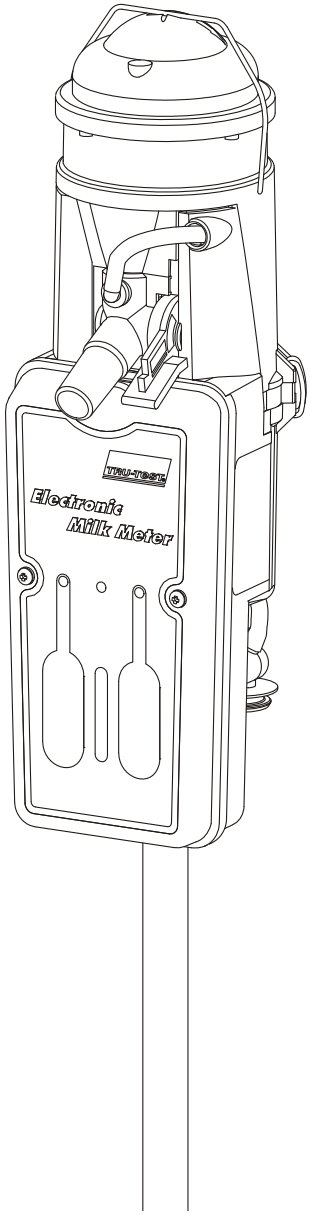
Tru-Test Electronic Milk Meter

Service Instructions



These instructions have been written to assist you with troubleshooting, maintenance and repair of the Tru-Test Electronic Milk Meter and the Tru-Test Data Handler.

It is assumed that you are familiar with the normal use and care of the Tru-Test Electronic Milk Meter and the Data Handler. For more information on using the EMM and the Data Handler refer to one or more of the following documents:

MDD00001	Tru-Test Electronic Milk Meter Operating instructions
MDD00002	Tru-Test Electronic Milk Meter Quick Guide
	Upgrading Meter and Data Handler Software
	LinkTTEMM User Guide
	LinkTTEMM Extra Details
	Retrieving lost Data Handler data
GCQ00001.14	Barcode label specs

The ‘Operating instructions’ provide information on proper operation, care and maintenance of the milk meter. The document also includes a troubleshooting section. When any EMM is giving (or suspected to give) problems use the information given in the ‘Operating instructions’ as a first attempt to correct the problems. If problems persist, use the information in these ‘Service instructions’.

Note: These specifications are subject to change without notice.

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Contents

How the Tru-Test Electronic Milk Meter (EMM) works.

The milk yield measurement system.

Principle and calibration curve.

During milking of each cow the Tru-Test EMM separates a known and accurate portion of the cow's milk and collects that small portion of milk in the flask. The milk meter then measures how much milk is held in the flask by measuring the height to which milk has collected in the flask. Each milk meter is programmed with a calibration curve, which is used to convert height of milk in the flask to a known volume in the flask.

Note: The calibration curve is specific to each milk meter, which means that components such as the circuit board and flask components can not be freely replaced or swapped with similar parts from other milk meters without risking loss of accuracy of the milk yield measurements.

Measurement system.

The two stainless steel probes inside the lower half of the flask form part of the milk height measurement system. The probes are connected to electronic circuits located on the internal printed circuit board (PCB). When the Tru-Test EMM is operating, the electronic circuits place a low electric potential on the two stainless steel probes. When milk is present in the flask the electric potential causes a small AC electric current to flow through the milk. The magnitude of the electric current is very low (less than 1 mA RMS), so that it does not have any detrimental effect on the quality of the milk in the flask.

The electric current that flows through the milk produces a weak magnetic field. A coil is mounted inside the 'outer' probe. The coil consists of a few hundred turns of fine copper wire wound on a plastic former. Because the probes are made from a non-magnetic variety of stainless steel, the magnetic field that is produced by the electric current that flows through the milk is also present inside the stainless steel probes. Hence, the magnetic field is present at the coil and causes a small electric signal voltage to develop on the coil windings.

The electronic circuits on the PCB amplify the signal voltage from the coil and then accurately measure the signal amplitude. The electronic circuits, the probes and the coil are arranged in such a way that the signal voltage varies as a linear function of the milk height in the flask.

Tilt correction

The orientation of the Tru-Test EMM should always be as near to vertical as possible. If a milk meter is not in a perfectly vertical position then the height of the milk in the flask, as viewed by the instrument, will not be uniform (i.e. the milk collects in that part of the flask that is lowest). This can have a small but significant effect on the signal amplitude in the milk yield measurement system and thus lead to measurement errors.

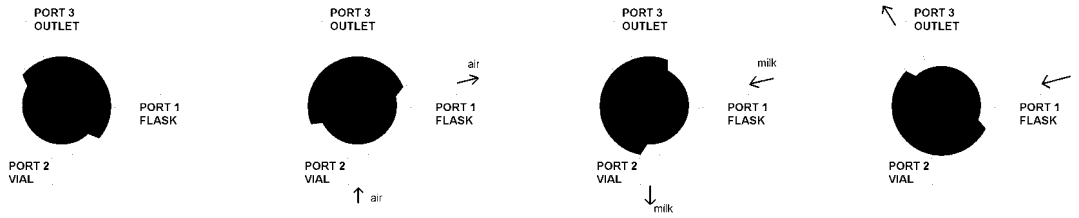
To correct for small errors in the milk meter position the EMM is equipped with a 'tilt' sensor, or more accurately a 'dual axis static accelerometer'. This sensor allows the milk meter to measure its position relative to perfectly vertical. The EMM measures the milk meter position once every second and uses the measurement result to make a correction on the milk yield.

The tilt sensor cannot allow for the mechanical sampling error that will occur if the milk meter is excessively tilted. If the milk meter is tilted such that more or less milk flows through the nozzle, this error cannot be calculated. The recommended maximum tilt is $\pm 5^{\circ}$ from vertical.

The sampling system.

When a cow has finished milking, a sample of the cow's milk will usually be dispensed into a sample vial. The EMM controls the volume of the dispensed milk sample, reducing the amount of milk lost and saving time when analyzing the milk samples. After dispensing the milk sample into a sample vial, the milk meter automatically returns the remainder of the milk that has collected in the flask to the milk vat.

To perform these functions the milk meter is equipped with a rotary valve, located just underneath the flask. The rotary valve is operated by a DC motor with reduction gearbox and optical shaft position sensor contained inside the milk meter housing. The valve has three ports: (1) to the flask, (2) to the vial and (3) to the milk meter outlet. The DC motor also operates an air admission valve near the top of the flask, via a cam (on the same shaft as the rotary valve) and a pushrod.



A: milking position	B: stirring position	C: sampling position	D: draining position
Pushrod is down	Pushrod is down	Pushrod is up	Pushrod is up

A: Milking position

During milking, ports 1 and 3 are closed. Milk collects in the flask. A vial may or may not be attached. If a vial is attached then it may be empty (ready to receive the new milk sample) or the vial may contain a milk sample from the previous cow.

B: Stirring position

Once the cow has finished milking and the operator confirms this, the EMM will check that a new, empty vial is in place. The EMM will report to the operator if this is not the case. Once a new vial has been attached the valve will rotate the rotor counter-clockwise until ports 1 (flask) and 2 (vial) are open.

The flask is still under vacuum. The vacuum will cause air to be sucked in via the small air admission hole in the top of the vial holder, through the valve and into the flask. The air bubbles enter at the bottom of the flask and cause a thorough stirring action of the milk in the flask. Stirring the milk before dispensing the milk sample into the sample vial ensures that the milk sample is a good representation of the composition of all the milk from the cow.

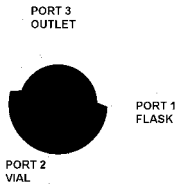
C: Sampling position.

When the milk in the flask has been adequately stirred by the air bubbles, the valve rotates further to the sampling position. In the sampling position ports 1 (flask) and 2 (vial) are still both open, but the cam (mounted on the same shaft as the rotary valve) pushes the pushrod upwards. The pushrod opens the air admission valve at the top of the flask. The in-rush of air closes the flap valve at the top of the flask so that it is now no longer under vacuum. Milk will then flow from the flask into the vial. The vial holder has a small air bleed hole to let the air escape while milk flows from the flask into the vial.

D: Draining the flask.

As soon as the correct volume of milk has been dispensed into the sample vial, the milk meter rotates the valve further to the draining position where ports 1 (flask) and 3 (outlet) are open. Port 2 (vial) is then closed. The cam still pushes the pushrod upwards to open the air admission valve at the top of the flask.

The vacuum present at the outlet of the milk meter will suck the remaining milk out of the flask. The milk is replaced by air coming in via the open air admission hole.



The rotary valve has a fifth position (E), which is shown left. After draining milk from the flask, the valve briefly stops in this position. In this position ports 1 (flask) and 3 (outlet) are still open, but the cam allows the pushrod to come down, closing the air admission hole at the top of the flask. This allows the vacuum to build up again in the flask and opens the flap valve.

E: washing position

Pushrod is down

As the name already indicates, the washing position is also used when the milk meter is in washing mode.

After allowing the vacuum to build inside the flask, the valve returns to the milking position (A) and the milk meter is ready for milking of the next cow. The sample vial with the dispensed milk sample can be removed from the vial holder, ready to go the laboratory for analysis.

The barcode reader.

In some markets the sample vials have stickers with printed barcodes attached. To use these vials, the Tru-Test EMM can have a built in barcode reader. This allows automation of the process of identifying which cows produced each milk sample.

The barcode reader views the sample vial barcode through the red transparent window located below the rotary valve. Inside the milk meter, behind the red transparent window are six LED's (red light emitting diodes) that shine a bright red light onto the barcode. Also in the milk meter, behind the window, is a lens assembly which focuses an image of the barcode onto an electronic linear image sensor. The sensor is located on the main PCB inside the milk meter.

The red LED's, the linear image sensor and the other associated electronic circuits normally only operate briefly when the Select or Finished Milking keys are pressed. At other times these parts are turned off to conserve battery energy.

The barcode type used is called 'interleaved 2 of 5' with check digit'. This code allows only numbers (no letters or other characters). Normally a vial has a barcode representing 7 decimal digits, allowing numbers from 0 to 9,999,999. The check digit is used by the Data Handler to check that the barcode number is correct. To understand more about this barcode type refer to the website http://www.barcodeman.com/info/c2of5.php

The RFID reader

In some markets the sample vials are uniquely identified with RFID tags. To use these vials the Tru-Test Electronic Milk Meter can have a built in RFID tag reader/writer. This allows automation of the process of identifying which cows produced each milk sample.

The RFID reader has an antenna located inside the milk meter, near the vial holder.

The RFID reader, and the other associated electronic circuits normally only operate briefly when the Select or Finished Milking keys are pressed. At other times these parts are turned off to conserve battery energy.

The RFID tag type used is 13.56MHz of which there are several manufacturers. These tags come in a range of memory capacities and are read/write in most cases.

The EMM can be programmed to only read data from the tag, or to read from and write to the tag.

The battery and battery charger.

The Tru-Test EMM has an internal rechargeable battery pack. The battery pack has five NiMH (nickel-metal-hydride) cells and produces a nominal voltage of 6 volts. The nominal battery capacity is either 2100 or 2700 mAh, which is sufficient to allow the milk meter to operate for at least 30 hours before it is necessary to recharge the battery. This means that, in most cases, the milk meter requires only one charge per week.

