensor Assembly. Carry out all work in a well ventilated area away from fuel vapour.

The Dip Sensor may be disassembled in two stages. If the electronic Sensor Assembly (item 3) requires replacement, this may be carried out without the need to first empty the cylinder of fuel. However, it should be noted that the joint between the jack socket and connector plate is provided with a seal. This seal is fitted in order to prevent a catastrophic fuel leak in the unlikely event of a failure of the dip tube metalwork inside the cylinder. A failure of the tube will most likely result in a failure of the electronic function of the Sensor Assembly. Thus incorrect electronic function may indicate that there has been a failure of the tube inside the cylinder (albeit very unlikely). Proceed to remove the connector plate and jack socket with caution therefore. If there is any doubt, empty the cylinder of fuel before removing any components.

- To remove the Electronic Sensor Assembly (item 3) undo and remove the four cap head screws (item 8) securing the Connector Plate to the Sensor tube Assembly head using a 3mm AF Allen key.
- Carefully withdraw the Electronic Sensor Assembly from the tube taking care not to damage the three soldered wires between the jack socket and the circuit board.
- Using a pair of suitable pliers, carefully undo the threaded ring securing the jack socket to the Connector Plate.
- Remove the “O” seal (item 10) fitted around the body of the jack socket.
- Replacement is generally the reverse procedure of removal. Prior to fitting the seal, apply a thin smear of Molycote® 111 silicone grease over it.
- Apply a small amount of Loctite® 222 to all cap head screw threads (items 8 and 9) before replacement.

Note that repair of the Electronic Sensor Assembly is by replacement only. However, a repair to a soldered joint on the wires linking the circuit board to the jack socket may be carried out. The process of creating reliable soldered electrical joints requires a high degree of skill on the part of the operator. Consequently, repairs to soldered joints may only be performed by experienced and approved personnel.

If removal of the complete Dip Sensor Assembly is necessary, proceed as follows:

- Completely empty and vent the fuel cylinder as described in the Ultramagic Maintenance Manual. Under no circumstances attempt to remove the Dip Sensor Assembly without having first completely emptied the cylinder.
- Using a 5mm AF Allen key, undo and remove the four M6 cap head screws (item 9) securing the Dip Sensor Head to the fuel cylinder.
- Carefully withdraw the Dip Sensor Assembly from the fuel cylinder.
- Using a 10mm AF open-ended spanner, undo and remove the M6 Aerotite lock nut and plain washer (items 7 and 6) from the lower end of the Dip Sensor Tube.
- Slide the magnetic float off the tube.
- Prior to re-assembly, remove any magnetic particle contamination from the float and tube. In addition, check inside the fuel cylinder for any contamination and clean if necessary.
- Replacement is generally the reverse procedure to removal. Make sure that the float is positioned in the correct orientation. Always fit a new seal (item 4) between the Dip Sensor Head and the cylinder mount. Apply a small quantity of Loctite® 222 to the M6 screw threads securing the head to the cylinder.

- Upon completion, pressure test the cylinder using a compressed air supply not exceeding 7 bar. Check the joint between the head and cylinder using leak detection fluid.

4.2.13.3 Jack Lead

The Jack Lead connects the Dip Sensor Assembly to the Readout Assembly. Due to the nature of its construction, the soldered connections cannot be accessed. Repair is therefore by replacement only. Refer to Figure 1.

