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1. INTRODUCTION AND SYSTEM DESCRIPTION

- The *Master*Filler is an instrument designed to deliver measured quantities of distilled water as required in the service of Aircraft Nickel-Cadmium batteries.
- The *Master*Filler consists of a microprocessor controlled pump, a level sensing probe, a keypad and a display.
- It is part of a system comprising Intelligent Charger-Analyzers and Software for Battery Data Acquisition/Analysis designed to improve the accuracy and efficiency in the process of testing batteries for airworthiness certification.

2. BLOCK DIAGRAM

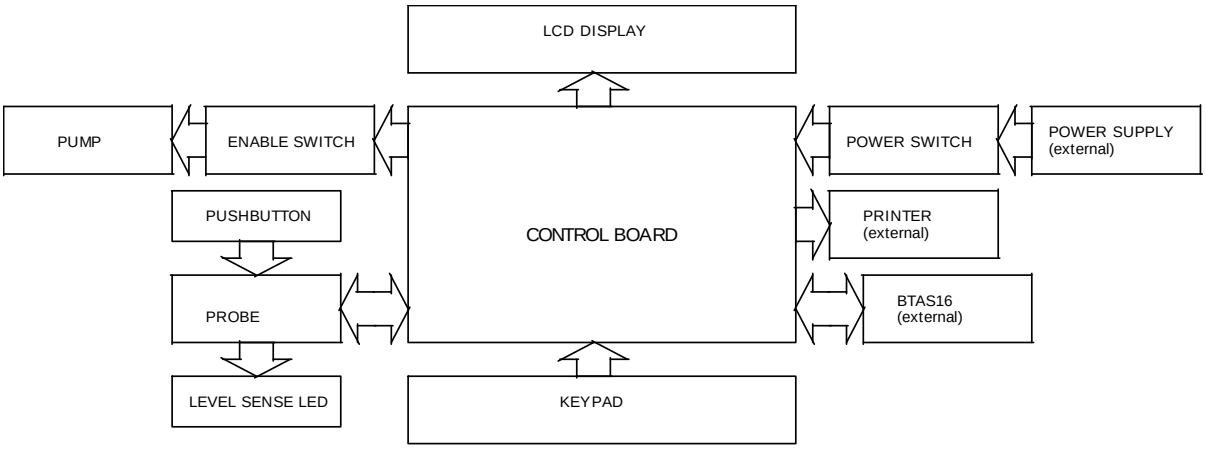

Figure 1 – *Master*Filler Block Diagram

3. GENERAL INFORMATION

3.1 The Significance of Water Consumption

3.1.1. Nickel-Cadmium cells consume water as a normal part of their activity.

3.1.2. Water is consumed as a result of the in-flight charge process and when current is demanded from the battery as it occurs with the starting of engines or the APU.

3.1.3. The amount of water consumed is a measure of the activity of the battery.

3.1.4. When water is consumed beyond the levels given by the manufacturer of the battery, it is an indication that the battery must be serviced more frequently or that there is a possible electrical problem in the aircraft (overcharging).

3.1.5. If the battery is allowed to function with water levels below the minimum specified electrolyte level, then, in-flight battery overheating will be experienced. This in turn will contribute to an accelerated deterioration of the cell separator material and eventual cell failure.

3.1.6. When cells are operating with less than the minimum required electrolyte level, the active area of the plates is reduced hence forcing current over a smaller area (higher current density) resulting in an overheating of individual cells or the entire battery.

3.1.7. In extreme cases, this may result in a catastrophic in-flight failure (thermal runaway), a condition that requires that the battery be disconnected from the bus. Note that when a battery experiences an in-flight thermal runaway it will normally need to be replaced (new cells/new battery).

3.2 Ground Service

3.2.1. When batteries are ground serviced, distilled water is added at the end of the charge and the amount of water delivered is recorded for each of the cells.

3.2.2. In the electrochemical process in the cells, water is absorbed by the plates during discharge and water is released during charge. It is for this reason that the only time when the electrolyte level can be tested and adjusted is at the end of the charge process (topping charge). Typically, when cells reach 1.6V or higher.

3.2.3. If water is added at other than at full charge, there is the danger that spilling of electrolyte will take place when the battery reaches full charge. When the water evaporates, there will be a conductive white residue (Potassium Carbonate) deposited over the cell top, links and posts giving a clear indication of overfilling.