The milk meter also contains electronic circuits to control the recharging of the battery, to measure the voltage of the battery pack, the current flowing in/out of the battery and the temperature of the battery pack. In addition the milk meter is programmed with software that uses the battery voltage, current and temperature measurements to model the state of charge of the battery.

The recommended charging input voltage range is 12V to 14V. The charge control circuit inside the milk meter can accept input voltages between 11V and 16V. However if getting close to the upper limit, the charging time will increase as the EMM will go into trickle charge state so as to avoid overheating. The milk meter is protected against accidental incorrect polarity of the charging input voltage. The charging input terminals of the milk meter are also protected against electrostatic discharges and voltage spikes and surges of short duration (1 ms or less).

The milk meter will automatically activate and enter the charge mode when a sufficient charge input voltage is detected on the charger contacts. It is not necessary to press any keys or to register the milk meter with a Data Handler. Normally the red indicator light will show that the milk meter has commenced charging the battery. If the light is on continuously then the milk meter is charging fast. If the light flashes then the battery has reached a certain minimum charge level and charging continues at a slightly reduced rate. If the red charging indicator light goes off, it indicates that the battery has been fully recharged.

The recommended ambient temperature for the milk meter while charging is 10°C to 30°C. For temperatures between 0°C to 10°C and between 30°C to 40°C, charging continues but at a slower rate. For temperatures below 0°C and above 40°C charging is reduced to the minimum (trickle) rate. This is to protect the battery from being damaged by being charged at extreme temperatures.

There are no fuses inside the milk meter, either in the charging input circuit or in the battery circuit.

Under normal usage of the milk meter and mild charging and operating temperatures, the internal battery pack is expected to last for at least 500 full charge/discharge cycles. This may mean the battery pack will last for the useful life of the milk meter. Leaving the milk meter on charge for longer than 24 hours is not recommended, especially for warm (30°C and higher) ambient temperatures.

If the milk meter is to be stored for a period, charge it overnight before storage, and every three months during storage.

When the milk meter is not in use for an extended period of time (say 2 weeks or longer) then the battery will partially self-discharge. Over very long times the battery will self-discharge completely. Self-discharging is very temperature-dependent: high temperatures (30°C and higher) will cause much faster self-discharging of the battery than low temperatures (below 20°C). The state-of-charge model included in the software of the EMM does not correct for self-discharge of the battery. Therefore it is recommended that a milk meter that has not been used for 2 weeks or longer is always charged before being used on a farm. Since the software model of the state-of-charge of the battery may be incorrect after prolonged storage of the milk meter, the milk meter should be left on charge for a period of 24 hours. The state-of-charge model will then be able to automatically correct itself.

The RF communications system.

The Tru-Test EMM and the Data Handler exchange data via radio frequency transmitters and receivers (transceivers). The transmitters operate in ISM bands (Industrial Science Medical) and comply with international and national regulations regarding wireless radio communications in these ISM bands. It is permitted to operate the wireless radio transceivers without having to obtain a radio transmitter license.

Two models of the transceivers exist: 2.45 GHz and 433.92 MHz. These are commonly abbreviated to 434MHz and 2.4GHz. The modulation used is amplitude modulation (AM), sometimes also called On-Off keying (OOK).

The 434MHz milk meter has a radio antenna fitted just above the electronics compartment, not far from the top of the stainless steel probes. The antenna is permanently connected and can not be removed or replaced.

The 2.4GHz milk meter has an internal antenna fitted to the RF PCA.

For best performance of the radio communications system between the milk meter and the Data Handler no metal parts should be held near to the antennae. A minimum distance of 10 to 15 mm is sufficient. Similarly, placing your hand or fingers on or near the antenna will reduce performance of the radio communication system. In most normal situations the radio communications systems will provide reliable performance over distances of three meters or more between the milk meter and the Data Handler.

The keypad and the red LED indicators.

The Tru-Test EMM has two large keys. These keys are used to turn the meter on or off, to make the meter exchange information with a Data Handler, and to change the status of the meter. For most of the time, the Data Handler is used as a means of controlling the milk meter. Information or instructions are entered on the Data Handler keypad and then the Select key on the milk meter is pressed to make it execute the instructions entered.

When an EMM is turned on, by pressing either the Select or Finished Milking key, all three red indicator lights briefly light up to show that it has been activated. The milk meter will then attempt to register with a Data Handler. If the registration process is successful, then the milk meter proceeds by operating the rotary valve to move into the milking state. The Data Handler will display the state-of-charge of the battery in the milk meter. The Data Handler will also report any problems the milk meter might have, for example water or milk was left in the flask or the milk meter did not receive a wash after the previous milking session.

If the milk meter fails to register with a Data Handler (e.g. there are no Data Handlers within range of the wireless radio communication system), then the milk meter will automatically turn off.

Whenever the Select key is pressed on a milk meter that is registered with a Data Handler the three red lights on the milk meter will briefly flash and the milk meter will attempt to communicate with the Data Handler. The red light on the Data Handler will come on for the duration of the data communication with the milk meter.

When the Finished Milking key is pressed the three red lights on the milk meter should also briefly flash, but there will not be any communication between the milk meter and the Data Handler.

The three red indicator lights of the milk meter have their respective functions as indicated on the front of the milk meter itself and as explained in the ‘Operating instructions’.

Troubleshooting the Tru-Test EMM.

In the first instance where a problem with an EMM is encountered, refer to the troubleshooting section of the 'Operating instructions'.

If the problem is not listed, or the possible solutions given in the 'Operating instructions' do not solve the problem, then refer to the list below.

For a number of errors reported via the Data Handler you have the option of ignoring the error by choosing 'Yes' to continue or 'No' to turn the milk meter off. The Data Handler display will show the options when available. For example:

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Draining problem
Go on?1=Yes 2=No
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For most other error messages you have the option of 'overriding' the error by pressing the Finished Milking key on the milk meter while the error message is shown on the Data Handler display. The milk meter will then attempt to operate as normal and, if successful, the error message will automatically be cleared. An example where you may want to override the error is where the rotary valve was previously unable to rotate properly for some reason, but you have corrected the problem and the valve is now free to move. When the milk meter is turned on the 'CHECK ROTOR' error message will be shown and can be cleared by pressing the Finished Milking key on the milk meter.

BARCODE DIRTY or ATTACH VIAL

Symptom	Problem	Solution
Message on Data Handler.	BARCODE DIRTY or ATTACH VIAL	Replace or attach sample vial, or clean the barcode. Clean barcode reader window on back of milk meter with soft cloth. Ensure that sample vial is attached to the milk meter and pushed home.

- Make sure that the barcode on the vial is clearly printed without faded, torn or scratched areas.
- The barcode must be facing the red window in the milk meter. Make sure that the barcode is in the correct orientation and position on the vial. If unsure try moving the barcode and press Select to check.
- The barcode must have a seven digit code in 'interleaved 2-of-5' format. The software in the milk meter is not able to read any other barcode formats such as 'code 39', or 'EAN-13'. Refer to the document 'GCQ00001.14 Barcode label specs' for full specification of the barcode label.
- Make sure you are not blocking part of the red window with your finger when pressing the Select key. Also check that there is no direct sunlight shining onto the red window or any part of the vial as very bright sunlight may overload the barcode sensor. Note that direct sunlight will not damage the barcode sensor.

- When you press the Select key on the milk meter the six red lights visible behind the red window should all briefly light up. If one or more lights do not flash but the milk meter does communicate with a Data Handler then it is likely that the barcode illumination circuit board assembly (803700) is faulty or not properly connected to the main PCB.
- Check that the barcode reading window is not dirty or scratched. If it is scratched the case back assembly will need to be replaced.
- Also check the periscope and lens assembly to ensure that they are not dirty.
- Otherwise the barcode control circuit on the main circuit board assembly 803510 may be faulty.

VIAL WRITE FAIL or ATTACH VIAL

Symptom	Problem	Solution
Message on Data Handler.	VIAL WRITE FAIL or ATTACH VIAL	Replace or attach sample vial. Check that the vial does contain an RFID tag. Ensure that sample vial is attached to the milk meter and pushed home.

- The RFID tag in the vial must have a format recognized by the EMM. The software in the milk meter may have to be specifically updated to read the tag format.
- Check the loom running between the main PCA and the RFID PCA. Check the continuity of each strand. The resistance should be less than 0.5Ω
- Otherwise the RFID reader control circuit on the main circuit board assembly 810891 may be faulty.

METER FAULTY BATTERY FLAT

Message on Data Handler.	METER FAULTY BATTERY FLAT	Recharge the milk meter battery.

If you are certain that the milk meter recently has had a full charge, then there may be a problem with the charging contacts on the back of the milk meter or a problem with the charging bracket and power supply. Check the following items:

- The two stainless steel contacts on the back of the milk meter (at the bottom end) must be free of dirt and corrosion.
- The two stainless steel spring contacts on the milk meter charging bracket must be clean, have the correct shape and make good contact with the contacts on the milk meter.
- Ensure the electrical connections from the power supply to the milk meter charging bracket are in good order.

- Ensure mains power to the charger power supply is sufficient, stable and uninterrupted.
- Make sure the charger power supply is not overloaded (eg. not too many milk meters are connected to the same power supply) and there is no short circuit. Each milk meter requires a charging current of up to 0.4A.
- Use a DC voltmeter to check that the DC voltage on the two stainless steel spring contacts of the milk meter charging bracket is in the range of 11V to 16V.
- Make sure the ambient temperature of the area the milk meter is in while charging remains in the range between 0°C to 30°C. Temperatures outside this range can cause the milk meter to charge at a very slow rate. This is necessary to ensure long service life of the battery. Make sure that whilst charging, the milk meter is not exposed to full sunlight, especially behind a glass window, that it is not placed near or above a heater, or that its temperature does not fall below freezing point (0°C) during the night or early morning.
- It is also possible that one of the keys on the front of the milk meter is stuck. A stuck key forces the milk meter to remain on and it will drain the battery. Care must be taken not to damage the keypad. If damage to one of the keys is visible then the case front lid assembly must be replaced. See page 23 for details on obtaining a log file from the milk meter that may aid in the diagnosis of a stuck key.
- The milk meter can also be forced to remain on if the milk meter is placed face down onto an irregular surface or when something leans against the milk meter thereby causing a key to be pressed. During transport and storage of the milk meter make sure nothing presses against the front of the milk meter.
- If all of the above checks out with no problems, then the rechargeable battery internal to the milk meter may be faulty. Replace the battery with a fresh one.

Note that batteries stored for a long period will deteriorate

SAMPLING / STIRRING / DRAINING / ROTOR PROBLEM

Message on Data Handler.		
	Sampling problem Go on?1=Yes 2=No	Check for blockage, not enough liquid in the flask or air admission valve not working properly.
	Draining problem Go on?1=Yes 2=No	Check for blockage, not enough liquid in the flask, no vacuum or sampling valve not moving properly.
	Check Rotor Go on?1=Yes 2=No	The milk meter has detected that the rotor shaft is not in the right rotational position.
	CHECK ROTOR TURNING OFF	The sample valve assembly may need replacing.
	METER FAULTY STIRRING FAILURE	Check for no vacuum, .blocked air hole, or sample valve failure.
	METER FAULTY SAMPLING BLOCKED	Check for blockage, or air admission valve not working properly.
	METER FAULTY DRAINING BLOCKED	Check for no vacuum, blockage, or sampling valve not moving properly.