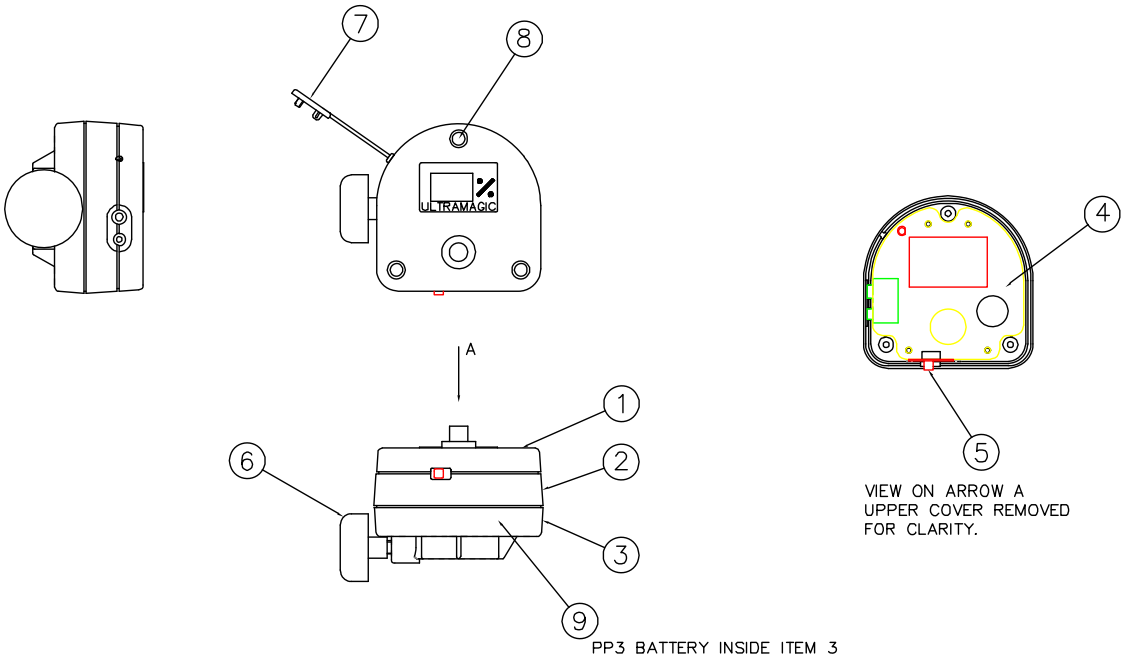
4.2.13.3 'FuelTek' Readout Assembly

The Readout Assembly uses a five-part plastic moulding to house the electronic circuit board and the battery. The moulding consists of an upper section, a centre section, a lower section, a slider providing a mechanical link to a switch and a flexible grommet dust cover used to protect the jack sockets.

Due to the nature of the equipment, repair is limited to battery replacement, pushbutton switch replacement, printed circuit board replacement and grommet replacement.

4.2.13.3.1 Battery Replacement

To replace the battery, refer to Figure 3 and proceed as follows:



ITEM	DESCRIPTION	DWG / PART NUMBER
1	BOX UPPER (TRANSLUCENT)	BO-NE-0100
2	BOX MIDDLE	BO-NE-0110
3	BOX BOTTOM	BO-NE-0120
4	READOUT PCB ASSEMBLY	BO-NE-0003
5	SLIDER (BATTERY ISOLATION SWITCH)	BO-NE-0130
6	POSITIONING HANDLE	BO-NE-0050
7	SOCKET COVER	BO-NE-0140
8	PLASTITE SPECIAL SCREW	BO-NE-0080
9	PP3 9V RECHARGEABLE BATTERY PP3	BO-NE-0020

Figure 3
'FuelTek' Readout Assembly

- Using a suitable crosshead screwdriver, undo and remove the three countersink screws (item 8) securing the Box Lower (item 3) to the Box Middle (item 2).
- Disconnect the battery and replace.
- It is strongly recommended that only the battery specified in the table above be used as this battery will provide excellent life and discharge characteristics. The use of other PP3 batteries will result in the premature illumination of the Low Battery Warning LED.
- Replace the cover and re-fit the three screws. When re-fitting the cover, take care not to trap the battery wires.

4.2.13.3.2 Socket Cover Replacement

To replace the Socket Cover, refer to figure 3 and proceed as follows:

- Using a suitable crosshead screwdriver, undo and remove the three countersink screws securing the Box Upper (item 1) to the Box Middle (item 3).
- Remove and replace the Socket Cover (item 7).
- Replace the Box Upper and refit the three screws.

4.2.13.3.3 Readout PCB Assembly

Repair work on the PCB is limited to re-fitting the pushbutton switch and battery wires in the terminal strip and re-soldering the wires to the pushbutton switch terminals. The process of creating reliable soldered electrical joints requires a high degree of skill on the part of the operator. Consequently, repairs to soldered joints may only be performed by experienced and approved personnel.

