Badger Meter Europa GmbH

LMS-RF-Low End

Oil-Management System

INSTRUCTION MANUAL

October 2008 (v. 1.08)

LMS_RFL_BA_02_0810

1. Introduction

The Badger Meter oil management system is designed to control and monitor the consumption and inventory balances of automotive fluid products with minimal installation and programming costs. Badger has used its years of expertise in the automated meter reading market to develop a modular control system utilizing RF communications.

The RF oil management system hardware consists of one dispense keypad and at least one radio frequency electronic preset meter (LM OG RF). The system verifies the operator's pin number and validates the work order number, fluid quantities and the valid hose / meter.

The dispense keypad can control up to 48 meters. The system supports up to 8 tanks and 8 fluids as a part of the system configuration. The system supports 150 unique operator IDs and pin numbers.

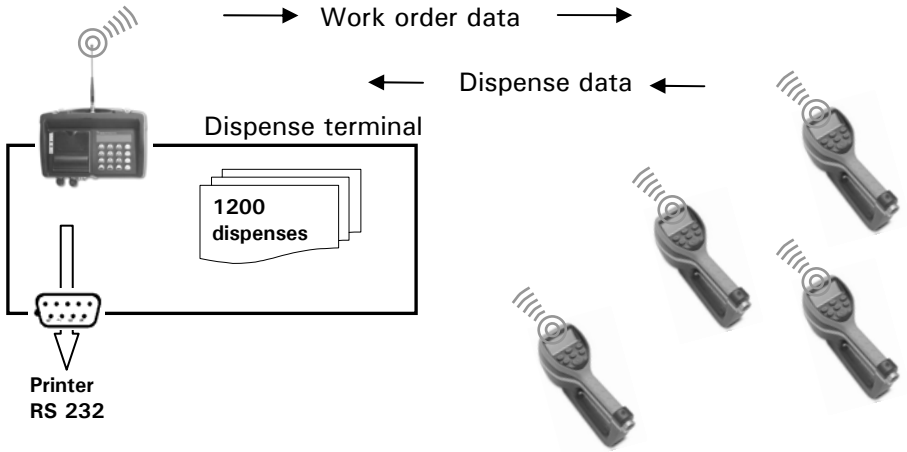
The system utilizes spread spectrum frequency hopping RF technology to prevent communication problems with other equipment in the facility. The RF system will look for a clear channel for transmission to insure that there is reliable communications at all times. Communication distances are typically up to 100 m but can go up to 300 m on plain areas.

The dispense keypad is used to configure the system, maintain system data and enter work orders. The service desk would utilize the dispense keypad to enter a work order selecting the fluid and quantity required. There is no need to predetermine where the work is going to occur. This allows the flexibility to service a vehicle at any open bay and select a meter when the work is going to be performed. When the work order is going to be performed the service operator simply enters his pin number, work order and hose that is going to be used at the dispense keypad.

There are a number of system utilization reports by user; fluid type, tank or meters available for the system's management.

A unique, patented feature of the system is that the RF meter's dispense trigger is locked until an authorization from the dispense keypad is received. After the dispense is completed, the user can top off the dispense, the actual dispensed amount is sent back to the keypad and the meter returns to the locked status. Additionally, the meter can be installed on portable dolly systems offering control and monitoring of high-cost lubrication products.

1.1 Composition and dataflow of the RF-System



1.2 Operation modes

1.2.1 RF-System in normal mode

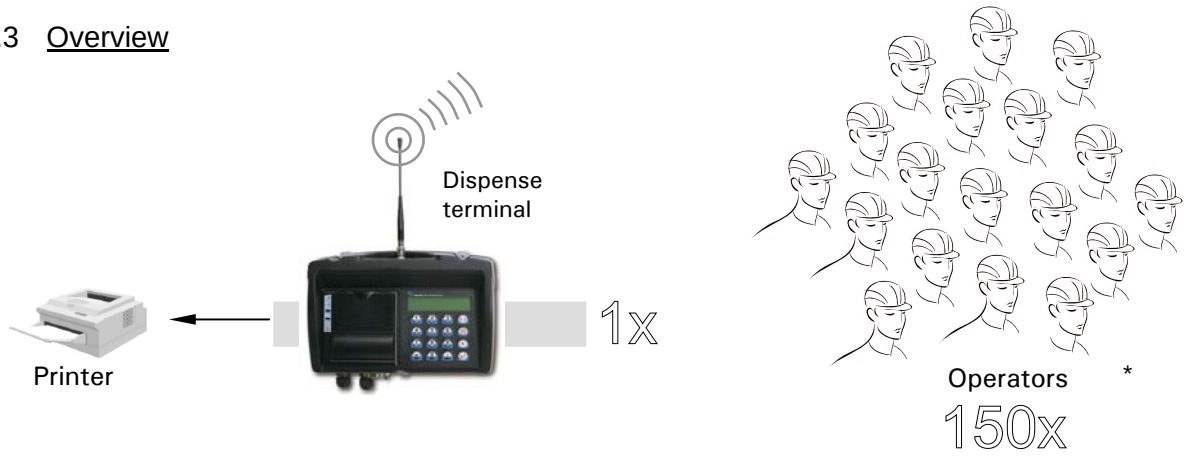
Work orders are entered at the dispense keypad and carried out with the meters.