3.2.4. An exception to the when-to-add-water-rule is if a high cell voltage develops during charge (usually over 2V). This is an indication that the cell is “dry”. At this time, an injection of 10cc to 20cc will bring the cell voltages to normal levels.

3.2.5. It is also advised to dispense 5cc to 10cc on each cell for a battery that has a known history of high water consumption or if the battery has remained on the shelf for a prolonged period of time.

3.2.6. Uneven water consumption can be an indication of cell imbalance, cell age and cell damage.

3.2.7. Battery overheating during bench charging can be the result of low initial electrolyte levels.

3.2.8. The CMM for each battery/cell provides the basic information of consumable water level as a guide to determine when the electrolyte loss becomes excessive.

3.3 Summary

3.3.1. It is for all of these reasons that measurement and recording of water levels during bench charging must be performed to obtain a more complete picture of the condition of the battery.

3.3.2. The *Master*Filler will easily provide to the BTAS16 the battery cells water level data to be added to the electrical data and thus provide a complete picture of the performance of the batteries being tested.

4. GLOSSARY

- Battery Manual: General Technical information provided by a manufacturer applicable to a series of batteries.
- BTAS16: A computerized Battery Test System
- Capacity Test: Test performed to determine if a battery can deliver the advertised, specified or required amount of current.
- CMM: Technical information provided by a manufacturer for a specific battery (Component Maintenance Manual)
- CPU: Central Processor Unit that under program control, processes commands to govern and monitor the operation of the instrument
- Deep Cycle: As applicable to Nickel-Cadmium batteries, the process of discharge to zero for each of the cells (to equalize the cells).
- Electrolyte Level Test: As applied to Nickel-Cadmium cells that have a vent cap, the process of verifying the level of the electrolyte and the addition of distilled water as required (Note that this test is performed only at the end of a charge cycle).
- Main Charge: As applicable to Nickel-Cadmium batteries, the charge current that provides 100% of the A-Hr rating.
- Nickel-Cadmium: Chemistry system of batteries as used in aviation and other heavy duty applications.
- Non-Volatile Memory: Memory area in the microprocessor where certain options can be stored that will remain recorded even if the power is turned off.
- Thermal Runaway: Destructive condition under constant voltage charging where one cell fails and heats up and causes all other cells to fail by transmission of heat from one cell to the next. The drop in internal voltage causes an increase in charge current that intensifies the heating, thus accelerating the process.
- Topping Charge: As applicable to Nickel-Cadmium batteries, the C/10 charge current that provides 40% of the A-Hr rating (after the Main Charge). This is required to complete the charge process (the Main Charge is not 100% efficient) and to determine the condition of the separator of the cells.

5. CONDENSED OPERATING INSTRUCTIONS

5.1 Prime (if required) – see 6.1

5.2 Calibrate the Pump (if required) – see 6.8

5.3 Dispense a pre-measured amount (if required) – see 6.7

5.4 Fill Cells – see 6.2

5.5 View Data – see 6.3

5.6 Print Data – see 6.5

5.7 Send Data – see 6.6

6. OPERATING INSTRUCTIONS (detailed)

Note 1: Level sensing is dependent on conductivity. Even though distilled water has a very low conductivity, as water mixes with the electrolyte in the cells it becomes instantly conductive and allows sensing to take place.

Note 2: Use ordinary tap water to perform familiarization tests. It has sufficient conductivity to simulate the presence of battery electrolyte (if not sufficiently conductive, add a small amount of table salt).

Note 3: Press RESET to exit any Operating Mode.

6.1 PRIME

This Mode is used to fill the input and output tubing and to remove any bubbles that may be present.

6.1.1. Press CLEAR

6.1.2. Select PRIME

6.1.3. Insert the probe in a container to catch the water dispensed

6.1.4. Activate the Pump by pressing the pushbutton in the Probe Handle

6.1.5. Deliver water until there are no bubbles in the tubing

6.2 FILL

This Mode is used to dispense water in each of the cells until the electrolyte level recommended by the battery manufacturer is reached.

Note: To avoid level sensing errors, maintain the tip of the probe free from electrolyte residues (wipe as needed).