All these problems can be associated with the rotary sampling valve. The rotary valve must be able to rotate freely inside the valve housing.

- Make sure the valve does not have foreign matter trapped inside. It is possible that the rubber rotor on the valve is damaged. Replace the rubber rotor if necessary.
- The rotor may have rotated on the shaft. In this case it is likely that the entire valve shaft assembly needs to be replaced.
- Check the vial air hole to ensure that it is not blocked. Check the ports and tubes to ensure that they are clear of debris. Check the tubes for cracks or splits, replace them if necessary.
- Ensure that the push rod is properly assembled and that the air admission valve is closing properly. Check also that the flap valve inside the meter is closing properly. Replace the air admission assembly or flap valve assembly if they are not working.

The motor used to operate the rotary valve is of high quality and must be replaced by exactly the same type of motor. Under normal circumstances the motor will last for the useful life of the milk meter and does not require any service during the life of the milk meter. Similarly, the speed reduction gears inside the milk meter are known to have a very long service life and should not require any service during the useful life of the milk meter. However, there is a small possibility that the motor or a gear becomes dislodged somewhat from it's correct position, thereby failing to properly operate the rotary valve. Often such a failure is accompanied by a 'rattling' or 'grinding' noise while the motor runs.

- Check that the four screws of the gearbox housing have been done up properly and that the plastic bosses for the screws have not been stripped.
- Check that the small black worm gear is properly located on the motor shaft and is not touching any other plastic parts.

- Check for wear on the black worm gear and grey gear. If there is any wear on these parts they should be replaced (use 812451: Kit worm gear). These two gears must be replaced as a pair and both gears must be well lubricated. Recommended grease type is Loctite Super-lube, a synthetic multi-purpose lubricant with PTFE. Be careful so that no grease touches the white code wheel and the position sensor.
- Check that the soldered connection on the motor wires is sound.
- Check that the wires are not corroded and that there is no water damage on the PCB.
- Ensure that the optical position sensor is correctly located. Make sure that there is a 0.5mm gap between the sensor and the wheel and that the sensor is pointing straight at the wheel. Also make sure that when the gearbox cover is screwed down, the legs on the sensor do not short together. The optical position sensor may be faulty. Replace it if necessary.
- Check that the timing wheel is clean and undamaged. Replace if required.

STALE MILK or NOT WASHED

Message on Data Handler.	METER FAULTY STALE/OLD MILK	Empty the flask by unclipping it from the body. Clean the probes.
	METER FAULTY NOT WASHED	Ensure that the milk meter is clean.

The milk meter detects electrical connections between the two stainless steel probes inside the flask. It is important that there is nothing wedged between the two probes and that the flask surface is clean, especially at the bottom where the two probes pass through the plastic.

INTERNAL FAULT

Message on Data Handler.	METER FAULTY INTERNAL FAULT	Return to a Service Centre. The electronics have a fault.

This error message indicates that some critical information stored in the internal memory of the milk meter has been lost or is incorrect. The milk meter should be returned to Tru-Test Ltd. for further investigation. Although it is possible to override this error message by pressing the Finished Milking key, the fault will not be automatically cleared and will show again the next time the milk meter registers with a Data Handler.

Sometimes this message is displayed after the EMM has experienced a rotor problem. Try over-riding the fault and note the messages displayed on the Data Handler. Check that the cam rotates and then stops in the milk position. If the milk meter now appears to be functioning, calibrate and MTR the milk meter before returning to use.

DISABLED

Message on Data Handler.	METER FAULTY DISABLED	The operator has disabled the milk meter for some reason.

If the reason why the meter was disabled is known and the problem has been corrected, then press the Finished Milking key to override the fault. The milk meter should continue with normal operation after that and the error message will automatically be cleared.

OTHER PROBLEMS

Inaccurate milk yield results. Milk Meter does not turn on. Milk Meter does turn on but does not register with the Data Handler. Can not turn the milk meter off. Milk Meter does not respond to keys. Milk Meter behaves in unusual way.	For all of the problems listed here, first follow the suggestions in the Troubleshooting section in the 'Operating instructions'.

If suggestions in the Troubleshooting section in the 'Operating instructions' do not solve the problem, check the following.

- Ensure that the probe connection is sound. Re-solder this if necessary.
- Check that the keypad is not damaged in any way.
- Check that the connection to the aerial is sound. Re-solder this if necessary.
- If the EMM is unresponsive it is possible that it is still registered to another Data Handler. Hold down the Select key for 5 seconds to manually turn the EMM off.
- If none of these suggestions solve the problem, then it is possible that a component on the main PCB is faulty.
- It is also possible that water has found its way into the electronics compartment.

WATER DAMAGE

When water has entered into the electronic compartment then the milk meter will almost certainly give problems. Water will very quickly cause damage to the electronic components inside the milk meter that can not be repaired. When it is suspected that water has entered the electronics compartment of a milk meter then that milk meter should be inspected **at the earliest possible opportunity** to limit the amount of damage due to corrosion inside the milk meter.

Closely inspect the main PCB for signs of corrosion and water damage. Telltale signs of water damage are black or dark areas under the green solder mask on the main PCB and/or white or blue powdery deposits on the soldering of the electronic components. If only a few small and isolated spots of white or blue corrosion products are found then it may be possible to dry and clean the main PCB and re-use it in a milk meter. If there are many such spots with corrosion and/or the dark areas are extensive then the main PCB will be unreliable and must be discarded.

Finding the location and cause of the water leak can be difficult and uncertain. If the water leak can be clearly identified then it is possible to repair the milk meter. If the reason for the water leak is not found or uncertain then the case should no longer be used.

Tru-Test EMM flashing light error codes

The three red lights on the front of the milk meter are used to provide basic information for the user. For the meaning of the various lights during normal use of the milk meter refer to the 'Operating instructions'. If the milk meter does not seem to operate normally and the red lights on the milk meter flash in an unusual way refer to this list to identify the problem and how to resolve it:

1. When the milk meter is placed on a charging bracket all three lights flash on and off repeatedly:  .

This can also be seen sometimes when the meter is OFF and is then turned on by pressing a milk meter key and the key is held down. A meter in this state will not register with a Data Handler. The flashing lights indicate that the information in the internal memory of the milk meter has been corrupted. For example this can occur when the user has attempted to upload new software into the meter but the upload process failed or did not properly complete for some reason.

To resolve the problem, upload new software into the meter.

If the software upload process fails repeatedly then it is possible that the internal rechargeable battery does not hold sufficient charge. In this case charge the meter first by placing it onto a charging bracket. Charge the meter for at least 15 minutes (and ignore the three flashing lights while charging) before attempting to upload new software.

2. When the milk meter is turned on the left light alternates with the other two lights as shown here:  .

This is the most common flashing code. The flashing code indicates that the internal battery does not have sufficient charge left.
To resolve the problem, properly recharge the milk meter. If charging the meter does not fix the problem then first check that the charging bracket and power supply are operating properly. If the problem persists then it is possible that the internal battery has developed a problem and needs to be replaced.

3. When the milk meter is turned on the centre light alternates with the other two lights as shown here:  .

Only software versions 3.1c and earlier will show this flashing code. A milk meter that shows this flashing code has re-started too many times without registering or entering charge mode. A common cause for this is when the meter has been transported in a way where one of the keys pressed against another object and vibrations have turned the meter on repeatedly.

To resolve the problem, simply recharge the meter.

Downloading data and the log-file from a Tru-Test EMM.

The Tru-Test EMM records milk yield data and stores this information in the internal non-volatile memory. It is possible to download the recorded information from the milk meter at a later time, after the milking session has ended. This can sometimes prevent data from getting lost if the Data Handler, which is normally used to transfer the information, has developed a problem (or is broken or lost). Contact Tru-Test Ltd. for the correct procedure on how to recover collected data from milk meters.

In addition to keeping records of milk yield data, the milk meter also stores a log-file in non-volatile memory. In the log file many different things are recorded. This includes such information as the date and time when the milk meter registers with a Data Handler, information about the state of charge of the battery and the battery voltage, the duration a milk meter was turned on, the duration a milk meter was being charged, error messages, etc.

The log-file can sometimes be used as an aid in troubleshooting because it contains information on what exactly the milk meter was doing when the fault occurred as well as the history immediately prior to the fault.

If the milk meter has run its battery flat charge it for approximately 30 minutes before attempting to download the log-file.

To download the log-file place the milk meter on the special charging bracket with serial data communications interface (the same one also used for upgrading the milk meter software). Connect the bracket to a serial port (usually COM1 or COM2) of a PC. Apply power to the bracket. Use one of the following programs to communicate with the milk meter.

Information in the log-file is arranged in chronological order with the most recent events at the end of the file.

Hyperterminal.

Start a program called ‘Hyperterminal’ on the PC. This program comes free with Windows software, you should find it by clicking on ‘Start’, ‘Programs’, ‘Accessories’, ‘Communications’, ‘Hyperterminal’.

Once the Hyperterminal program has started select ‘Direct to COM1’ (or COM2 as appropriate). Click on ‘File’, ‘Properties’ to access the settings. The COM port settings should be: 19200 bits per second, 8 data bits, no parity, 1 stop bit, no flow control. Also in the settings screen, click on the ‘ASCII setup’

button and check the box ‘echo typed characters locally’. Click ‘OK’ to close the settings screens.

Turn a Data Handler on and register the milk meter.

You should now be able to send and receive information to/from the milk meter via the PC. Type {ZA1}, you should see a ^ character appear directly after the closing curly bracket. This is the acknowledge character from the milk meter and shows that the PC and the milk meter are able to communicate via the serial cable.

Click on ‘Transfer’, ‘Capture text’ and enter a suitable file name such as E02301log311207.txt . Everything you type in and everything the meter sends will now be saved on the PC in the file with the specified name. T

Type {WFL}. The meter will respond with downloading the contents of the entire log-file. Once transfer of the log-file is complete click on ‘Transfer’, ‘Capture text’, ‘Stop’ to end the process and close the file.

You can view the log-file using any text editor such as Notepad, Wordpad or Word.

MacroTerm

MacroTerm is available from Tru-Test. For a picture see page 46.

Start MacroTerm and type the following commands into the text fields on the left hand side of the window. For a more complete list of SCP Commands with descriptions see Common SCP Commands on page 34.

button 1 {ZA1}

button 2 {ZE1}

button 3 {STAYON}

button 4 {VS}

button 5 {WFL}

button 6 {TTOF}

Press the buttons in sequence to send the commands to the milk meter. Be sure to press buttons 1 to 3 within 2 seconds of opening the COM port.

When the log-file download is complete, select all of the text in the main window and copy it to a text editor such as Notepad, Wordpad or Word. Save the file before exiting the program.

Disassembly of the Tru-Test EMM.

The following procedures describe how to dismantle the Tru-Test EMM. In many cases problems can be solved without needing to follow all the steps.

1 Disconnect the flask drain tube from the nipple on the milk meter outlet.

2 Using a flat blade screwdriver of appropriate size, carefully open the flask clips.

3 With one hand gripping the electronics' case and the other gripping the milk meter body, pull the two assemblies apart. Note that the push rod that operates the air admission valve may fall out at this time depending upon the orientation of the milk meter.

Disassembly of the Tru-Test EMM body (upper parts).