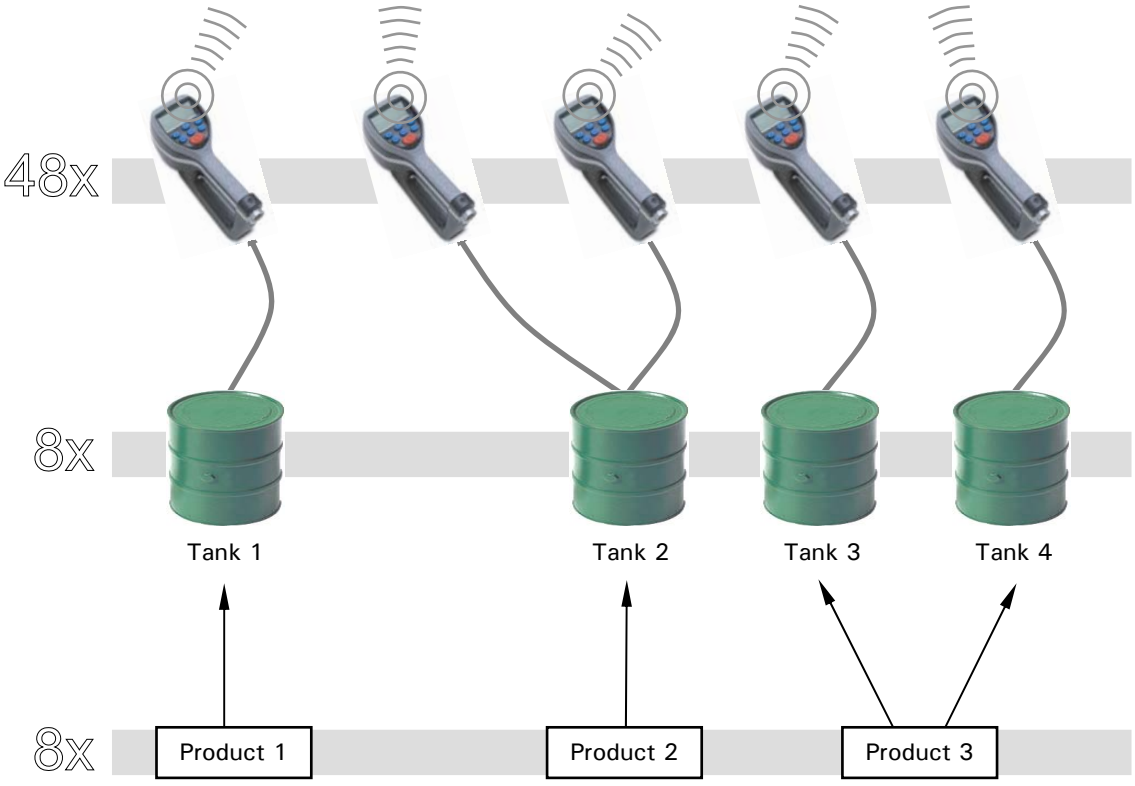
1.2.2 Calibrating / PTB mode

Operation in accordance with the specifications of the Physikalisch Technische Bundesanstalt (PTB) in Braunschweig.
Based on the German act of measurement and calibrating §13 from March 23rd,1992.

- Detection of small quantities (less than 0,5 litres)
- Detection of faulty impulses at the RF-meters
- Storing of the dispense data for at least 3 months in the data logger (RF-Memory).
- A PTB-approved meter is neccessary (green keypad).

1.3 Overview





2. Dispense keypad

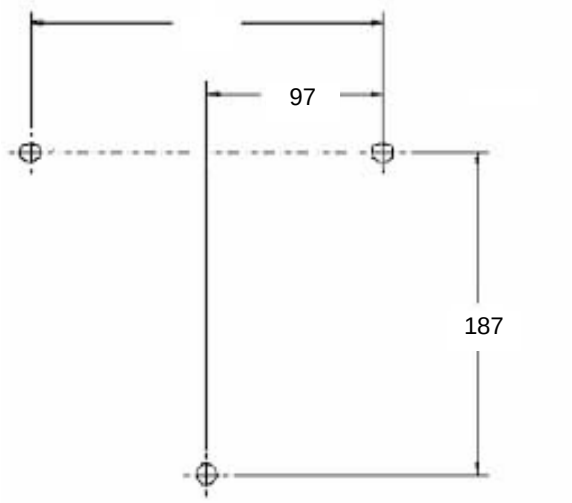
The dispense keypad is used to configure the system, maintain system data and enter work orders. The service desk would utilize the dispense keypad to enter a work order selecting the fluid and quantity required. To change system settings the supervisor PIN has to be entered.

2.1 Technical data

Power supply	230 VAC 50/60 Hz
EMC-approval	EN300 220-1
RF communication	2-way 868MHz according to FCC part 15.247 and part 15.109 16 bit encryption
Operating temperature	-10° C to +60° C
Internal printer	Thermal printer Type FT190 (optional)
External printer	Epson LX300 or similar (optional)

2.2 Wall fastening of the dispense keypad

The keypad should be mounted upright with the antenna pointing upward, near a 230 VAC electrical socket, to a structurally sound wall through the two holes on the top of the keypad casing. Height on the wall should be at eye level. Care should be taken to avoid mounting behind any steel objects (tool storage cabinets and metal chain linked fences) that may block the RF communication signal. Care should also be taken to avoid direct, significant heat sources.



Mounting dimensions for keypad
bore diameter: 5 mm

2.3 Keypad description

Scroll key: Used to select options on the active display

Home key: Pressing this key will return display to the PIN number and time/date screens

Backspace key: Used to backspace when entering data

Enter Key: Used to enter data and move to the next screen

Space key: Used to enter a space character when entering data

Alphanumeric keys: Used to enter data on display. Hold down key until desired character is on display. Then release the key.

2.4 Standard screen

```
12feb2005   12:48
  *Version 1.08
```

The standard screen shows the system date and software version number. The display will alternate between the standard screen and the enter pin number screen.The enter pin n° screen is used to access the supervisor menues.

A star ahead of the version number indicates the PTB mode.

enter a mechanic's PIN to start a wo or the supervisor PIN to enter setup (default: 0000).

```
  Enter PIN
```

+ 

2.5 Settings / supervisor menus

Menu INI is used to configure the system and to associate the system components.

Menu CNF is used to change system settings.

Menu MET is used to delete pending work orders.

Menu REP is used to print out system settings and work order reports at an external printer.

Menu 190 is used to print out system settings and work order reports at the internal printer.