6.2.1. If bubbles are present perform a PRIME first

6.2.2. Press CLEAR

6.2.3. Select FILL

6.2.4. Insert the probe in the cell opening

6.2.5. Activate the Pump by pressing the pushbutton in the Probe Handle.

6.2.6. Deliver water until the level in sensed.

6.2.7. Move the probe to the next cell.

6.2.8. Repeat until all cells have been serviced.

6.2.9. Press VIEW and then + or - to view the water readings for each of the cells.

6.2.10. If connected to the BTAS16 set the Work Order to receive dispensed water information (Water Level Window) then, press SEND (twice) to have the BTAS16 System read the amount of water dispensed for each of the cells (check with the BTAS Manual for screen entries required for this function).

6.2.11. If the water level is already at the required minimum (or higher), the LED in the probe will turn on and the display will show: “Level Sensed”.

6.2.11.1. Remove the Probe and Press CLEAR.

6.2.11.2. Re-insert the Probe to repeat the test of the electrolyte level.

6.2.11.3. If the level is not sensed, press the pump trigger to dispense water and continue operation.

6.2.11.4. If the level is sensed then press the pump trigger button once to record zero CC and advance the cell counter to the next cell.

6.3 VIEW CELLS WATER DATA

6.3.1. To view the recorded data during the FILL operation

6.3.1.1. Press CLEAR then press VIEW (the letter **W** will show in the bottom right hand corner of the screen).

6.3.1.2. Press + and – to increase/decrease the cell number

6.3.1.3. Press CLEAR to return to FILL

6.3.2. To view the recorded data after the FILL operation is complete

6.3.2.1. Press + and – to increase/decrease the cell number

6.3.2.2. Press CLEAR and then RESET to exit

6.4 DISP

This Mode is identical to FILL except that the dispensed volume is not recorded (requires manual recording).

6.5 PRINT DATA

6.5.1. Press PRINT

6.5.2. If there is no data, a message requesting to confirmation to continue will appear. Press PRINT again to print test data or press RESET to exit PRINT.

6.5.3. If there is data to be printed, the ticket will be printed immediately.

6.6 SEND DATA

6.6.1. Press SEND

6.6.2. If there is no data, a message requesting confirmation to continue will appear (press CLEAR or RESET to exit)

6.6.3. Pressing SEND again to proceed with no data

6.6.4. The message WAITING FOR BTAS will confirm that the MasterFiller is ready to receive a request from BTAS.

6.6.5. In the BTAS Water Level Window press ACQUIRE

6.6.6. The MasterFiller will recognize the request from BTAS and will send the stored data.

6.6.7. Messages REQUEST RECEIVED and DATA SENT will confirm that the operation was successful at the MasterFiller.

6.6.8. Dispensed water amounts in the BTAS Water Level window will confirm that the operation was successful.

6.7 DISPENSE 5, 10, 20, 50

This Mode is used to dispense a pre-measured volume. The level is sensed but information is not recorded.

6.7.1. If bubbles are present perform a PRIME first

6.7.2. Press CLEAR

6.7.3. Select DISPENSE 5, 10, 20 or 50

6.7.3.1. Note that for the 20cc mode, there will be a delivery pause at the 10cc point

6.7.4. Insert the probe in the cell opening

6.7.5. Activate the Pump by pressing the pushbutton in the Probe Handle

6.7.6. Deliver water until the selected volume is delivered or until the level is sensed.

6.7.7. Move the probe to the next cell

6.7.8. Repeat until all cells have been serviced

6.8 CALIBRATE (pump calibration)

This Mode is used to calibrate the pump timing to insure accurate delivery.

6.8.1. If bubbles are present, perform a PRIME first.

6.8.2. Press CLEAR

6.8.3. Select CALIBRATE

6.8.4. Insert the probe unto a graduated cylinder and hold the level sensing tip of the probe at the 50cc mark.

6.8.5. Activate the Pump by pressing the pushbutton in the Probe Handle

6.8.6. Deliver water until the level is sensed and the pump stops.

6.8.7. In case the pump does not stop, release the button to stop the pump and avoid the spilling of water.

6.8.8. When the level is sensed, the pump stops and the calibration value is stored in non-volatile memory.

6.8.9. To verify, use the DISPENSE 50 Mode and a graduated cylinder.

6.9 CALIBRATION VERIFICATION

This test will determine that the *Master*Filler pump is properly calibrated.

Note 1: For best performance during filling, maintain the water reservoir at the same level as it was when calibrated.