Refer to the 'Operating instructions', on how to service the wash valve and air admission valve assembly.

To clean the upper parts of the EMM, push the metal clip off the very top of the milk meter and lift the top off. Note that the top will only fit in one particular orientation and must have the o-ring fitted. When cleaning the milk meter internal surfaces be very careful not to damage or in any way change the shape of the nozzle located in the top of the milk meter, as this component is critical to the milk meter accuracy.

Disassembly of the electronics compartment.

All work with the electronics compartment of the Tru-Test EMM open must be performed with appropriate measures to eliminate electrostatic discharges. Electrostatic discharges (static electricity) can cause damage to delicate electronics components that are used inside the milk meter. Use a workbench with an anti-static top. An earthed wrist-strap should be used when handling the circuit board assemblies. Anti-static floor mats are recommended.

The working area of the bench top should be clean and dry.

Disassembly and re-assembly up to and including point 10 can be performed without having to re-calibrate the milk meter.

1 Pull the push rod out of the case assembly and put to the side.

2 Disconnect the flask drain tube from the valve, pull it out of the case and put it to one side.

3 While pushing the arm on the rotary valve towards the milk meter case, carefully rotate the valve clockwise (looking from the back), until the transfer tube disconnects. The transfer tube is the short tube between the flask bottom outlet and the rotary valve.

4 Pull the rotary valve away from the body and put to the side.

5 Undo the two case screws on the front of the milk meter electronics case and put to one side. Notice that the case screws have small rubber o-rings fitted.

6 Undo the four case screws on the back of the milk meter electronics case and put to one side. Notice that these screws also have small rubber o-rings fitted. Hold the front lid of the case together with the case back because the front case lid will now become loose.

7 Facing the front of the milk meter, carefully lift the front lid off the case back (just a little) and rotate it towards the left of the milk meter. You will notice that the front case lid is still connected to the case back via a short flexible circuit that connects the keypad to the printed circuit board. Gently pull the flexible circuit out of the connector that is mounted on the printed circuit board.

Caution: Read fully through the following steps before attempting to disassemble milk meter any further as the milk meter contains delicate components that can be damaged if the proper procedures are not followed.

8 If working on a 434MHz milk meter, use a small soldering iron to disconnect the wire that is soldered to the very top of the main PCB. Do not overheat the PCB or the wire. This wire connects the RF antenna to the main PCB.

9 Undo the five screws that attach the main printed circuit board (PCB) to the case back.

When proceeding with points 10 and further the Tru-Test EMM must be re-calibrated after re-assembly before it can be used again on a farm.

10 Carefully lift the main PCB up from the case bosses a little and rotate it towards the left. **Do not use force as you might damage components such as the barcode sensor!** If there is considerable resistance against rotating the main PCB then probably you will need to push the black plastic lens assembly (covering the red window) away from the sensor on the main PCB.

11 Take the two desiccant packs out.

12 Lift the black plastic barcode lens assembly out of the case back (if fitted).

13 You will notice there are many wires that connect to the main PCB, which will prevent the main PCB from rotating to the left very far. Taking care not to damage any of the wires and connectors, disconnect the wires from the main PCB one by one. You may want to use small long-nose pliers for this, but make sure **never** to pull on individual wires as they may break. The best order of disconnecting the wires is:

RFID reader wires (7 way loom) OR Barcode illumination wires (green and orange)

Sensor coil cable (shielded cable with four way connector and black heatshrink)

Battery wires (red and black)

Motor and position sensor wires (seven way connector)

Charging wires (red and black)

Probe cable (shielded cable with four way connector and red heatshrink)

Take note of the correct locations and orientations of the various connectors as this will make re-assembly of the meter much easier.

14 When all wires have been disconnected from the main PCB, lift the PCB away from the case back and place it to one side, preferably in an anti-static bag. Be careful not to touch or scratch the glass surface of the barcode sensor.

15 If fitted with an RFID board, remove the 2 screws holding it. Lift it out, being careful not to damage the RFID antenna board or the 4 pin connector joining them.

16 Undo the two screws that hold the aluminium strap over the battery pack. Lift the aluminium strap and the battery pack out of the case back.

17 Undo the other two screws that attach the gearbox cover to the case back. Lift the gearbox cover up and place to one side. The motor and two of the plastic gears (red and grey) now become loose. Take the red and grey gears out of the case back.

18 Hold the cam that operates the push rod between two fingers and undo the screw that attaches the gear and brass spacer to the rotary valve shaft. Lift the brass spacer and the green gear off the valve shaft.

19 Pull the black and white position sensor code wheel off the rotary valve shaft. If it is tight then you can use something that is blunt and made from soft plastic (e.g. the back of a large screwdriver) to push the valve shaft down until the code wheel comes loose.

20 Lift the optical position sensor out of its seat and place the motor-sensor-loom assembly to the side.

21 Push the rotary valve shaft out of the ball bearing.

At this point the milk meter is almost fully disassembled.

The flask and probes are permanently attached to the case back and can not be taken apart.

The ball bearing for the rotary valve shaft normally lasts for the useful life of the milk meter and does not require regular maintenance. The outer surface of the bearing may look rusty, but it is normally only surface rust and does not mean that the bearing will seize or that sealing is impaired.

The barcode illumination PCB is also permanently attached to the case back by means of a steel clip and glue, although it is still possible to remove the illumination PCB with care.

Re-assembly of the Tru-Test EMM:

In most cases the components of the EMM will still be mostly together. Start re-assembly from the appropriate point.

Re-assembly of the EMM body (upper parts).

Refer to the ‘Operating instructions’.

Re-assembly of the electronics compartment.

When inserting thread forming screws into plastic parts that have been used before (case front lid, case back, rotary valve shaft) then first rotate the screws backwards a little until you feel the screw fall into the old thread. This ensures the screw follows the old thread rather than cut a new thread, which preserves the strength of the plastic boss.

1 If the rotary valve shaft ball bearing is taken out of the case back it must be replaced with exactly the same type or else the milk meter may quickly fail due to water corroding the delicate electronic circuits inside the electronics compartment. The ball bearing is a waterproof sealing type. Apply a small amount of non-corrosive silicone rubber sealing compound (Dow Corning 1080 RTV is recommended) to the outer surface of the bearing and the plastic surface of the bearing cavity in the case back. Push the waterproof ball bearing into the cavity on the case back. Ensure the bearing is fully pushed down against the case wall.

2 Leave the silicone rubber compound to cure overnight.

3 After curing, use iso-propyl-alcohol (IPA) to clean the outside surface of the bearing. Use a pair of tweezers to place the thin plastic cover over the ball bearing.

4 The rotary valve shaft must have a small black rubber o-ring fitted in the groove just below the cam that operates the push rod. Lightly smear the inner end of the shaft with silicone grease and push the rotary valve shaft into the ball bearing from the outside of the case.

5 The rotary valve shaft and the black and white valve position code wheel each have a locating feature so that the code wheel only has one correct position on the shaft. Carefully line up the locating features and place the black and white valve position code wheel onto the valve shaft. The white face of the code wheel should be visible. Make sure the black and white surfaces of the code wheel are clean and bright.

6 Place the optical position sensor in its seat directly beside the code wheel. Notice that the sensor is round with one side flat. The flat side of the sensor should be positioned upwards (towards you as you look down onto the case back assembly).

7 Ensure that the black worm gear is pushed fully home onto the motor shaft. The motor case must have three large black o-rings fitted. An 8 x 12mm piece of self-adhesive rubber foam must be stuck to the motor directly beside the motor shaft with worm gear. Place the motor in the case back, so that the three o-rings fit between the ridges of the case back. The rubber foam piece must push against the blind plastic boss of the case back. The green motor wire should be at the bottom of the case back, the orange wire should be closest to you.

8 Place the green gear on the valve shaft on top of the position code wheel.

9 Fit the self tapping screw through the brass shaft spacer and fit the brass spacer and screw onto the rotary valve shaft. Ensure the screw is tight and the spacer sits straight (the spacer should not wobble side to side when the shaft is rotated).

10 Fit the small grey gear and then the red gear into the case back. Apply a small amount of grease to all of the four small plastic gears. Recommended grease type is Loctite Super-lube, a synthetic multi-purpose lubricant with PTFE. Be careful so that no grease touches the white code wheel and the position sensor.

11 Place the transparent gearbox cover over the gears. Ensure that the shafts of the grey and red gears fit into the openings of the gearbox cover and that the motor is properly in place. While pushing down onto the gearbox cover, attempt to rotate the cam in both directions. When all the gears and the motor are in the right positions you will not be able to rotate the valve shaft except for a small amount of gear backlash. The backlash allows you to see if the gears are free to rotate.

12 Place the two lower screws into the gearbox cover.

13 Place the battery pack into the case back with the battery wires in the lower left corner. The orange and green motor wires should pass underneath the battery pack. If replacing the battery, note its capacity as this may need to be programmed into the EMM. See page 55.

14 Place the aluminium strap over the battery and fit the two screws.

15 Before fitting the main printed circuit board (PCB), please note that PCBs and 'flask bases' form matched pairs. When re-fitting the original PCB to the base then continue directly with point 16. However, when replacing the original PCB with a different PCB then the new PCB must first be fitted with the correct 'sensor coil tuning capacitors'. The required value of the 'tuning capacitors' is written with permanent marker pen inside the base. Provided on the rear-side of the main PCB are two sets of solder pads for fitting one or two tuning capacitors, marked in the photo by the circle. Fit only surface mount type ceramic capacitors of the correct value (as written in the base) and with the following specifications: Dielectric material type NP0 or C0G, size 0805, tolerance 5% or lower. When soldering use a small soldering iron with controlled temperature and fine

tip. Take care not to overheat the capacitors. (Note: the capacitors must be fitted 'vertically'.)

16 Lead the valve position sensor wires and the charging wires through the narrow gap between the middle left case boss and the left side wall of the case back. Use a small piece of rubber foam to hold the wires in place.