2.6 Menu INI (system initialisation)

This menu is used to set date and time, tank and product data, meters (/hoses) and operators.

Always go through all menu steps, even if you just want to change a few settings.

Choose the menu INI and press enter.

```
  Enter time
    --:--
```

+  Format hh:mm

enter the actual time (two / four digits) and press enter.

```
  Enter date
  --/--/----
```

+  Format dd.mm.yyyy

Enter the date. Scroll from left to right through the fields by using the scroll key (the date cannot be changed in PTB-mode).

The screen changes to *tank unit.*

2.7 Tank initialisation

Before starting the tank initialisation, set the following issues:
(You can use the work sheets provided in chapter 5)

1. Set the tank number for each tank (1-8).
2. Assign the oil types to the corresponding tanks
3. Take down the actual levels in the tanks
4. Keep the meters in reach.
5. Assign each meter to a tank.
6. set name and PIN for each user / operator

The tanks are entered considering the following conditions:

- A maximum of 8 tanks.
- Tank number from 1 to 8.
- The default measurement unit is liters.
- The tank level in the system is being automatically refreshed after a dispense.
- Level format: 99999,999.

Start to enter the tank number (1-8) and a level (with corresponding unit) for each tank now.

```
Tank Unit
Tank No =
```

Enter a number between 1 and 8

```
Tank Unit No X
 <- LITER ->
```

You can change between: < LITER, GALLONS, PINTS, QUARTS and REMOVE >

```
Tank Stock Level
 No X ---------
```

Enter the actual level.

Repeat these steps for the other tanks. If you do not want set further tanks enter no tank number and press

The screen changes to *select fluid*.

2.7.1 Select fluid

The fluid types are entered considering the following conditions:

- A maximum of 8 types (oil, antifreeze, etc.).
- The label can consist of numbers and letters.
- There are no predetermined labels

Select Fluid No =	 Enter a fluid number (1-8).
Fluid No X ---------	 Enter a valid type label e.g. 5W 38 Mo.

Repeat these steps for the other fluids. If you do not want set further fluids enter no number and press 

2.7.2 Assign tank - product

The tank- / product assignment is 1:1. Each tank is assigned to one fluid type. E.g. tank no 1 is assigned to fluid no 1 or tank no 1 is assigned to fluid no 2

Tank-Fluid Tank No =	+  Enter the tank number you want to assign with a fluid
Tank-Fluid Fluid No =	+  Enter the fluid number you want to assign with this tank.

Repeat these steps until all fluids are assigned to their tanks. If you do not want to assign further tanks, enter no tank number and press 

The screen changes to *create hose.*

2.7.3 Create hose / meter

- The label with the meter's serial number and RF address is located in the battery compartment.

- The RF address has 10 digits.
- Meters can be created and deleted.
- A maximum of 48 meters can be created.
- The dispense keypad can only communicate with a registered meter.
- All addresses are clear.

```
Create hose
-.---.---.---
```
+  (e.g. 0 036 700 061)

- If the adress is already assigned the following display will indidcate that:

```
Hose Address
already used
```

Background: The system is checking the last three digits of the entered RF address. If this message appears, please make sure that you are not creating a meter already in use.

2.7.4 Assign meter – tank

Now assign the created meter to its tank.
Therefore enter the corresponding tank number.

```
Tank - Hose
Tank No X
```
+ 

- The assignment to a tank is 1: n
  (i.e. one tank can be assigned to several meters. Because each tank is assigned to one fluid type, all these meters are automatically assigned to the same fluid type).

Repeat these steps until all meters are assigned to their tanks. If you do not want to assign further meters, enter no tank number and press 

The screen changes to *delete hose.*

2.7.5 Delete hose / meter

If a meter has to be replaced, it has to be deleted in the system by using this function.

```
Delete Hose
- , - - - , - - - , - - -
```
+ 

When replacing a meter the new one will be set on the deleted one's position.

2.7.6 Creating and deleting operators

- Work orders can only be started with a valid operator PIN.
- A maximum of 150 operators can be created.
- The PIN is a 4-digit number.
- The operator name can consist of a combination of numbers and letters.
- At the beginning the operator list is empty.

```
New operator
    ----
```
+  Enter the 4-digit operator PIN you have set for this operator

```
New operator XXXX
_ _ _ _ _ _ _ _ _ _
```
+  Enter a name.

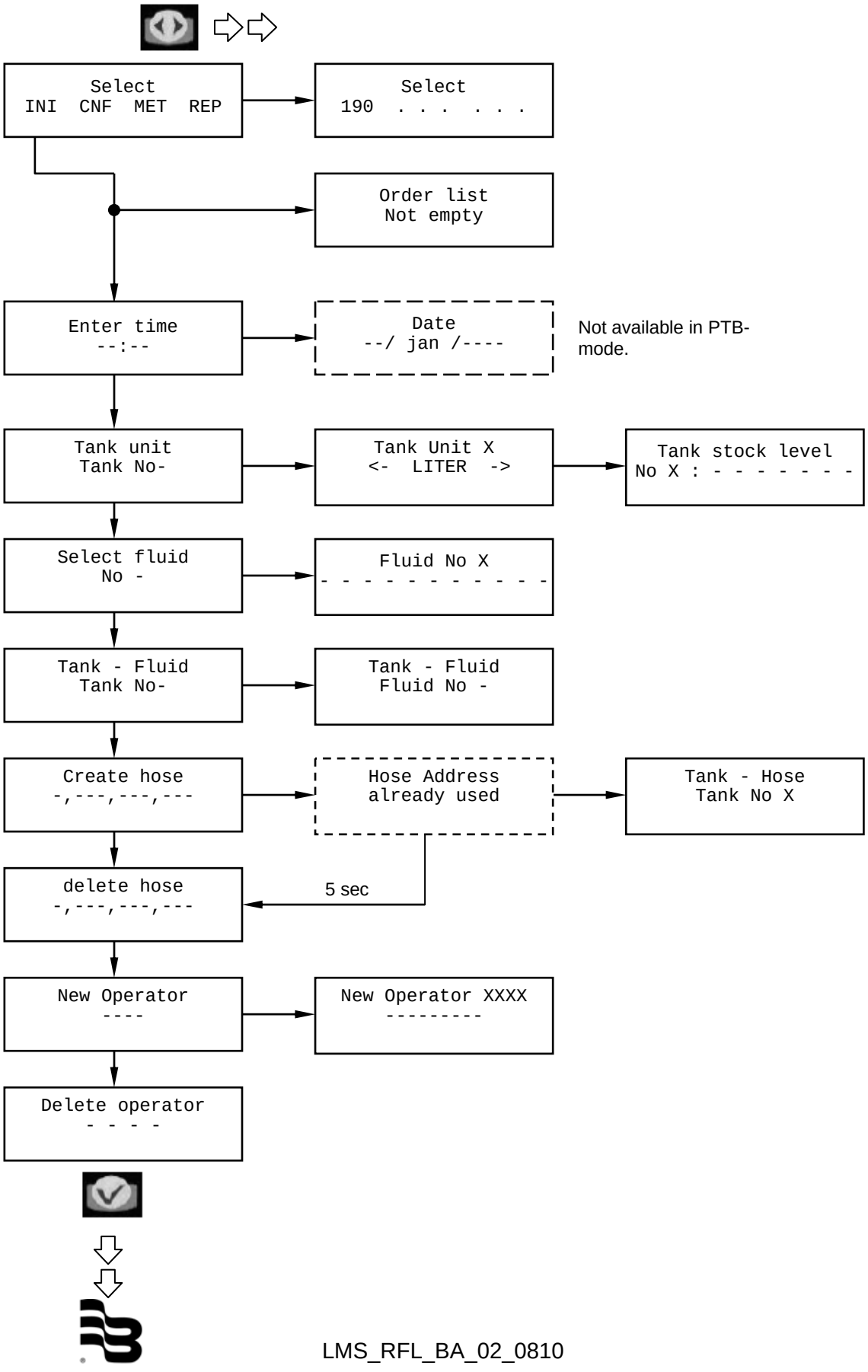
Repeat these steps until all operators are created. If you do not want to create further operators press 

```
Delete Operator
    _ _ _ _
```
+  Enter the PIN of the operator you want to delete

If you do not want to delete any operator press 

You are now leaving the INI menu.

2.7.7 Flowchart menu INI



2.8 Menu CNF (configuration)

The menu is used to change system settings.

2.8.1 Clear transactions

These functions allow to delete all finished work orders.

2.8.2 System reset

This function is used to set the system back to factory settings.

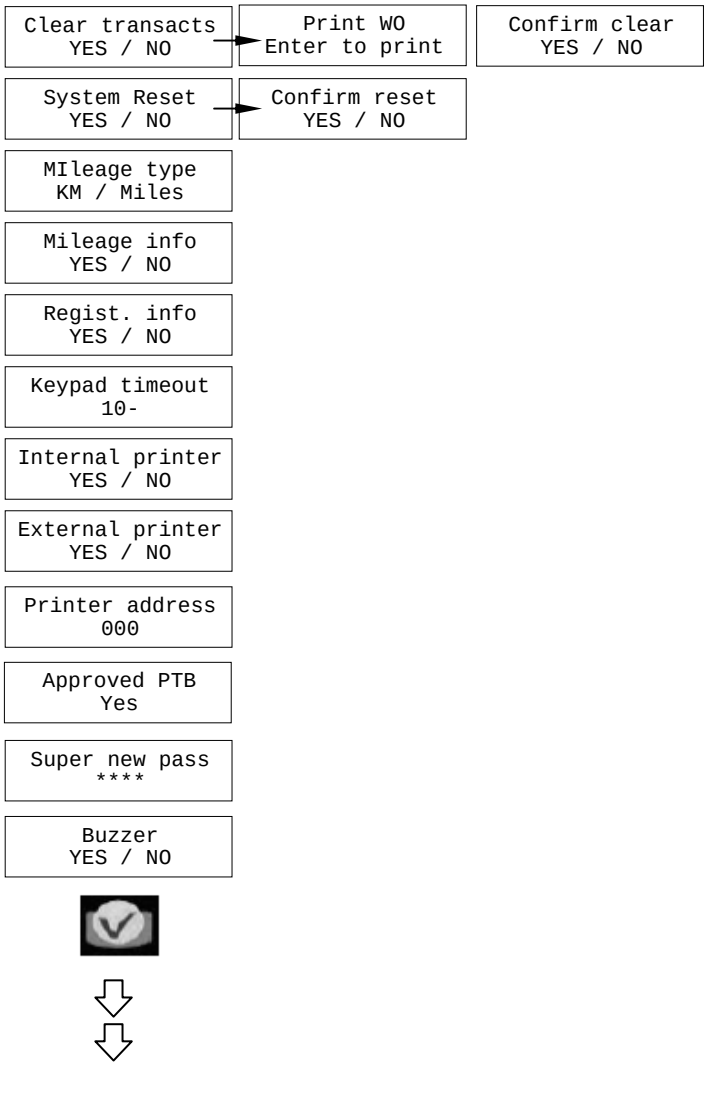
2.8.3 Mileage info and registration Info

Regist. info YES / NO + 	Alphanumeric field with 16 digits. Can be used for the car's registration number
Mileage info YES / NO + 	Numeric field with 12 digits. Can be used for entering the car's mileage

Change from numeric to alphanumeric keys: Press the key for at least 3 sec. until the desired character is on the display. Then release the key.

2.8.4 Flow chart menu CNF

 ⇨⇨ CNF



2.9 Menu MET (delete)

Work orders that have been entered at the keypad are being stored untill they will be picked up by the propriate meter (by pressing RESET at the meter). Meanwhile the meter is locked for other suspenses.

By using this menu, the prepared work orders can be deleted to release the meter for new work orders.

```
Init all hose
  YES / NO
```

YES All pending work orders will be deleted.

```
Start Hoses Init
  Press enter
```

NO You can select single wos to be deleted by entering the propriate meter / hose

```
  Hose Init
Hose no __
```

2.10 Menu REP (reports)

By using this function reports about the following subjects can be printed out by an external printer:

```
Select Report ->
 INI CNF COM ORD
```

```
Select Report ->
 MEC PRO HOS SRB
```

INI	Initialising	MEC	sort list by operator /mechanic
CNF	Configuration	PRO	sort list by product
COM	*not set*	HOS	sort list by hose / meter
ORD	sort list work order	SRB	sort list by tank

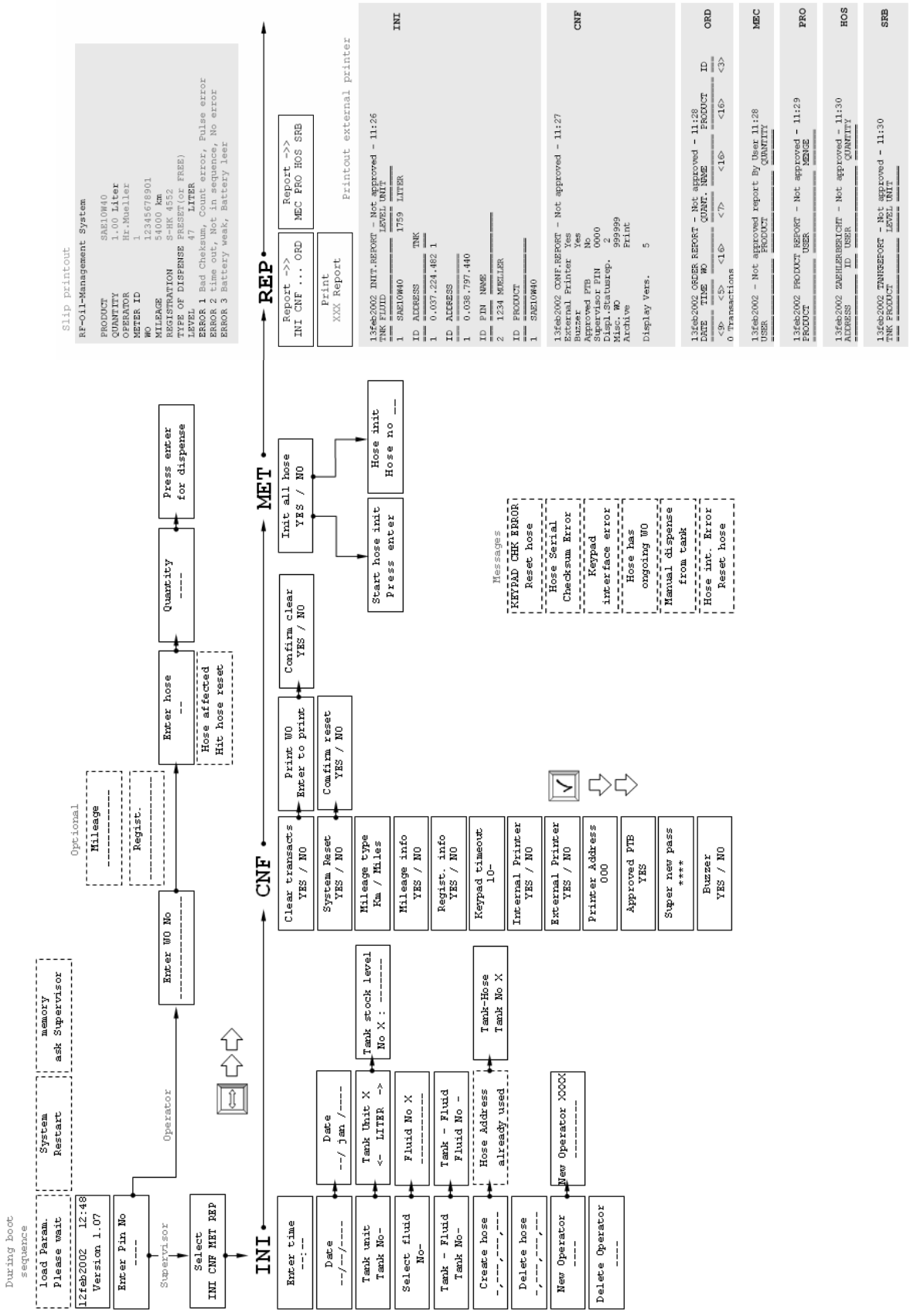
An appropriate printer or a PC (terminal program) can be connected to the serial printer port (RS 232).
Settings: 9600 Baud, Data Bits 8, Stop Bits 1, Parity None

2.11 Menu 190 (internal printer)

By using this menu, the configuration and status reports can be printed out by the internal printer FT 190.

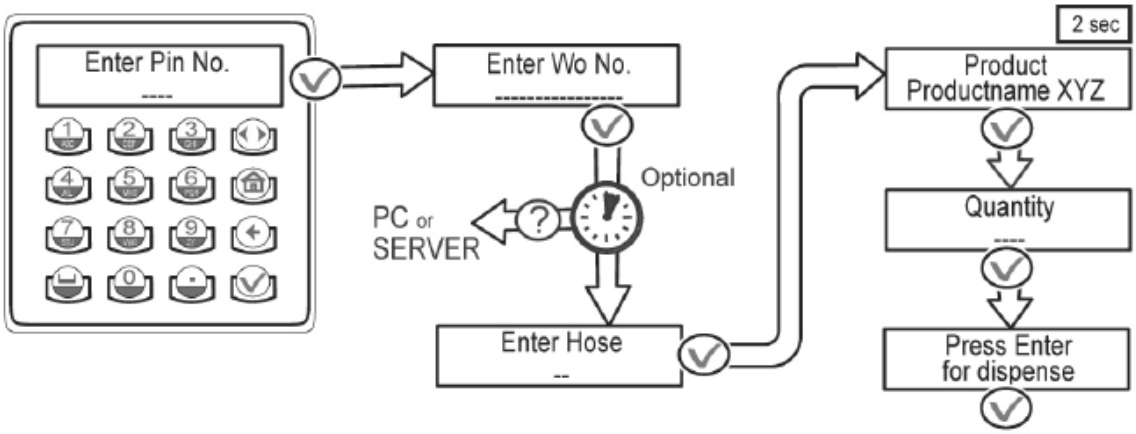
Menu	Example	Menu	Example
FLU	FLUID address: 258 Size: 18 1-> 1 / SAE10W40	PEN	Meter 1 inactive *(or asking)*
HOS	HOSE address: 142 Size:12 1-> 0.036.700.715 / 1	PAR	Unit Km *(or Miles)* AN-Field Yes ... etc.
TNK	TANK address: 194 Size: 8 1-> 10000 / LITER		
USE	USER address: 402 Size: 20 1-> 1234 / HR.MUELLER	MEM	Item Size Max Nb Adress Between ----- ---- ---- ---- ------ ---------- ... etc.
WO	WO 1 485801020230022B		

2.12 Menu flow chart



2.13 Dispense / start a work order

2.13.1 Overview



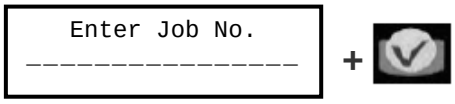
2.13.2 Process

1.) Enter PIN

To start a work order a mechanic / user enters his PIN.

2.) Enter work order number

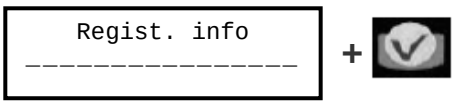
Work order number: Enter an alphanumeric number (max. 16 chars) and press Enter.



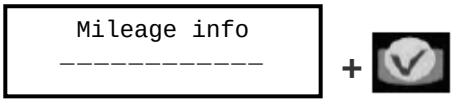
Alphanumeric keypad: To change from the numeric to the letter keypad press the equivalent key for at least 3 seconds until the desired letter is shown.

3.) Enter AN-field and N-field

These optional fields are only shown, if they have been enabled.



alphanumeric field, 16 chars:
Can be used for the registration number



numeric field, 12 chars:
Can for example be used for the actual mileage

Alphanumeric keypad: To change from the numeric to the letter keypad press the equivalent key for at least 3 seconds until the desired letter is shown.

4.) Preset meter selection

Enter a preset meter ID, that is aligned to the desired product.

```
Enter hose
__
```

+ 

5.) Display fluid

The choosen fluid type is shown for three seconds.

```
fluid type
XXXXXXXXXXXXXXX
```

3 sec.

6.) Enter product quantity

Enter the desired quantity. Optionally, the quantity assigned to this wo is shown.

```
Enter quantity
0___
```

+ 

- The quantity can be chosen between 0,0 - 99,9 and 100 - 999 liters. The maximum quantity in the PTB-mode is 90,0 liters. A quantity less than 0,5 liters will be indicated as not calibrateable (no star).
- The pre-selection can be made with one decimal place.
- Quantities of more than 100 liters will be displayed decrementally.
- A quantity of 0.0 will put the RF meter in a free-dispense mode, the RF meter will not latch and the user may dispense fluid as long as the trigger is manually held in the open position. The user must press RESET on the RF meter to exit this dispense and communicate the dispense order to the keypad.

7.) Dispense confirmation

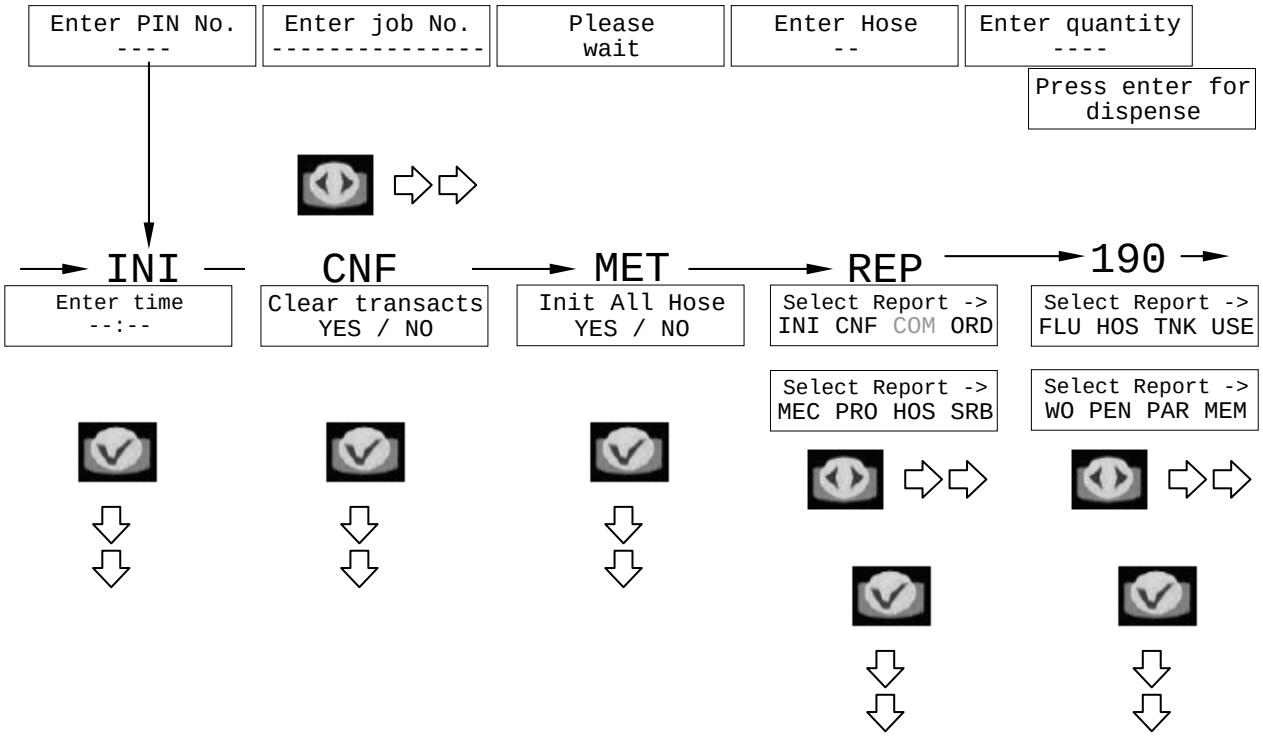
Press Enter to confirm the dispense.

```
Press Enter for
dispense
```

+ 

The work order is now ready for being picked up by the RF-meter.
*(See chapter 3.2 "*RF mode (standard) *")*

2.14 Functions overview



3. LM OG-RF meter

The meter is equipped with RF communications allowing authorization and dispense information. Once a work order has been set up, the operator simply pulls the trigger and the authorized amount of fluid for that meter will dispense. The valve will automatically shut off when the full quantity has been dispensed. A “top off” feature allows additional quantities to be dispensed and tracked after the valve closes. Upon completion of the dispense effort, the valve locks prohibiting any unauthorized dispense to occur.

For more detailed instructions, see the LM OG P manual delivered with the meter.

3.1 Key description

The following keys (except for RESET and SHUT-OFF) are only active in the autonomous mode (described down below)

10 - History
Used to enter the quantity to be dispensed (10 liter steps).
In operational mode it shows the five latest dispensed amounts.

1
Used to enter the quantity to be dispensed (1 liter steps).

0.1 - Flow
Used to enter the quantity to be dispensed (0.1 liter steps).
In operational mode it shows the actual dispension flow.

TOTAL
Used to display the accumulated total of fluid, as well as the resettable total (hold for 3 seconds) during operational mode.

AUTO
Used to enter and exit the auto mode when RF communications are not available.

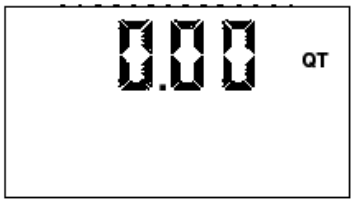
RESET
Used to accept a dispense order from the keypad. Used in normal operating mode (RF, manual or auto) to clear the previously programmed batch and to reset the meter. Press the button while viewing the resettable total to set it back to zero.

Shut-off
Used to stop the flow manually through an electrical override.

3.2 RF mode (standard)

Work order validation via the dispense keypad.

When the battery pack is attached to the meter, the meter will automatically enter the RF mode. The trigger is in a locked-out position and no oil can be dispensed until a dispense order is received by the meter.



RF mode

3.2.1 Procedure

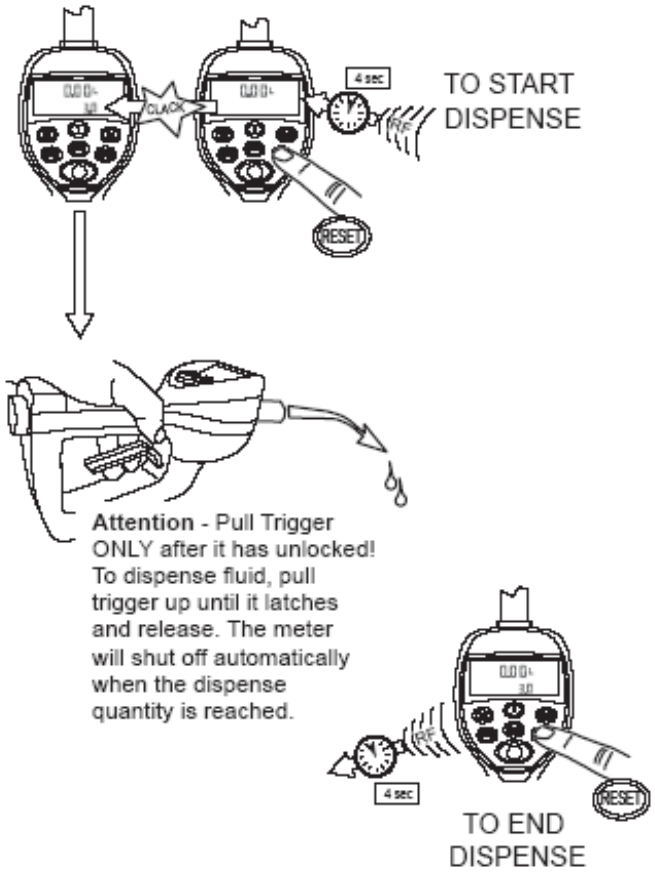
1. Press the RESET button on the meter to enable it to receive a dispense order provided by the dispense keypad. The trigger will unlock.

2. Pull the trigger to begin the flow. The valve will automatically lock in place, even though the trigger will fall back to the closed position. The flow will automatically shut off when the preselected quantity has been dispensed.

3. To top off, pull the trigger to begin the flow and release when the desired amount has been pumped.

4. Press the RESET button when finished. The total quantity dispensed will be transmitted to the keypad and the meter will return to a locked-out position. The meter is now ready to receive the next dispense order from the keypad.

3.2.2 Illustration



3.3 Auto mode (autonomous)

Attention: This function allows unauthorized dispenses. The dispenses will not be assigned to any mechanic / operator.

- Operation will take place with the normal functions.
- The total dispensed quantity will be stored under the general work order number (999999)
- The **AUTO** sign at the display's lower left corner indidcates the autonomous mode

3.3.1 Procedure:

Program the meter to auto mode by holding down the TOTAL button and pressing 0.1, 10, RESET, 1 and AUTO .

The solenoid will now unlock and the meter may be used as a normal meter.

3.3.2 Reset to standard mode

To set the meter back into standard mode advice a work order from the assigned dispense keypad to it (see chapters 2.13 und 0 for the procedure). After terminating the work order, the meter will lock and set back to standard mode.

3.4 Electrical override

In case of an emergency or to interrupt a batch, the meter is equipped with an **electrical override**. This option automatically closes the valve in the meter, stopping the flow immediately. The display will begin to flash because the meter does not sense any flow. Batching can be continued after an override, even if the meter is in the middle of a programmed batch and the display continues to flash.

Press the red button to activate the electrical override. This button can only be used when the valve is open.

Press the RESET button to cue up the next batch and stop the display from flashing.

3.5 Changing the battery

When the batteries need to be changed, a progression of warnings will appear on the screen.

The battery compartment is located on the underside of the trigger guard. Unscrew the two screws located under the guard and remove the battery cover to expose the batteries.

3.6 Programming the LM OG-RF meter

The units of measurement, scale factor and the pulse delay factor can be changed. To enter / leave the programming mode, press and hold the **"PROGRAMMING"** key located in the access hole at the meter's bottom for 2 seconds.To gain acces to this key, a seal has to be broken.

For more detailed instructions see the LM OG P manual delivered with the meter.

4. Troubleshooting

4.1 Dispense keypad error messages

These error messages can be displayed by the dispense keypad. The associated action to reset the system is listed behind.

Message	Description and error recovery
`Wrong hose for fluid`	The meter selected is not a valid meter for the fluid assigned for this work order.
`Radio communication`	System communication is in progress, please wait.
`Keypad interface error`	The meter has a work order on process. Please complete this work order or press reset on the meter to reset the status.
`Key hose Int Err Reset on hose`	An error occurred during communications to the meter, please press reset on the meter to retry the communications.
`Pending WO Please res. hose`	The meter has already been selected for a dispense. Complete the dispense or reset the hose status to continue.
`Order list not empty`	To change settings in the INI menu, all work orders have to be deleted first. Carry out in menu CNF „`clear transacts`“ and in menu MET „`Init. all hose`“ to delete all wos.
`KEYPAD ERROR`	An error occurred in the keypad. Press RESET on the meter.
`HOSE AFFECTED HIT HOSE RESET`	The selected meter currently has a dispense order in processor waiting to be processed, complete the active order. The user should clear out the requested dispense by selecting MET in the Supervisor Menu.
`Hose has ongoing WO`	The hose has a work order in process. Please complete this work order or press rest on the meter to rest the hose status.

4.2 Other problems

Problem:	Description and error recovery:
Meter: The **AUTO** function is shut off, the auto icon disappeared and can not be activated again.	The battery sign is flashing in the lower left corner. This means the battery power is too low to run the auto function. The meter can still run in manual mode. Change the batteries.
It is not possible to set back the meter from auto mode to standard mode.	Carry out in menu MET „`Init. all hose`“ to delete all wos at the dispense keypad Afterwards send a new work order to the meter.

5. Worksheets

Fluid ID	Fluid name
1	
2	
3	
4	
5	
6	
7	
8	

A maximum of 8 products.
The alphanumeric name, max. 16 chars.

Tank ID	Fluid	Tankvolume	Unit	Content
1				
2				
3				
4				
5				
6				
7				
8				

Maximum 8 Tanks.
Tank volume format: 00000.000.

Meter ID	Address x . xxx . xxx . xxx
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	

Max 48 meters/hoses.
The address is a 10 digit number.

User ID	Name user	PIN ID
1	Supervisor	0000
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		

Up to 150 users. The user field is alphanumeic, max. 16 chars.
The user PIN ID is a 4 digit number

6. Manufacturer´s declaration

Badger Meter Europa

CE

Herstellererklärung
Manufacturers Declaration

Bauart Typ *Model Type*	Managementsystem für Schmieröle *Management System for Lubricant Oil*
Typenbezeichnung *Model Name*	MDS-2000, LMS-RF, LMS-Baby *MDS-2000, LMS-RF, LMS-Baby*
Seriennummer *Serial Number*	Nach Komponenten gelistet *Listet by components*
Baujahr *Construction year*	ab 1997 *from 1997*

Referenz / Reference:

Maschinen Richtlinien *Machine Directives*	CE-Richtlinien Elektrische Betriebsmittel *Electrical Device Directives*
89/392/EEC	73/23/EEC
91/369/EEC	93/68/EEC
94/44/EEC	BGB 0.9.11.92
93/68/EEC	

Hiermit bestätigen wir die Übereinstimmung unserer Geräte mit den o.g. Richtlinien.
Vor Inbetriebnahme der oben genannten Geräte muss sichergestellt sein, dass die Gesamtanlage bzw. Maschine, in der die Geräte verwendet werden, den geltenden Richtlinien und Bestimmungen entspricht.

We herewith confirm that our products are in accordance with above mentioned directives.
The equipment identified above must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of above directives.

Erstellt: M.Steiner Datum: Juli 2002 Revision: .14.10.2008	Geprüft: H.Fauser Datum: 01.12.2004	Freigabe: K.Porth Datum: 01.12.2004	Gesehen: E.Wannenwetsch Datum: 01.12.2004	Seite 1 von 1

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8. DIN ISO certificate

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD Management Service

CERTIFICATE

The Certification Body
of TÜV SÜD Management Service GmbH
certifies that

Badger Meter Europa GmbH
Nürtinger Strasse 76
D-72639 Neuffen

has established and applies
a Quality Management System for

Flowmetering and Control,
Design, Selling and Production.

An audit was performed, Report No. 70002816
Proof has been furnished that the requirements
according to

ISO 9001: 2000

are fulfilled. The certificate is valid until 2011-02-13
Certificate Registration No. 12 100 24674 TMS

Munich, 2008-02-16

QMS-TGA-ZM-07-92

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