Note 2: For Pump Calibration see [6.8]

6.9.1. Press CLEAR

6.9.2. Select DISPENSE 50

6.9.3. Insert the probe unto a graduated cylinder and hold the level sensing tip of the probe above the 50cc mark.

6.9.4. Activate the Pump by pressing the pushbutton in the Probe Handle

6.9.5. Verify that the amount of water dispensed is 50cc ±1cc

6.9.6. Note that in this mode, with distilled water, the level will not be sensed. Release the button to stop the pump in case of an impending overflow.

6.9.7. If the level dispensed is not within ±1cc, repeat CALIBRATION holding the probe slightly higher/lower to increase/decrease the amount dispensed.

6.9.8. The calibration value is retained in a non-volatile memory and it will remain until CALIBRATION is performed again.

6.9.9. It is recommended that this CALIBRATION VERIFICATION be performed periodically to determine proper functioning of the instrument. Also, perform this calibration if any of the parts of the instrument are replaced or repaired, such as the Pump, Probe or Electronics.

6.10 PROBE DEPTH

Probe depth must be adjusted to provide the required electrolyte level in the cell.

To adjust, loosen the set screw that holds the probe sheath on the probe handle. Slide the sheath in or out as required to set the probe depth.

See [Figure 2] for depth dimension reference.

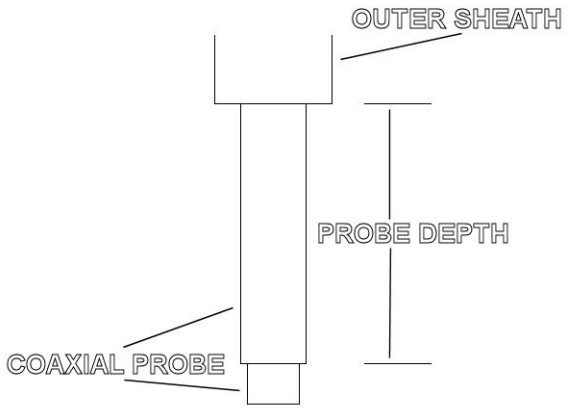

Figure 2 – Probe Depth

7. SPECIFICATIONS

7.1 PUMP

7.1.1. Type

Peristaltic

7.1.2. Flow Rate

5cc per second

7.1.3. Repeatability:

±1cc

7.2 LEVEL SENSING

7.2.1. Type:

Electrical (conductivity)

7.2.2. Accuracy and repeatability (after calibration):

±1cc

7.3 FILL MODES

7.3.1. FILL

- This is the main mode.
- Note that prior data will be lost (overwritten) when initiating this mode.
- Water is delivered until the level of the electrolyte is sensed by the probe.
- At this time, the pump stops and it displays and records the amount of water delivered.
- At any moment, VIEW can be pressed to review the information obtained. Exit the VIEW by pressing CLEAR.
- After the filling operation is complete (and RESET has been pressed), press VIEW to review the recorded information.

7.3.2. DISPENSE

- In this mode, water is delivered until the level of the electrolyte is sensed by the probe.
- At this time, the pump stops and it displays the amount of water delivered, but no information is recorded.

7.3.3. PRIME

- This mode is used to fill the pickup and dispense tubing and to remove bubbles.

7.3.4. PUMP CALIBRATION

- This mode is used to calibrate the pump timing for accurate delivery.

7.3.5. DISPENSE 5cc

- In this mode, the MasterFiller will deliver 5cc.
- The pump will stop when 5cc have been delivered
- If the electrolyte level is sensed by the probe, the pump will stop.
- In either case, the LCD display will show the amount of water delivered.

7.3.6. DISPENSE 10cc

- In this mode, the MasterFiller will deliver 10cc.
- The pump will stop when 10cc have been delivered
- If the electrolyte level is sensed by the probe, the pump will stop.
- In either case, the LCD display will show the amount of water delivered.

7.3.7. DISPENSE 20cc

- In this mode, the MasterFiller will deliver 20cc.
- The pump will stop when 20cc have been delivered
- If the electrolyte level is sensed by the probe, the pump will stop.
- In either case, the LCD display will show the amount of water delivered.

7.3.8. DISPENSE 50cc

- In this mode, the MasterFiller will deliver 50cc.
- The pump will stop when 50cc have been delivered
- If the electrolyte level is sensed by the probe, the pump will stop.
- In either case, the LCD display will show the amount of water delivered.