There are no user-serviceable parts on the PCB itself and repair is by replacement only.

To replace the Readout PCB Assembly, refer to Figure 3 and proceed as follows:

- Using a suitable crosshead screwdriver, undo and remove the three countersink screws securing the Box Lower (item 3) to the Box Middle (item 2).
- Disconnect and remove the battery.
- Using a suitable crosshead screwdriver, undo and remove the three countersink screws securing the Box Upper (item 1) to the Box Middle (item 2). Take care as at this stage, the red Slider (item 5) will become loose. Remove the Slider.
- Using a suitable pair of pliers and a 14mm open-ended spanner, carefully undo and remove the knurled nut ring securing the pushbutton switch to the Box Upper. Withdraw the pushbutton switch from the Box Upper.
- The battery connection leads are looped around a plastic section in the Box Middle. Untie the loop and allow the leads to become free.
- Carefully withdraw the Readout PCB assembly.
- Whilst the circuit board is removed check the terminal block on the rear face of the board. Make sure all wires are securely fitted inside the terminal block. If any wires have become loose or disconnected, replace them and tighten the associated fixings. The wiring arrangement is shown in Figure 4 below.
- Replacement is generally the reverse procedure to removal. When replacing the circuit board, remember to loop the battery leads around the Box Middle cross piece.

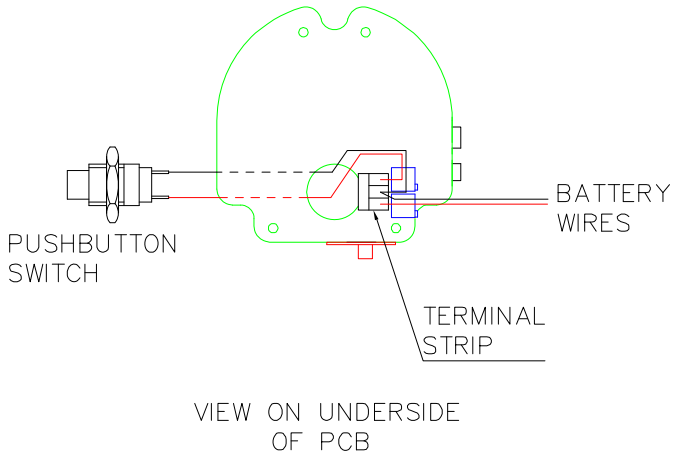


Figure 4
Terminal Strip Wiring

4.2.13.3.4 Pushbutton Switch

The Pushbutton Switch is a highly reliable unit and failure of the switch itself is unlikely. The most likely mode of failure will be a broken or dry soldered joint where the wires are attached to the switch terminals. In the event that the wire joints do require re-soldering refer to section 4.2.13.3.3 above.

In the unlikely event that the switch requires replacing, then the easiest way to remove the switch is by disconnecting it from the terminal strip.

- Disassemble the box as described in section 4.2.13.3.3 without removing the battery leads from the Box Middle. Refer to Figure 4 and using a small flat-blade screwdriver, undo the two terminal screws to which the pushbutton switch wires are attached. Withdraw the wires from the terminal strip and remove the switch.
- Replacement is generally the reverse procedure to removal. Make sure all wires are placed back in the terminal strip in accordance with Figure 4 and that the terminal screws are tight.

4.2.13.3.5 Readout Assembly Calibration

The Readout PCB assemblies are calibrated at the factory in order to ensure that the display registers the correct fuel quantity levels in the cylinder. Consequently, further calibration should not be necessary. However, should re-calibration be required refer to Figure 5 and proceed as follows:

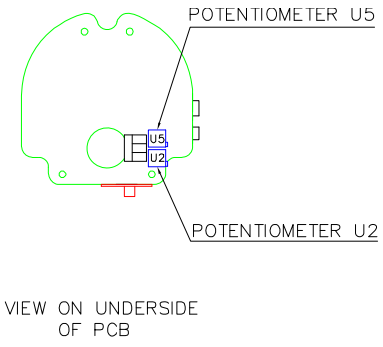
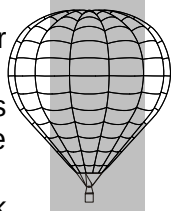