17 If required, place the black plastic barcode reader lens assembly into the case back.

18 Otherwise place the RFID board into the case back and screw into position using 2 screws.

19 Attach the wires to the main PCB. Note that all connectors will only mate in one orientation. The best order of connecting the wires is:

A: Probe cable (shielded cable with four way connector and red heatshrink)

B: RFID loom OR

C: Barcode illumination wires (green and orange)

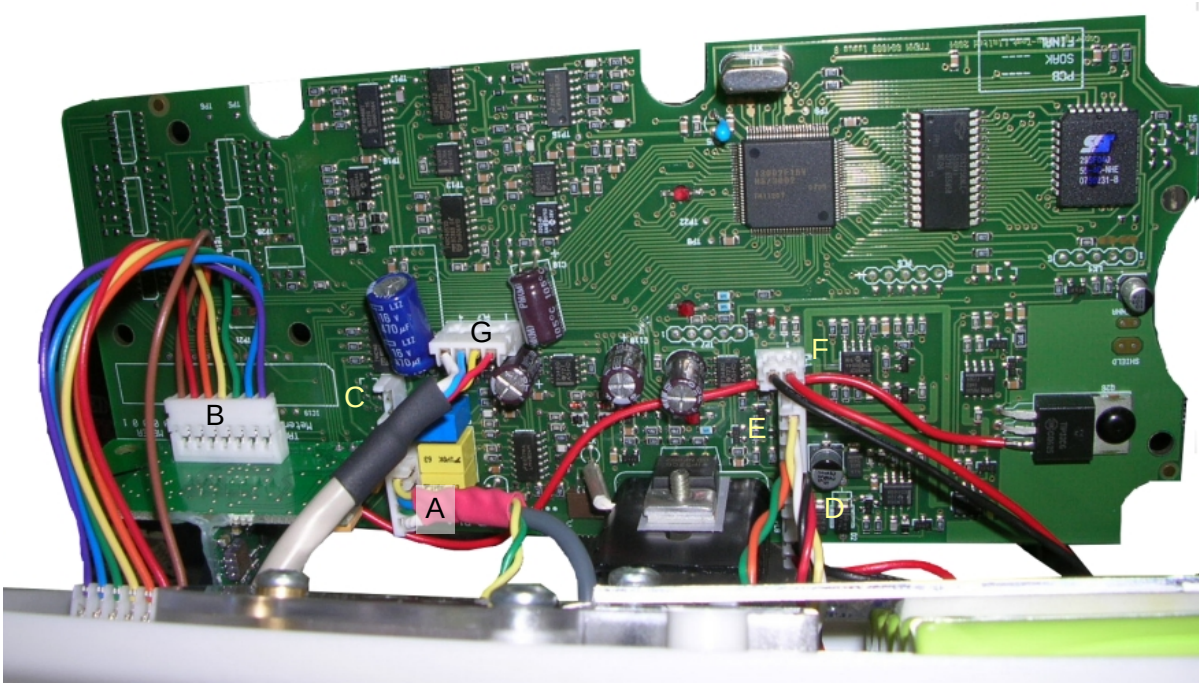
D:Charging wires (red and black), these go to PL8 directly beside the heatsink.

E: Motor and position sensor wires (seven way connector)

F: Battery wires (red and black), these go to PL1 nearest to the microcontroller.

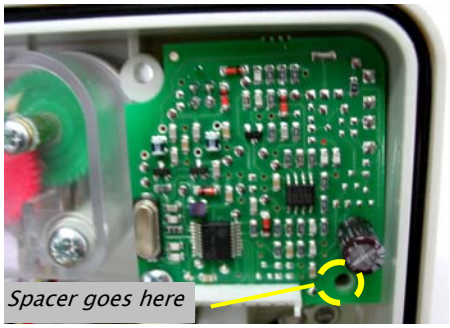
G: Sensor coil cable (shielded cable with four way connector and black heatshrink)

Make sure the charging wires and the battery wires have not been swapped!



20 Place two fresh packs with desiccant in the case back. One pack lies on the right side of the battery pack, beside the aluminium strap. The other pack is to go between the three bosses of the barcode reader lens assembly, **or** on top of the gearbox housing ensuring that it is not sitting on the RFID board. The silica balls in the desiccant pack should be clear or blue.

21 If repairing an RFID milk meter, place the RFID spacer in the position shown.



22 Gently place the main PCB onto the two case bosses (at the top) and the barcode reader lens assembly (if fitted). The barcode sensor should easily fit into the opening of the lens assembly without requiring any force.

23 Ensure no wires are trapped or under stress.

24 When the main PCB properly rests onto the bosses fit the five screws (barcode version) or three screws (RFID version).

25 For a 434MHz milk meter, use a small soldering iron to solder the antenna wire to oval shaped solder pad at the top of the main PCB. Solder quickly but securely.

26 Use small long nose pliers to hold the end of the flexible circuit coming from the keypad on the case front lid. Hold the case front lid in the other hand and gently insert the flexible circuit into the connector on the main PCB. Note that the flexible circuit should not have any twists or the keypad may not function properly. While inserting the flexible circuit the milk meter may turn on and flash the red LED's. This is normal and will not damage the milk meter.

27 Push the excess length of the flexible circuit down between the main PCB and the side of the case back and place the front case lid onto the milk meter. Ensure the flexible circuit is not trapped between the case back and the lid.

28 Insert the two case screws on the front and four case screws at the back. Note that all six case screws must have small rubber o-rings fitted. Wind the o-rings to the head of the screw before inserting the screw in the case. The o-rings are necessary to maintain a waterproof seal of the electronics case. If any of the o-rings on the case screws is damaged or missing then fit a new o-ring of the same type. The correct torque setting for the case screws is 0.9Nm.

29 At this point it is advised to test the functioning of the electronics of the milk meter. Refer to the Work instruction document "EMM Base Functional Test" (copy on page 36.) Turn on a Data Handler. With the milk meter held 2 to 4 meters away from the Data Handler turn the milk meter on. The red lights on the milk meter should flash and the red light on the Data Handler should illuminate. If the Data Handler reports any particular problem then press the Finished Milking key on the milk meter to override the fault. The milk meter should register with the Data Handler and operate the rotary valve. The valve should rotate smoothly without making any 'grinding' noises. The Data Handler should not report any problems (unless the main PCB needs to be calibrated or certain fault flags may need to be cleared).

30 When the milk meter has registered and operated the rotary valve, press the Select and Finished Milking keys each a couple of times. Each time a key is pressed the red lights on the milk meter should briefly flash.

31 Turn the milk meter off using the Data Handler and then press Select on the milk meter.

32 If the milk meter fails to complete the tests described above it may be necessary to open it up again to correct the problem. If the milk meter appears to operate properly then proceed with the remainder of the normal re-assembly procedure as described in the ‘Operating instructions’.

If at any time the main PCB has been taken out of the case, the milk meter must be re-calibrated before using it on a farm.

Detailed Electronics Trouble-shooting and repair

The following pages contain additional information for the detailed trouble-shooting and repair of certain aspects of the electronics in the EMM.

These items may be added to from time to time.

In this version the following topics are covered:

Common SCP Commands

Meter	{ZA1}	Turn acknowledgments on
	{ZE1}	Turn error codes on
	{ZC1}	Turn carriage return, linefeeds on
	{STAYON}	Disables auto-power down
	{TTOF}	Turn off
Meter Diagnostics	{CONFIG}	Read back all config items
	{CRALL}	Read back all 64 calibration points
	{WFL}	Write full log
	{WFLF}	Write last farm log
	{WEFL}	Write whole error flash log
	{ZN}	Device name
	{VS}	Serial number
	{VE}	Manufactured date
	{VW}	Software Version
	{VD}	Software date
	{VT}	Software time
	{VE}	Manufacture date
	{VP}	PCB revision
	{VQ}	PCB serial number
	{VC}	Communications version
	{VBT}	Battery capacity
	{NORDICVER}	Nordic device s.w. version.
	{PROGAVR}	Programme AVR firmware
	{TTLDn}	LED test (n: 0=off, 1=Select LED, 2=Battery LED, 3=EOM LED)
	{NS5}	Move motor 5 positions (1 revolution)
	{MRT}	Time of last motor movement given by {NS_} command

		(msec)
	{TTBB}	Returns barcode, and valid scan frequencies
	{RFVIALID}	Test RFID read, returns read error and tag UID
Error codes	No error messages are returned unless the {ZE1} command is switched on	
	(FF)	Invalid checksum or CRC
	(FD)	Command unknown (by this device)
	(FC)	Improperly formatted address
	(FB)	Improperly formatted command
	(FA)	General syntax error
	(F9)	Out of range parameters
	(10)	Parameter mismatch
	(11)	Parameter string too long
	(12)	Parameter expected
	(13)	Too many parameters
	(14)	Command could not be executed at this time
	(15)	No “Other Device” response

EMM Base Functional Test

F:\projects\....\workinst**EMM Base Functional Test**
29 July, 2009

Subject: *EMM Base Assembly* Operation: *Functional Test*

Issue	C.N. No.	Prepared	Approved	Date
2	03/262C	C. Kinley		05/01/2004
No copies allowed without Quality Department approval.				

Important Steps in the Operation	*Key Points*
A logical segment of the operation which substantially advances the work	Anything in a step that might make or scrap the work, injure, make the work easier to do, i.e. knack, trick, special timing, special information.
No variation from these instructions is permitted	

Required: Data Handler	
1) Turn the data handler on.	
2) Press Select to turn the meter on.	• This is the LH of the two pads when viewing the meter from the front.
3) Watch the data handler display. The data handler should beep and display **METER FAULTY** **INTERNAL FAULT**	
4) Press the end of milking key to override the internal fault.	• This is the RH of the two pads when viewing the meter from the front.
5) The camshaft should start to rotate. Check that it rotates in an anti-clockwise direction.	• This is when holding the meter upright and viewing the meter from the rear.

6) Check that the cam stops briefly at the drain position (11 O'clock) and then the wash position (10 O'clock) before rotating and stopping in the milk position (4 O'clock)	
7) On the data handler press "State" then "Meter Off", then press the Select key on the meter to shut down the meter.	• This is the LH of the two pads when viewing the meter from the front.
8) The meter should now motor to drain position (11 O'clock) and then to the stir position (2 O'clock) before shutting down 90 seconds later.	
9) Turn the data handler off.	

Tilt Sensor

Identifying tilt sensor assembly problems

The meter tries to correct the yield based on the amount of tilt the meter is on. Noticeable tilt assembly problems usually cause significant changes to the reported yield.

Correct tilt sensor operation can be checked manually by using SCP commands.

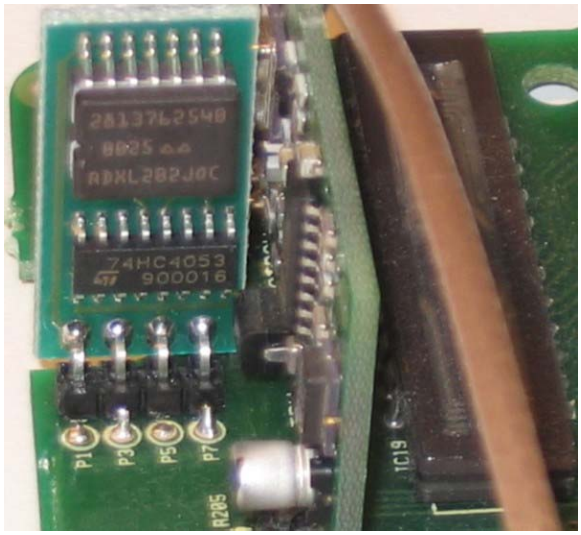
Place meter in normal upright position.

Send the following commands to the meter:

{RAWXTILT} // returns x axis tilt.
{RAWYTILT} // returns y axis tilt.

The tilt assembly is a dual axis accelerometer. These commands return a result from 0-10230.

Tilt Assembly MDC00013 used on PCAs manufactured prior to Jan 2005



With the meter in the normal upright position the value should be between 2557 – 7673. The nominal value is 5115.

Verify that the upright position is near the factory calibrated values.

{XTILTZ} // returns factory calibration value of upright X axis
{YTILTZ} // returns factory calibration value of upright Y axis

Tilting the meter 90° in one plane only will change the above value by 1023 – 1535 counts. This is the gain for a 1g change in static tilt.

Verify that the gain is near the factory calibrated values.