7.4 FUNCTIONS

7.4.1. CLEAR

- Clears the Screen

7.4.2. RESET

- Resets the Operating Mode and clears the Screen

7.4.3. VIEW

- Viewing of water delivered to each of the cells
- Use the + and – buttons to move forward and in reverse

7.4.4. SEND

- Send Data to the BTAS16

7.4.5. PRINT

- Send Data to an optional external ticket printer

7.5 POWER REQUIREMENT

7.5.1. 12VDC

7.5.1.1. External Power Supply: 12V, 1A

7.5.1.2. Optional External Battery: 12V

7.5.2. Power consumption

7.5.2.1. Idling current: ~100mA (with Pump off)

7.5.2.2. Full current: ~700mA (with Pump on)

7.6 DIMENSIONS

7.6.1. Case: 210mm (8.27in) wide, 150mm (5.91in) high, 179mm (7.05in) deep

7.6.2. Probe: 250mm (9.84in) overall length

7.7 WEIGHT

2.1Kg (4.6lb), with Power Supply and Probe

7.8 ENVIRONMENTAL

7.8.1. Ambient Temperature:

5^{o}C to 35^{o}C (41^{o}F to 95^{o}F)

7.8.2. Relative Humidity:

95%, non condensing

7.8.3. Altitude:

TBD

8. CONTROLS AND DISPLAYS

8.1 FRONT PANEL – see [Figure 3]

8.1.1. LCD DISPLAY

8.1.1.1. Status and Function information

8.1.2. KEYPAD

4 x 4 membrane keypad to select Fill Modes and other Functions

8.1.3. PROBE CONNECTOR

Connector for the Probe Cable

8.2 REAR PANEL see [Figure 4]

8.2.1. 12V POWER INPUT

Connection for an external 12V Power Supply

8.2.2. DATA

Connection for the BTAS16 system to output the volume of water dispensed in each of the cells

8.2.3. PRINTER

Optional output to a serial printer

8.2.4. POWER SWITCH

Switch to disconnect the Power Supply

8.2.5. PUMP SWITCH

Switch to disable the pump

Figure 3 – Front Panel Controls

Figure 4 – Rear Panel Connections and Controls

8.3 PROBE see [Figure 5]

8.3.1. PUSHBUTTON SWITCH

This switch has a momentary contact and it is used to turn the Pump on. Releasing the pushbutton deactivates the Pump.

8.3.2. LED

The LED located in the Probe Handle indicates when the fluid level is sensed.

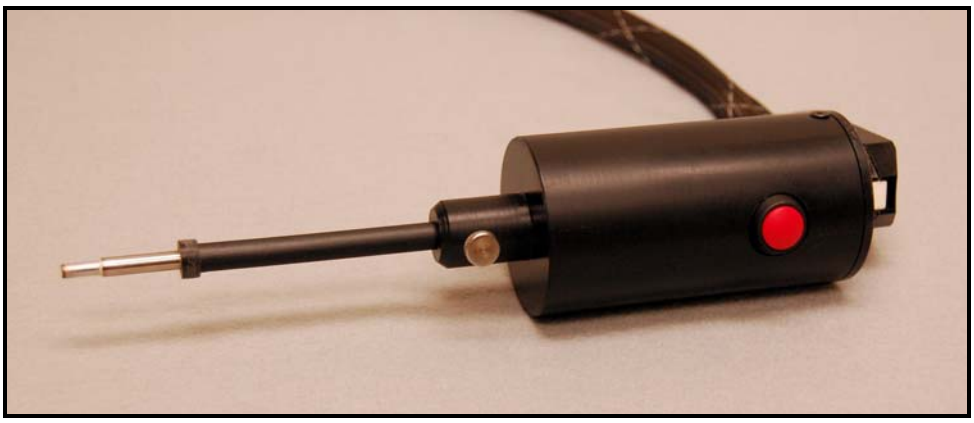

Figure 5 – Probe

9. INSTALLATION

9.1 BENCH SPACE

9.1.1. Case footprint: 210mm (8.27in) wide, 150mm (5.91in) high, 179mm (7.05in) deep.

9.1.2. Other space as required to store the Dispense Probe, for the external power supply (or optional battery charger) and the distilled water container(s).

9.2 POWER

Line (Mains): 85 to 250VAC, 42 to 64Hz (for the external power supply).

9.3 SYSTEM CONNECTIONS

See [Figure 4]

9.3.1. Data:

Connect to the BTAS16 Data Interface (Controls – Chargers side).