Figure 5
Readout Calibration



- Prepare an empty fuel cylinder fitted with the Dip Sensor Assembly. The cylinder may be a 20kg, 30kg or 40kg unit. Ensure the cylinder is standing upright.
- Using a suitable crosshead screwdriver, undo and remove the three screws securing the Box Upper to the Box Middle. Carefully separate and expose the underside of the Readout PCB Assembly.
- Connect the Readout PCB 2.5mm jack socket to the Dip Sensor Assembly jack socket using the Jack Lead and turn on the equipment.
- Using a small flat-bladed screwdriver, adjust potentiometer U2 so that the display reads 0%.
- Switch off the equipment.
- Fill the fuel cylinder in the usual fashion so that it is full as indicated by the bleed valve. Once full, stop re-fuelling and close all cylinder valves. Allow the area to completely clear of fuel vapour.
- Turn on the equipment. Adjust potentiometer U5 so that the display reads 100%.
- Calibration is now complete. Switch off the equipment and re-assemble.

Note that calibration using this method sets the Readout Assembly against the zero and 100% positions for an individual cylinder. Manufacturing tolerances associated with the cylinder and the incremental nature of the Dip Sensor sensors may result in small differences in the maximum contents displayed when the Readout is used with other fuel cylinders.

4.2.13.4 Troubleshooting

Refer to the table below to identify the source of a problem. If none of the actions proposed are effective, or the symptom does not match any entry in the list, contact Ultramagic for advice.

Symptom	Possible Cause	Corrective Action
Digital display reads the same irrespective of the fuel level inside the cylinder	Excessive magnetic particle contamination inside cylinder	Clean cylinder, float and dip tube and remove all magnetic particle contamination
	Sensor failure on Dip Sensor PCB Assembly	Replace Dip Sensor PCB Assembly
	Broken wire connection between Dip Sensor PCB and Jack socket	Repair soldered joint (only by qualified welder) or replace Dip Sensor PCB Assembly
	Jack lead disconnected from Readout Assembly.	Re-connect Jack Lead
Readout displays zero	Fuel cylinder empty	No corrective action necessary
	Jack Lead damaged	Replace Jack Lead
	Broken wire connection between Dip Sensor PCB and Jack socket	Repair soldered joint
	Jack Lead not connected to Dip Tube Assembly	Connect Jack Lead
Red Warning Light Illuminates	Battery Voltage low	Recharge internal battery or connect an auxiliary battery
Battery looses charge quickly	Battery has reached end of working life	Replace battery
	Battery Isolation Switch left connected, (I) position	Turn switch (O) when the readout is not in use
Audio warning sounds when fuel contents not 10% or 20%	Failure of magnetic sensor or sensors on Dip Sensor PCB	Try fitting Readout to another functioning dip sensor. If problem disappears, replace Dip Sensor PCB
	Jack Lead not connected	Connect Jack Lead
	Jack Lead damaged	Replace Jack Lead
	Failure of Readout PCB	Try fitting Readout to another functioning dip sensor. If problem remains, replace Readout PCB.

Equipment will not switch on	Battery exhausted	Recharge / replace battery / connect emergency pack
	Red power switch in off position	Move switch to on position and operate the pushbutton
Battery will not charge	Red power switch in off position	Move switch to on position and charge
	Battery reached end of working life	Replace battery
Readout does not provide accurate display of fuel contents.	Failure of electronic component on Dip Sensor PCB Assembly	Replace Dip Sensor PCB
	Jack Lead not connected	Connect Jack Lead
	Jack Lead damaged	Replace Jack Lead
	Readout requires calibration	Calibrate Readout Assembly
	Incorrect Dip Sensor PCB Assembly fitted	Fit correct Dip Sensor PCB Assembly
	Dip Sensor Assembly PCB "jumper" links incorrectly set	Replace Dip Sensor PCB Assembly

Section 5 – Instruments

No change.

Section 6 – Inspection Schedules

6.1 Pre-flight Checks ("A" Type)

(add the following)

Burner and Fuel System

[...]

7. ☐ Check the gauge battery voltage by removing the 2.5mm jack lead from the side of the gauge box. As reference, the low battery alert (flashing led) appears below 8.2V. It is not allowed to take off if the voltage is below this level. In this case recharge the battery or attach an auxiliary supply.
8. ☐ Check that the 2.5mm jack lead is fully connected to the box. Note that if the lead is not fully connected, the display will provide a reading of battery voltage and the audio warning will sound
9. ☐ Check that the gauge provides a reading commensurate with the fuel contents in the associated cylinder
10. ☐ Check that the gauge is fully secured to the cylinder
11. ☐ Check that at least one auxiliary battery is free, available and fully charged at the moment of the take-off.

6.3 100 hour / Annual inspection ("B" Type)

(add the following)

Fuel Cylinders

[...]

8. ☐ Fully connect the equipment and switch it on. Check that the Readout display corresponds approximately to the quantity of fuel in the cylinder.

9. ☐ Draw off some fuel from the cylinder either by draining the fuel into another cylinder or by connecting to a burner. Check that the Readout displays a corresponding reduction in fuel quantity.
10. ☐ Check the condition of the Jack Lead. Make sure that the connectors and cable are in good condition.
11. ☐ With the equipment switched on, disconnect the Jack Lead from the Readout Assembly. Check that the readout displays a battery voltage greater than 8.5 Volts. Check also that upon disconnection, the audio warning is triggered and that operation of the pushbutton cancels the audio warning. Re-connect the Jack Lead and check that the Readout reverts to a display of fuel contents.
12. ☐ Press the pushbutton and check that the display backlight illuminates.

6.5 Special Inspection of cylinders and fuel hoses after 10 years ("D" Type)

(add the following)

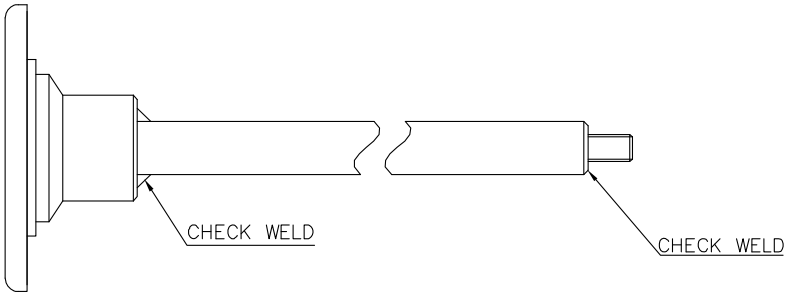
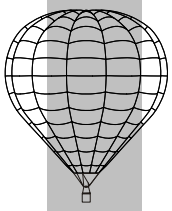


Figure 6
Dip Tube Assembly Weld Inspection Requirements

Fuel Cylinders
[...]
10. ☐ Ensure the fuel cylinder is completely empty of fuel and fully vented so that there is no internal pressure remaining. Remove the Dip Sensor Assembly. Check the condition of the two welds in the positions shown in Figure 6 above. If any deterioration of the weld is detected such as cracking, the Sensor Tube Assembly must be replaced.
11. ☐ Remove the Connector Plate from the Dip Sensor head. Refer to Figure 2 and check that the "O" seals fitted to the Jack Socket are all present and in good condition. Replace if necessary.
12. ☐ Check the underside of the Jack Socket to ensure that the resin coating surrounding the area where the electrical terminals protrude through the connector body is present and in good condition. If any deterioration of the resin is detected, the Jack Socket must be replaced.

Section 7 – Airworthiness Limitations

No change.



APPENDIX 2 – Inspection Checklist

Add the following items to the 'Cylinders' section:

REGISTRATION		CYLINDER S/N's	

CHECK	SECTION	ASPECTS	YES / NO	INSPECTOR
CYLINDER (B-Type)	6.3	11. Gauge Function Check (I)		
		12. Gauge Function Check (II)		
		13. Jack Lead Condition		
		14. Battery voltage, Audio Warning		
		15. Display Backlight		
CYLINDER (D-Type)	6.5 (If due)	16. Check welds		
		17. Check o-rings		
		18. Check integrity of the resin seal		