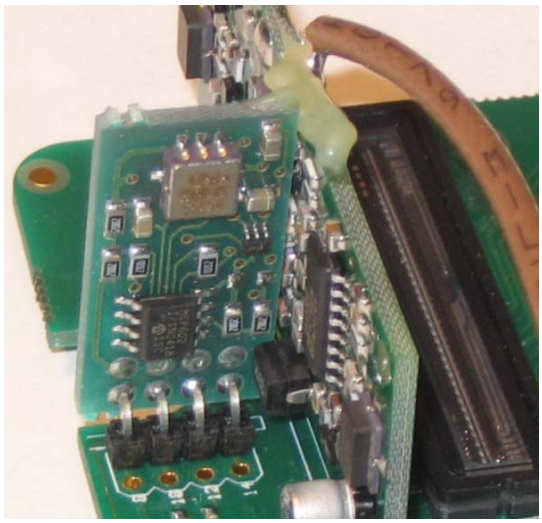
{XTILTG} // returns factory calibration X axis gain value
{YTILTG} // returns factory calibration Y axis gain value

If any of these checks are more than 200 counts difference or the:

{RAWXTILT}
{RAWYTILT}

SCP commands return values near 0 or 10230, the tilt assembly can be deemed faulty. In this case the complete EMM pcb assembly will need to be replaced and returned to a Level 3 Service Centre for repair.

Tilt Assembly used on PCAs manufactured after Jan 2005



With the meter in the normal upright position the value should be between 4910 – 5320. The nominal value is 5120.

Verify that the upright position is near the factory calibrated values.

{XTILTZ} // returns factory calibration value of upright X axis
{YTILTZ} // returns factory calibration value of upright Y axis

Tilting the meter 90° in one plane only will change the above value by 3965 – 4471 counts. This is the gain for a 1g change in static tilt.

Verify that the gain is near the factory calibrated values.

{XTILTG} // returns factory calibration X axis gain value
{YTILTG} // returns factory calibration Y axis gain value

If any of these checks are more than 200 counts difference or the:

{RAWXTILT}
{RAWYTILT}

SCP commands return values near 0 or 10230, the tilt assembly can be deemed faulty. In this case the complete EMM pcb assembly will need to be replaced and returned to a Level 3 Service Centre for repair.

Configuring MDC00013 Tilt assemblies

To set TILTTC
E.g. If this value is 10 send the following SCP command

{TILTTC10} // set Tilt temperature compensation to +10PPM/°C

To set XTILTG
E.g. If this value is 1320 send the following SCP command

{XTILTG1320} // set X axis tilt gain to 1320 counts

To set YTILTG
E.g. If this value is 1355 send the following SCP command

{YTILTG1355} // set Y axis tilt gain to 1355 counts

Once meter PCA is assembled back into a meter, it must go through the calibration rig. This will set the actual upright tilt positions.

Configuring current Tilt assemblies

The current tilt sensor will have to be set as follows:

{TILT1} // ensure tilt function is still enabled

{TILTTC0} // set tilt temperature compensation value to zero

{XTILT4100} // set tilt X axis gain to 4100 counts

{YTILTG4100} // set tilt Y axis gain to 4100 counts

{XTILTZ5120} // initialise upright X position to default value

{YTILZ5120} // initialise upright Y position to default value

{VMS65} // Sets manufacturing flags for PCA & tilt calibration rig compatibility

Once the meter PCA is assembled back into a meter, the meter must go through the calibration rig. This will set the actual tilt upright positions.

Identifying Rail Splitter Problems

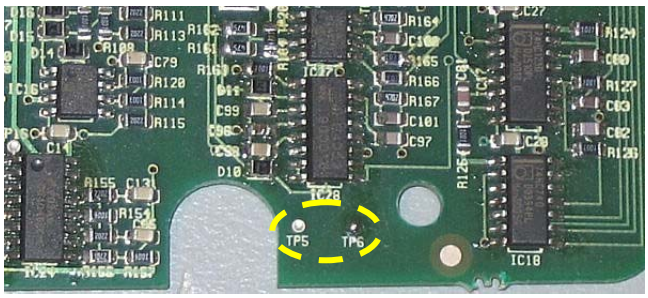
The following is only applicable to Issue 6C PCAs and below. These earlier main PCAs have a rail splitter daughter board located above PL7. The most common faults are the solder connections from the rail splitter assembly to the main board.

Meter PCA Issue 7 or greater do NOT have a rail splitter assembly.

Rail splitter issues usually manifest themselves as too low or too high of a yield. The rail splitter nominal +2.425V output is the bias point for the analogue measurement circuit.

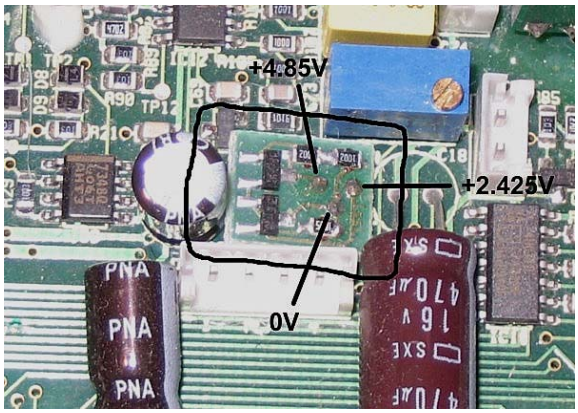
1 Power up the meter PCA.

2 Find a reference ground point such as TP5 or TP6.

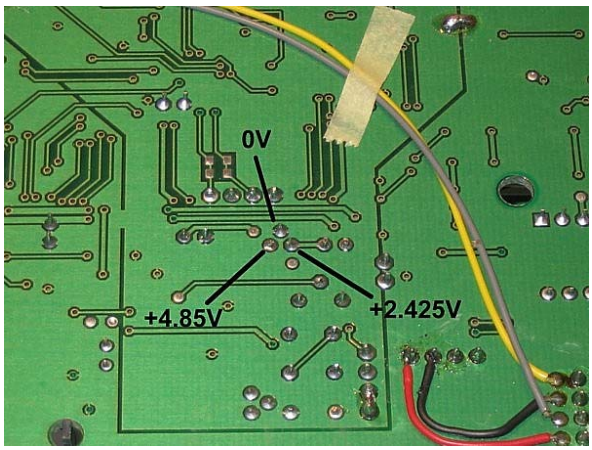


GND reference points

3 Power up the PCA and probe between TP5/TP6 using a voltmeter and the following:



Rail splitter top Side



Rail splitter Bottom Side

These should measure within the following ranges:

0V	- between -0.1 to +0.1V
+2.425V	- between +2.37 to +2.47V
+4.85V	- between +4.75V to +4.95V

If not in range, the complete EMM pcb assembly will need to be replaced and returned to a Level 3 Service Centre for repair.

Barcode Problems

There are a number of items to check as the barcode system includes optics and an illumination system to read bar coded vials.

Checking Barcode Reads

Using a Data Handler with a communication bracket, a meter can be configured to read barcodes. To do this SCP commands will be sent over a RF link to a registered meter.

1 Place Data Handler on a communication bracket. Turn it on.

2 Using MacroTerm (available from Tru-Test). Type the following into the window:

button 1 {ZA1}

button 2 {ZE1}

button 3 {ODL1}

button 4 {RM}

button 5 {OD41}

button 6 {41ZA1}

button 7 {41VW}

button 8 {41BF}

button 9 {41TTBB}

3 Open the appropriate COM port and click on the buttons 1 to 3 in order.

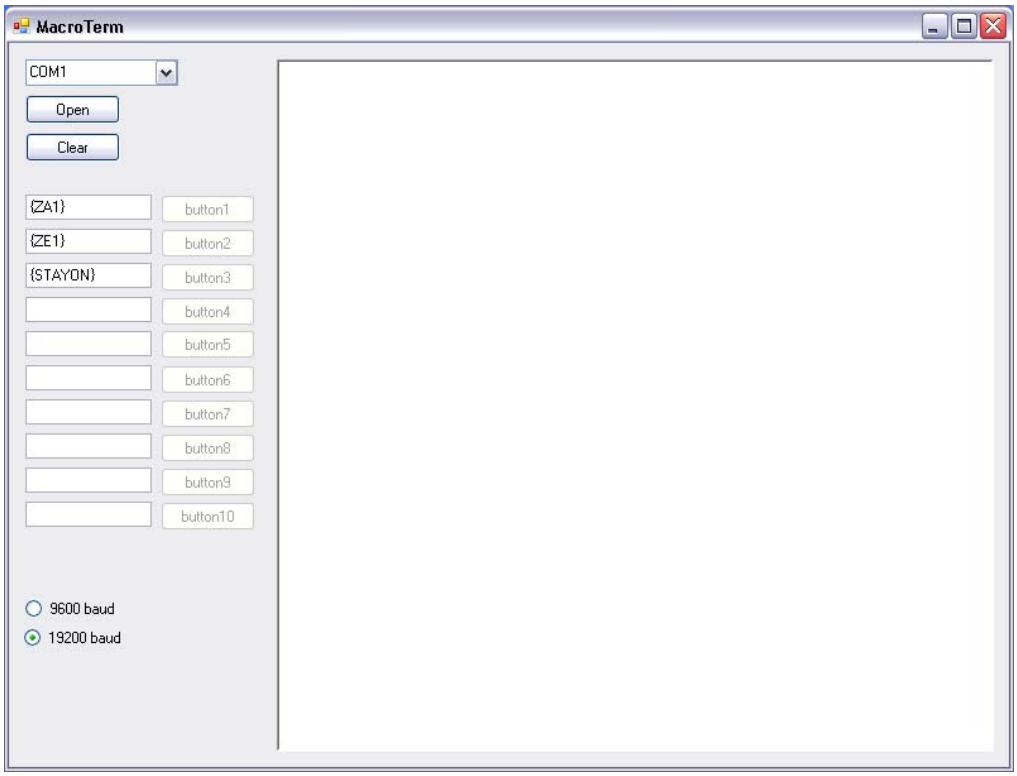
4 Turn on a meter. Place a barcode vial onto the vial holder.

5 Once the meter has registered, click on buttons 4 and 5.

6 The command in buttons 6 – 9 will now interrogate information specific to the meter.

7 Click on button 9. This SCP command will attempt to read a barcode. The first field returned in the window is the barcode number; the second field is a decimal value of the number of read speeds. Converting this number into binary, the set bits will correspond to a particular read speed the system was able to read the barcode at. There should be at least 2 bits set ie the system could read the barcode at 2 different read speeds. 1 bit or less indicates potential problems for the meter reading barcodes.

MacroTerm



Use the following checks as a guide for diagnosing barcode read problems.

Basic Checks

1 Check that the CCD device, lens mirror assembly and barcode window is grease, scratch and dirt free.

2 Check that all 6 LEDs on illumination assembly turn ON. This can be checked by pressing the Select key when the meter is OFF. LEDs are arranged in 3 banks of 2. This means that LEDs will drop out in pairs of 2. Losing 1 bank of LEDs is enough to prevent the system reading a barcoded vial successfully.

3 If some LEDs are faulty replace the complete EMM pcb assembly and return the faulty part to a Level 3 Service Centre for repair.

RFID Problems

The loom running between the main PCA and the RFID PCA is most likely the cause of any RFID reading or writing problems.

Improperly updating the EMM software may mean that the RFID reader stays on and over-heats. When updating EMM software ensure that the process has completed before removing the EMM from the serial interface unit. Once the update has completed, remove the EMM from the serial interface unit so that it does not receive extraneous commands.

Basic Checks

Check that the wires are fixed at each end. Check the continuity of each strand. The resistance should be less than 0.5Ω.

Visually check the RFID PCA for components that are damaged.

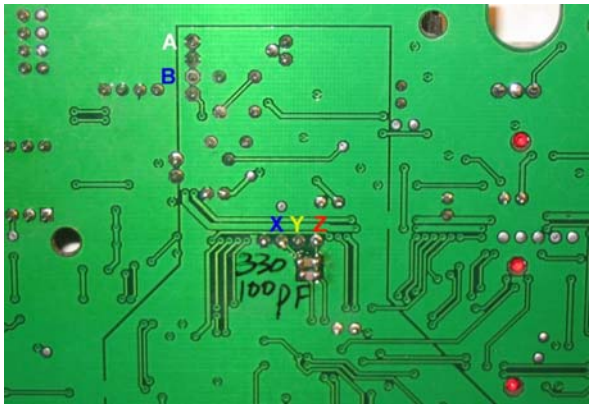
Ensure that the dessicant pack has not been incorrectly located and melted onto the RFID PCA.

Yield Measurement Issues

There are a number of possibilities for yield related issues. It is important to note that many yield related problems can also be of a mechanical nature. It is easier to diagnose these problems by running these meters firstly on the Calibration rig and then on the MTR rig. The Calibration rig calibrates the volume measurement of the proportional sample separated off by the meter body during milking. Meters that fail this rig can be categorised as having a problem with the electronics. Some checks associated with the electronics are detailed on the following pages.

The MTR records what proportion of the yield is separated off and stores it in the meter for use in yield calculations. Meters that fail this test are likely to have a mechanical related problem. These are detailed in the table on page 53.

Probe loom pins and capacitor tuning location on PCA



Probe Counts do not increase as volume increases

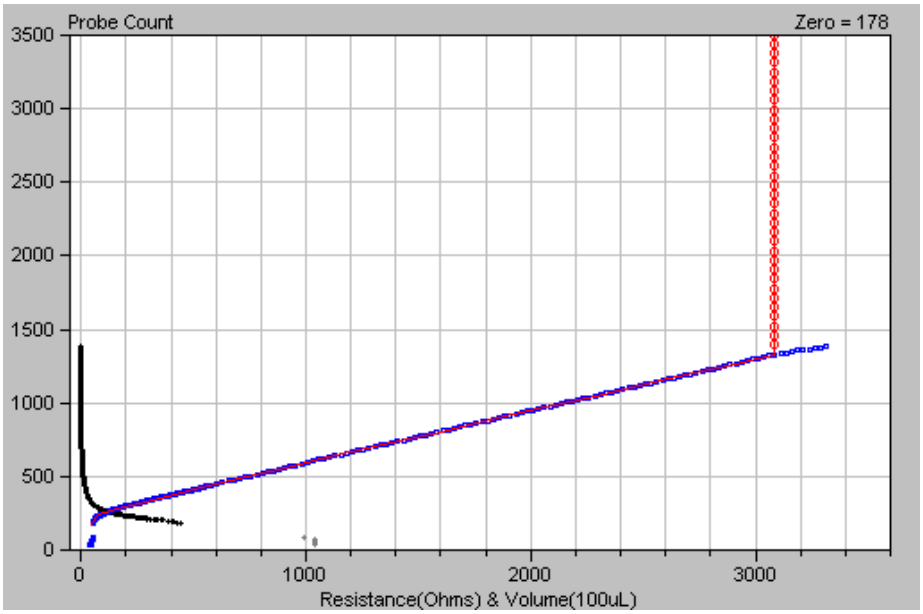
This problem is characterised on the Calibration rig, by a flat blue line (probe counts vs volume curve).

Check probe loom connections	Short out both probes with a solid metallic object. Check that the resistance reading across WHITE & BLUE wires (A & B, page 48) of the excitation probe loom measures less than 10Ω.

Note the PCA does not have to be removed to check this.

- If measured resistance is greater than 10Ω, check that the excitation probe loom is plugged into PL6 correctly. Re-measure the resistance.
- If measured resistance is still greater than 10Ω, replace the caseback assembly.

Low gain of probe count vs volume curve



Open circuit in one winding

Check pickup coil winding resistance

Typical probe count reading at the end of a calibration is 3000 ± 500 counts. Less than 1500 counts indicate there is likely to be a problem with one of the windings on the pickup coil.

Check the following on the pickup coil probe loom (plugs into PL7). The resistance across each of the following pair of wires should have a reading between 245-260Ω.

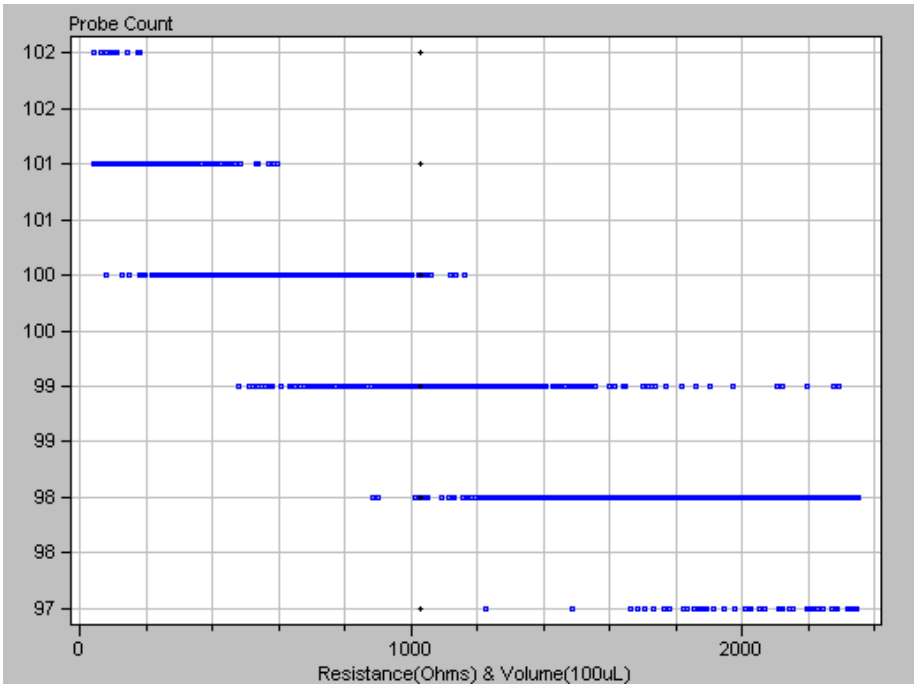
- Yellow and Blue (X & Y page 48)
- Yellow and Red (Y & Z page 48)

Note the PCA does not have to be removed to check this.

Pick up coils fail by becoming a very high resistance (open circuit), in 1 or more of the windings. If both windings have a resistance much greater than 1kΩ, verify that the coil pickup loom is plugged into PL7 correctly on PCA.

If the coil resistance measurements fall out of the above range, replace the caseback assembly.

Problems with AC current source and oscillator circuitry



Faulty AC current source or oscillator circuit

Discoloured fluid inside calibration rig

A watch crystal failure (XT4) will cause the fluid inside the flask while on the calibration rig to discolour. Return the complete EMM PCB Assembly (PCA) to a Level 3 service centre for repair.

Check version of PCA

On PCAs, issue 6B and earlier, there were some signs of the 32kHz watch crystal (XT4) failing. Later version PCAs operate more reliably.

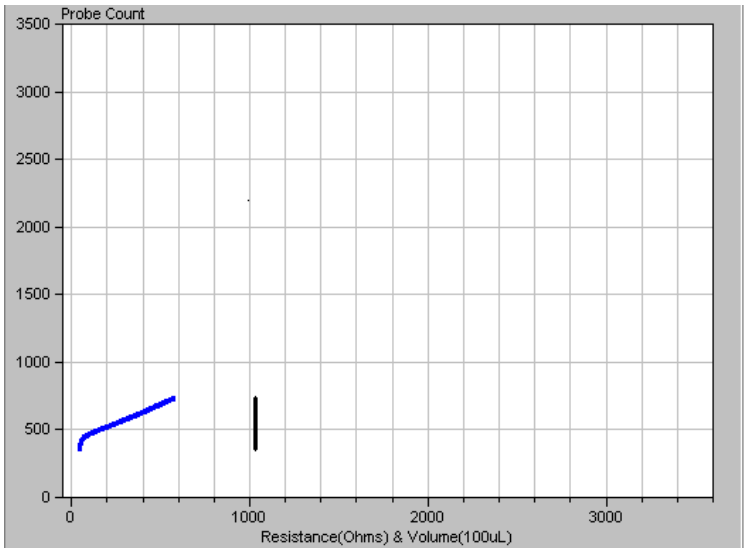
Check the following components for all Issue 6 PCAs:

- R86 – 100kΩ
- R91 – 47kΩ
- Replace the PCA.

Other checks

To be used in conjunction with the calibration curve from the Calibration Rig.

Meter is unable to determine resistance across probe



Possible causes

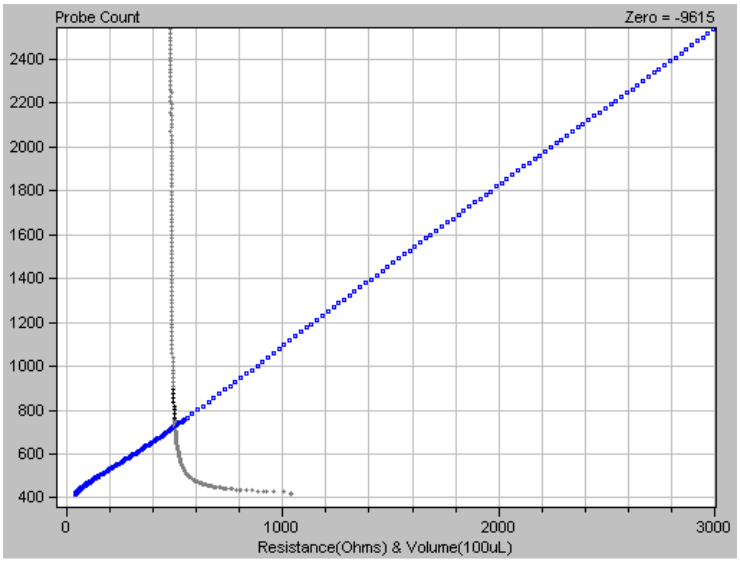
1 Resistance between blue and red wire (X & Z, page 48) of excitation probe loom is greater than 1000 Ω when a short is placed across the probes.

- Verify that the coil pickup loom is plugged into PL7 correctly.
- There may be high resistance in the probe loom soldering. Replace caseback assembly.

2 If the unit is deemed to have passed item 1. It can be assumed there is a fault in the probe impedance monitor circuit.

- Replace the PCA.

Resistance curve fails to converge towards 0Ω



Possible causes

1 Resistance between white and blue wire (A & B, page 48) of excitation probe loom is much greater than 10 Ω when a short is placed across the probes

- Verify that the excitation loom is plugged into PL6 correctly.
- If probe loom resistance is greater than 10Ω, replace the caseback assembly.

NOTE: In all instances when replacing either the caseback or PCA, it is important that the tuning capacitor values written at base of probe looms in caseback, are the same values on the PCA as shown on page 48. These capacitors tune the pickup coil to a centre frequency close to 32768 Hz.

Yield issues relating to Mechanical items

The table below covers a majority of common causes to check. It is not however a complete or exhaustive list of mechanical items to check.

This table is to be used in conjunction with meters that fail the MTR rig.

SYMPTOM	POSSIBLE CAUSE	SOLUTION
The milk meter has failed the leak test.	O-ring seal missing on milk meter cover	Replace o-ring and try again
	Flask gasket is misaligned or damaged.	Re align body or replace gasket
	Flap valve leaking	Replace flap valve
	Flask elbow leaking	Replace body
	Back port elbow leaking	Replace body
	Drain elbow leaking	Replace body
	Crack in bottom of flask near probes.	Replace caseback
	Leak in sample valve	Replace sample valve
The milk meter cannot detect stirring.	Blocked air admission hole	Rectify and try again
The milk meter stir air admission not within limits.	Check air admission hole is clear and of correct size 0.7mm diameter.	Rectify and try again
	Sample valve leaking	Rectify and try again
	Leaks in vial o-ring	Rectify and try again
The milk meter could not drain.	Air admission valve leaking	Replace air assembly rocker
	Blocked flask drain tube or transfer tube	Clear blockage in tube.
The milk meter did not drain fully.	Air admission valve leaking	Replace air assembly rocker
	Blocked flask drain tube or transfer tube	Clear blockage in tube.
Sample weight not within limits.	Flap valve sticking	Replace flap valve assembly
	Air admission valve leaking	Replace air admission assembly
	Leak in sample valve	Replace sample valve

SYMPTOM	POSSIBLE CAUSE	SOLUTION
	Recalibrate meter	Recalibrate and try again
'Electronic SR' outside limits.	Meter calibration outside limits	Run milk meter through Calibration rig
'Mechanical SR' outside limits.	Body cap may be damaged or not on correctly	Rectify and try again
	Nozzle damaged	Replace and try again
	Flap valve not working	Check or replace and try again
Flask volume does not match the flask weight.	Meter calibration is outside limits	Run milk meter through Calibration rig

Battery Replacement

If replacing the battery in an EMM, note the capacity of the battery being replaced and the capacity of the replacement battery.

If the capacity of the two batteries is the same, then you do not need to do the following steps.

If the capacity of the replacement battery is different (usually will be larger) then the EMM will need to be told of this to ensure that the charging works properly.

To check the programmed battery capacity, send the following command to the EMM.

{VBT}

The response should be either [-1], [2100] or [2700]. (-1 means that it has never been set, and it will behave as for 2100.)

To change the programmed capacity, send the following command to the EMM.

{VBT2700,galumPhing} where 2700 is the new battery capacity (2700mAHrs).

NOTE: Only do this if you are sure of the capacity. Setting this level above that actual battery level could cause long term harm to the EMM.

The value chosen must be one of either [2100] or [2700]. If the battery nominal capacity does not equal one of these, choose the next lowest value e.g. [2100] for a 2300mAHr battery.

The meter will have to be recharged before the DH will report the full charge available.

Body Elbow Replacement

Tru-Test Electronic Milk Meter Servicing

TRU-TEST

Milk Meters

For the modern milking environment

Info Brief: Replacing broken EMM body elbow

Step 1: Clamping the EMM body

Tools: Drill press or Mill

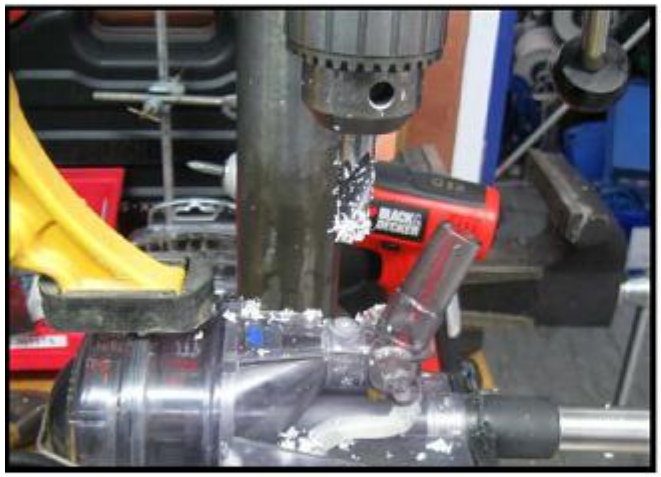
Clamp the EMM body securely to the drill press or mill bed to ensure it doesn't move during machining.

Remove the wash valve and the air admission valve assembly prior to clamping.

Take care not to over-clamp as this may break or deform the body.

Do not remove the cover as this offers protection to the sensitive internals of the EMM body.

Do not clamp solely on the inlet tube as this could result in cracking between the tube and the body.



Info Brief: Replacing broken EMM body elbow

Step 2: Milling off broken elbow

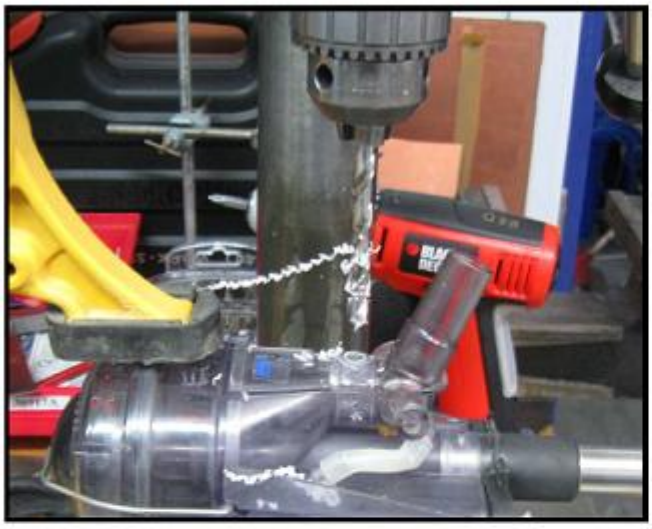
Tools: 14mm (or bigger) End Mill Cutter

Use a 14mm (or larger) end mill to machine off the remanants of the broken elbow.

Use a sharp cutter to get the best surface finish.

Machine the plastic with a slow feedrate as this will reduce the stress on the body and the clamping.

Only machine as far as the end of the old elbow base.



Info Brief: Replacing broken EMM body elbow

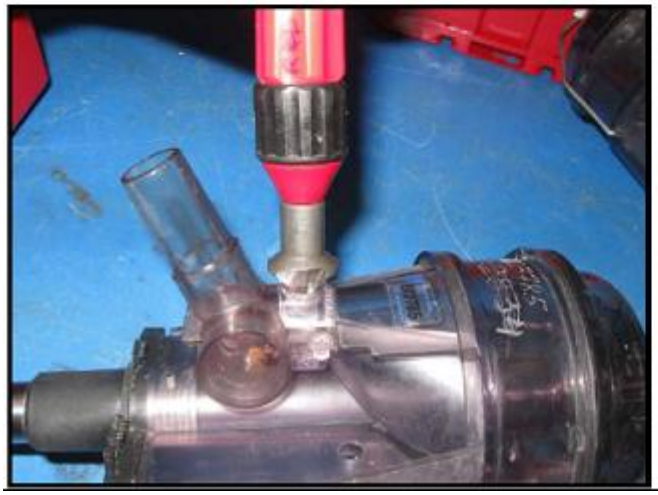
Step 3: Drilling new elbow hole

Tools: 7.0mm Drill Bit

De-Burring Tool

Use a 7.0mm drill to open up the hole that the new elbow will be glued in to.

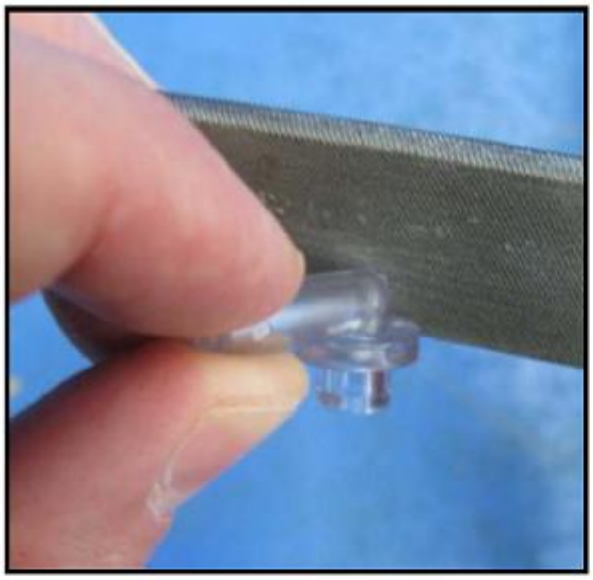
Ensure that this hole is drilled square to the milled surface.



Use a de-burring tool to remove the sharp edge on the hole you have just drilled.

This will provide a lead-in for the elbow when it is being glued into place.

After drilling and deburring, clean the loose plastic from the body (remove the cover if necessary).



Info Brief: Replacing broken EMM body elbow

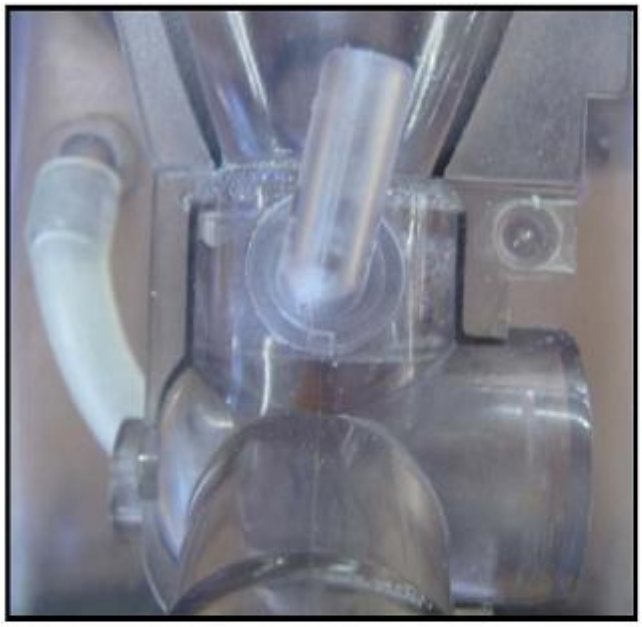
Step 4: Preparing EMM Body Elbow

Tools: File

Sharp knife

The new EMM Body Elbow needs to be prepared by doing the following:

1. File burr from the top of the elbow. This will ensure there are no sharp edges that could hurt users.
2. Remove the part line from the top and bottom of the elbow diameter. This will allow a better seal against the silicon tubing and avoid any potential leaks.



Info Brief: Replacing broken EMM body elbow

Step 5: Gluing on new EMM Body Elbow…

Tools: Artist brush

Press the elbow into the machined hole whilst:

a. Ensuring the elbow is pressed hard down so there is no gap between the round flange and the machined surface of the EMM body.

b. Align the centre of the elbow notch with the part line on the outlet elbow. This will set the new elbow on a slight angle to verticle.

Hold pressure on the elbow for 30 seconds to allow a good bond to be formed before releasing.

Use an artist's brush to lightly apply solvent around the joint between the elbow and the body. This will enable a better bond between the two parts.

Be careful not to drip solvent onto other areas of the body.

Info Brief: Replacing broken EMM body elbow

Step 6: Checking the assembly

The solvent bond will take 24 hours to reach full strength.

Ensure that all plastic swarf has been cleared from the EMM body before re-assembling.

Run the re-assembled EMM through the MTR to ensure the calibration of the meter is correct.

Record of Changes

Rev 1 0907: Reference to Battery Replacement added

Body Elbow Replacement Instructions added