9.3.2. Printer:

Connect to a Serial Printer.

9.4 WATER CONTAINER POSITION

9.4.1. For accurate performance, always maintain the water container at the same level when the pump was calibrated.

9.4.2. Place the water container no higher than the level where the pump is at.

9.4.3. Place the water container no lower than 75cm (30 inches) from the level where the pump is at.

9.4.4. When not in use, maintain the probe at the same level as the pump (to avoid dripping).

10. UPDATES

10.1 Control Software Update – see [Figure 6]

The Control Software is located in a plug-in microprocessor in the Control Board.

Observe the following to perform an update:

- Review the Software Upgrade Notes
- Turn power off and disconnect the Power Supply from the Rear Panel
- Remove the four screws that hold the feet. This will allow the Panel to be separated from the Base.
- Remove the four screws that hold the Board to the Panel.
- Remove the four screws that hold the LCD Readout to the Board.
- Remove the Microprocessor and replace it with the one with the updated software. Note the location of pin 1 in [Figure 6]
- Warning: The Microprocessor will be damaged if not inserted properly in the socket.
- Re-attach the LCD Readout to the Board
- Re-attach the Board to the Panel
- Replace the cover and reconnect the Power Supply
- Turn-on and verify proper operation

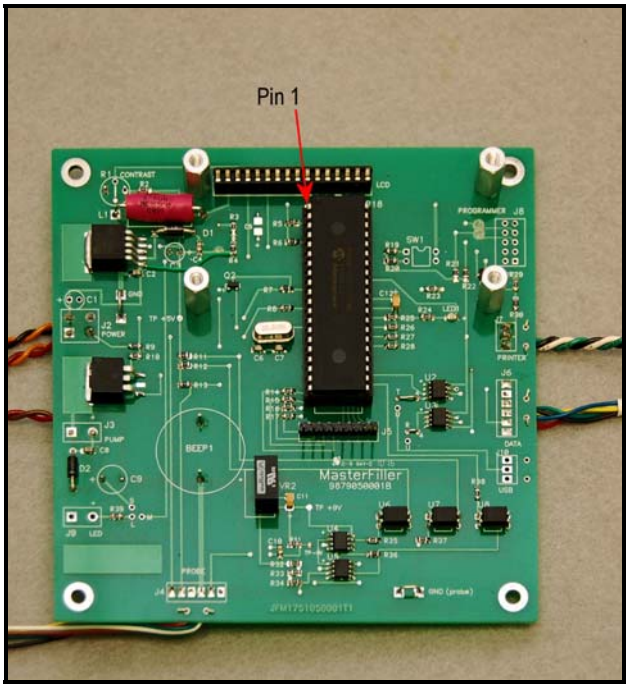

Figure 6 - Installed Processor

11. VERIFICATION OF PERFORMANCE

Note: Perform these tests at least once a year or at any time to determine if the instrument is operating properly

11.1 POWER-UP TESTING

11.1.1. Turn Power ON (rear power switch)

11.1.2. Verify the cycling of information in the LCD display:

11.1.2.1. Initial Screen

Figure 7 – Initial Screen

11.1.2.2. Final Screen

Figure 8 – Final Screen

11.2 KEYPAD and DISPLAY TESTING

Press all keypad buttons and determine that the response is as shown:

11.2.1. PAR

System Parameters: Program Version, 12V, Pump Speed, Pump Calibration Factor

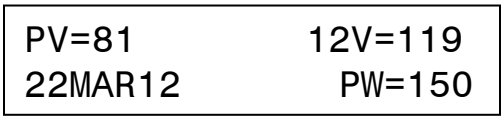

Figure 9 – System Parameters

11.2.2. VIEW

View Cell Water dispensed

Press + and — to cycle through all cells (24)

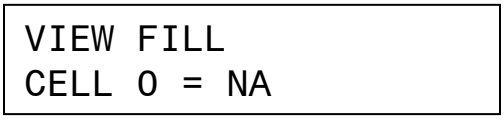

Figure 10 – View Cell Data

11.2.3. D5

Dispense 5cc (with level sense)

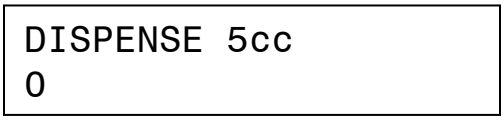

Figure 11 – Dispense 5cc

11.2.4. D10

Dispense 10cc (with level sense)

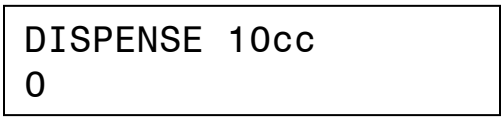

Figure 12 – Dispense 10cc

11.2.5. D20

Dispense 20cc (with level sense)

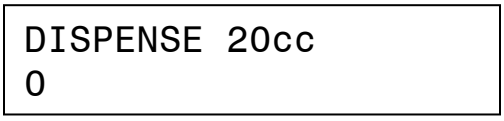

Figure 13 – Dispense 20cc

11.2.6. D50

Dispense 50cc (with level sense)

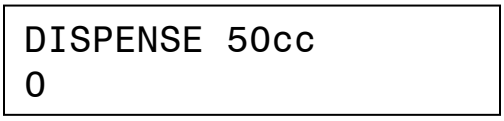

Figure 14 – Dispense 500cc

11.2.7. FILL

Fill Cells (with level sense and data recording)

11.2.7.1. Initial Screen

Figure 15 – Fill Cells Initial Screen

11.2.7.2. Press CLEAR or RESET to exit without overwriting prior data or Press FILL to accept overwriting prior data

11.2.7.3. Final Screen (accepting reset of stored data)

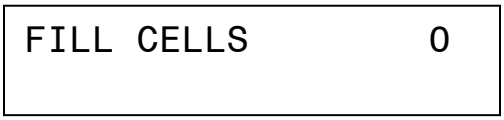

Figure 16 – Fill Cells Final Screen

11.2.8. DISP

Dispense (with level sense)

Figure 17 – Dispense 10cc

11.2.9. PRIME

Prime (no level sense)

Figure 18 – Prime

11.2.10. CAL

Calibration based on 50cc

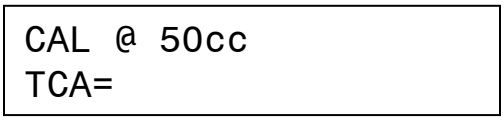

Figure 19 – Calibrate

11.2.11. SEND

Send Cells Data to BTAS16

- Data is available

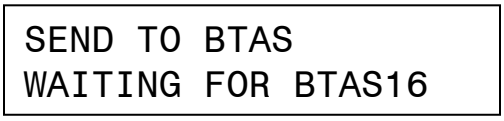

Figure 20 – Send (waiting for BTAS)

Figure 21 – Send (request received from BTAS)

Figure 22 – Send (data sent to BTAS)

- No Data is available

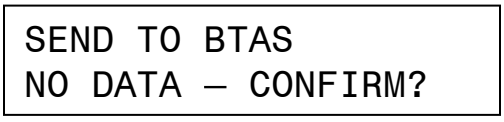

Figure 23 – Send (no data – confirm?)

Figure 24 – Send (request received from BTAS)

Figure 25 – Send (data sent to BTAS)

11.2.12. PRINT

Print Cells Data on a ticket

- The Printer is not available (power off, cable unplugged, no paper)

Figure 26 – Printer not available

- Data is available

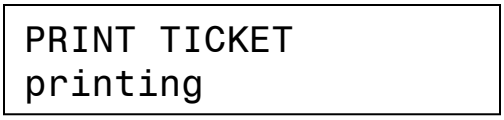

Figure 27 – Print (printing)

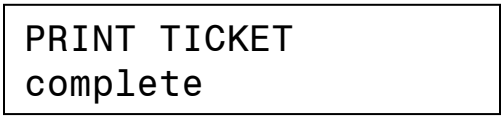

Figure 28 – Print (complete)

- No Data is available

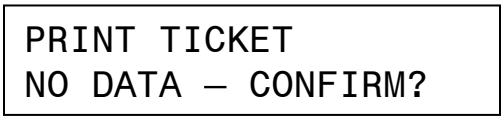

Figure 29 – Print (no data – confirm?)

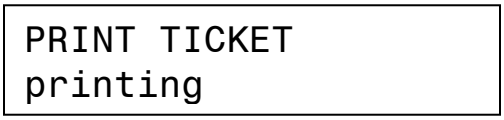

Figure 30 – Printing (printing)

Figure 31 – Printing (complete)

12. CALIBRATION (internal)

Note: There are no internal adjustments in the MasterFiller. Perform Verification of Performance if there is any indication that Instrument is not operating as specified. For Pump Calibration see [6.8]

13. TROUBLESHOOTING AND REPAIRS

The following are hints and directions to help you locate the most probable causes of deviation of performance as established in the procedures of section [11] Verification of Performance.

13.1 WARNINGS AND ERROR MESSAGES

13.1.1. "Undefined …"

Pressing the Probe Button with no dispense mode defined.

13.1.2. "Pump Power Off"

Selecting a dispense mode with the Pump Power Turned Off.

13.1.3. "Invalid 12V"

12V input out of the acceptable range. Check the output of the Power Supply (or optional Battery).

13.1.4. "Invalid CAL"

Pump calibration value out of the acceptable range. Verify proper flow of water and repeat the Calibration step.

13.1.5. "Printer Not Ready"

The printer is turned-off, the cable disconnected from the MasterFiller, or out of paper.

13.1.6. "No Data – Confirm?"

Attempting to SEND or PRINT with no data recorded. Pressing SEND or PRINT again allows the process to continue (used for system testing).

13.1.7. "Reset Data"

A warning that existing data (previously recorded) will be erased when initiating a FILL cycle.

13.2 TROUBLESHOOTING

13.2.1. No level sensing:

13.2.1.1. Fluid not sufficiently conductive

13.2.1.2. Defective Probe Cable

13.2.1.3. Defective Circuit Board

13.2.2. Continuous level sensing:

13.2.2.1. Electrolyte deposit on the probe tip

13.2.2.2. Internal probe short

13.2.2.3. Defective Circuit Board

14. REPLACEABLE MODULES AND PARTS

14.1 Control Circuit Board – P/N 9879050001

14.2 Pump – P/N 3551RF1002

14.3 Pump Tubing and Fittings – P/N TBD

14.4 Power Supply – P/N 47210122R0

14.5 Probe Assembly – P/N 9895050601

14.6 Input and Output Tubing – P/N TBD

15. BATTERY TESTING NOTES

Note: Battery testing is a hazardous operation. Handle batteries with extreme care as they are capable of very high discharge currents if short circuited.

15.1 Check the Battery Manual, CMM or Aircraft Manufacturer Instructions for information on charging, discharging and testing.

15.2 Check the CMM for the maximum consumable amount of water

15.3 Charge the batteries as indicated by the manufacturer of the battery

15.4 At the end of the charge cycle proceed to fill the cells to the required level

15.5 Record the amount of water dispensed in each cell. Transmit to the BTAS16, print a ticket or simply view and transcribe the information presented on the LCD readout.

16. DISCLAIMER

16.1 Qualified Personnel

- The *Master*Filler is a precision instrument intended to be operated by personnel qualified in the servicing of aircraft, industrial or medical batteries.

16.2 JFM's Responsibility

- JFM Engineering's responsibility is limited to the repair/replacement of any malfunctioning part of the system (not responsible for any losses incurred from the usage of the system).

16.3 User's Responsibility

- It is the user's responsibility to verify suitability in the intended application.
- It is the user's responsibility to verify the performance of the instrument and to operate and maintain it in accordance with the above given instructions.
- It is the user's responsibility to test batteries in accordance to the instructions and recommendations of the manufacturers of the batteries.
- It is the user's responsibility to operate the Instrument within standard safety procedures applicable to the operation of a Battery Test Facility.
- It is the user's responsibility to install power receptacles and wiring in accordance with local wiring codes.
- It is the user's responsibility to observe all necessary precautions and to be equipped with personal protective equipment when working with batteries to avoid injury due to electrolyte splashing, short circuits with tools and to avoid injury due to the size and weight of the batteries.
- It is the user's responsibility to verify the integrity of the performance of this instrument in accordance with the instructions of Section [11].
- It is the user's responsibility to operate this instrument within the limits and guidelines as described in the Precautions and Installation sections [9 and 10].

17. REVISION INDEX

Table 1 - Index of Revisions

REVISION	DATE	NOTES
E0.11	27 February 2010	Preliminary writing
E0.12	8 December 2010	Minor text corrections
E0.13	23 June 2011	SW Version 75 Minor text corrections
V1.1	30 June 2011	SW Version 77 Augmented text
V2.0	6 July 2011	SW Version: 78 Updated pictures Additional information on initial level sensed Troubleshooting section added
V2.1	10 June 2013	SW Version: 81 (22 March 2012) Figure Labels and Text corrections

Notes: