DOSIMETRY

DMC 2000

Dosimeters S, X, XB

User's Manual

MGP INSTRUMENTS

MIRION TECHNOLOGIES

To use your DMC 2000 immediately in stand-alone mode *

refer to the following :

- this operating mode allows the DMC 2000 to be used alone, without using any other equipment.
- to verify that your DMC 2000 is in the stand-alone mode:
  - verify that the display reads " PAUSE " or " REPOS "
  - press the selector button 3 times:
    - if the message " AUT " is displayed, your DMC 2000 is in the stand-alone mode.

    if the message " SAT " is displayed when the selector button is pressed the first time, your DMC 2000 is in the satellite mode, and not in the stand-alone mode.

Revision Table

Indice	Date	Written by	Description of modification	Modified pages
A	03/02/1998	JP Guillemot	Document created	First edition
	13/05/1998	JP. HURIAUX	Integrated comments on the first version of the document, and those on the SOR 501 user's manual	
	05/30/1998	D. KINGSMAN	Entire document	English translation
B	02/03/2000	F. L'ELCHAT	Chapters "Description" and "Technical Characteristics": Additional information (physical characteristics) on the DMC 2000X and DMC2000 XB dosimeters, Adding of a new message relative to the dose equivalent rate saturation (Software release 2.6)	
A	July 2003	Documentation department	Application of new model – updating with the French user's manual No. 115170D New number No 128104A	
	03/12/2002	D. Chatron	DEVN12237 New Software version DEVN13516 REV 6614 New Software version: V2.A	 § 5.2.2, § 8.2 § 8.4, § 1.1, § 11.6,
D			Not issued	
E	10/06/2005	P. MARTIN	Back to the old number . Updating with the French user's manual No. 115170E REV 6845 New Software version: V3.x	All document
F	23/01/2006	P. MARTIN	Add calibration method	§ 12.2
G	05/03/08	P.MARTIN	DEVS 15358 New software version 3.7	§ 3.2.3, § 5.2.4.1, § 5.2.6.1, p 18, p 27 § 6.2.4.1, § 6.2.6, p 43, p 63, § 11.1 § 11.8, § 11.9, § 12.1 p 70, § 13.5, § 13.6, § 14.

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1. General

1.1 Document Overview

This document provides the information necessary to use the dosimeters belonging to the DMC 2000 family (DMC 2000 S, X, XB) as either part of a centralized dosimeter system, or to use it in the stand-alone, or “stand alone” mode.

In the whole course of the present document, the term **DMC 2000** will apply for the dosimeters of the **DMC 2000 family**, that is the **DMC 2000 S**, **DMC 2000 X**, **DMC2000 XB** dosimeters, except if an explicit mention to one of these dosimeters is made

It will facilitate its use by providing information about its functions (alarms, display), normal use (alarm acknowledgment), and first level maintenance (changing the battery, troubleshooting).

However, information concerning its operation as part of a centralized dosimeter system is not covered in this document. For additional information, and in particular, relating to the functions listed below; refer to the user’ s manual for the centralized dosimeter system.

- assigning dosimeters
- configuring dosimeters
- pass by readers

For some uses of the dosimeters from the DMC 2000 family (dosimetry system, teledosimetry…) additional equipment or extension cases are required (DOSIVIEW, LDM, WRM...).

Refer to the specific manual for Gamma and Neutron dosimeters, DMC2000 GN and DMC2000 XN.

For additional information, refer to the corresponding equipment’s user’s manual.

1.2 Reference Documents

For complementary information to the current User's Manual, refer to the User's Manuals listed below (MGP Instruments reference)

- DOSIMASS-DM Software User's Manual 117905EN
- DOSIVIEW Software User's Manual 117331EN
- LDM2000 User's Manual 115373
- LDM101 User's Manual 122865

1.3 Conventions

Use of typographical symbols:

Symbols " ■ " and " □ ":

These symbols are used for descriptions and lists.

The symbol " ■ " corresponds to the **first** level of a list.

The symbol " □ " corresponds to the **second** level of a list.

For legibility reasons, these symbols are aligned vertically.

1.4 Illustrations

On the illustrations of the display:

- shaded areas indicate that the information flashes
- the indicator light as shown below is flashing
- the "functional indicators" are always flashing unless otherwise specified

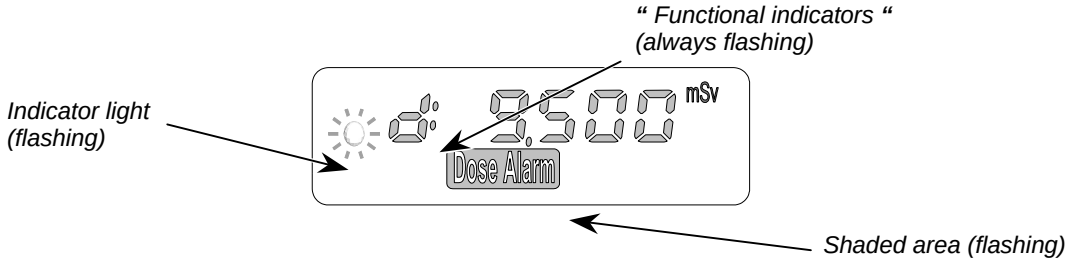


Figure 1 - DMC 2000 dosimeter display

Note :
the illustration above is not an actual display (an actual display is shown on page 5)

2. Description

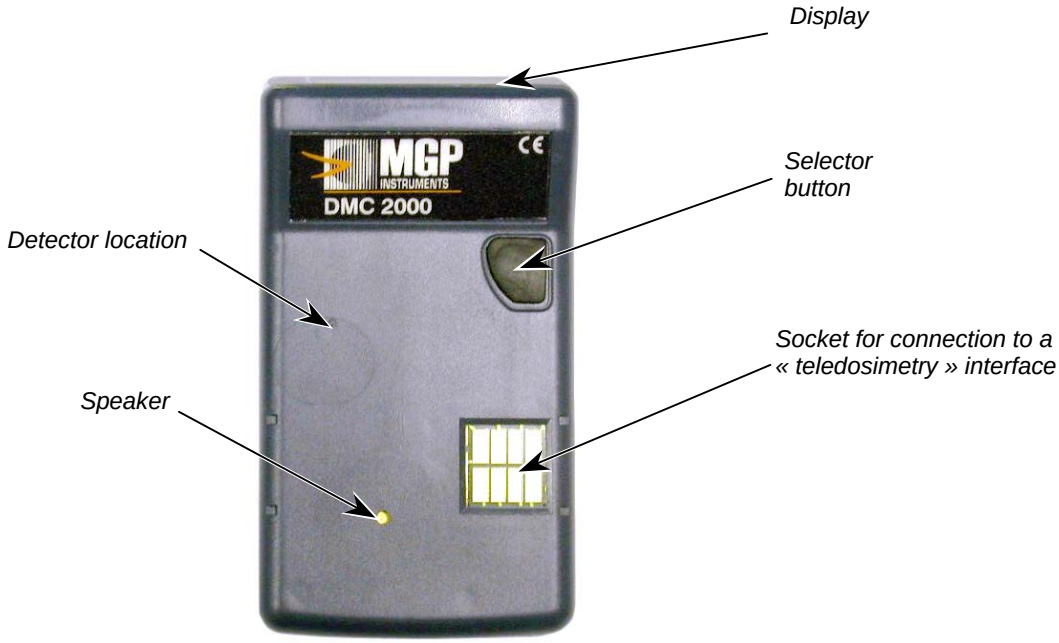


Figure 2 - DMC 2000 S Front view

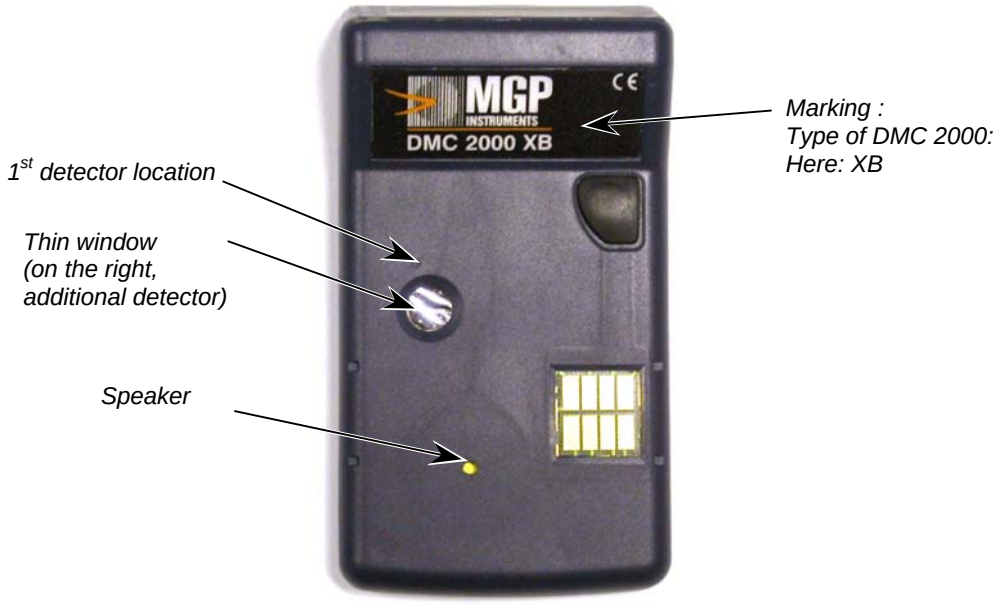


Figure 3 - DMC 2000 X or XB Front view

2.1 Handling recommendations

The thin window of the DMC 2000X and XB dosimeters is protected against the consequences of an untimely press of the finger.

Yet, take care NOT TO PERFORATE or TEAR the thin window with any object, which would result in making the dosimeter inoperative

2.2 DMC 2000 X: special feature

The DMC 2000 X dosimeter differs from the DMC 2000 S dosimeter in the range of the detected X and Gamma radiations.

2.3 DMC 2000 XB: special feature

The DMC 2000 XB dosimeter differs from the DMC 2000S and DMC2000X dosimeters in the simultaneous measurement of the following quantities:

- Hp(10): deep dose
- Hp(0.07): shallow dose.

The measurement of the Hp(0.07) quantity requires to take into account the « electron » contribution additionally to the photonic contribution.

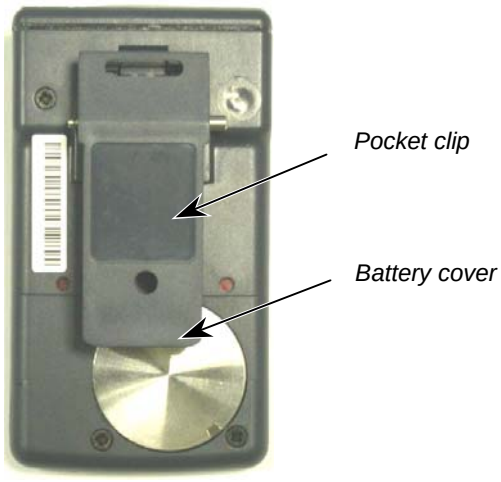


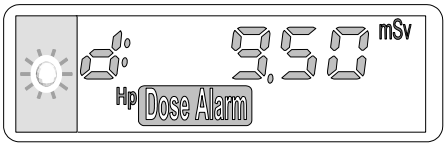
Figure 4 - DMC 2000 back view

2.4 Display

The display allows viewing of measurements and alarms

In the example shown below the display indicates a dose alarm (the alarm threshold programmed in the dosimeter for the dose equivalent has been exceeded):

- the indicator light flashes
- the “ Dose Alarm ” indicator flashes
- the value of the dose is displayed (9.5 mSv)



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3. Operating Modes of the DMC 2000-type Dosimeters

The main operating modes and function modes of the **DMC 2000-type dosimeters (S, X, XB)** are described below.

3.1 Operating Modes

The DMC 2000-type dosimeters can be used in two different operating modes: the "**stand-alone**" mode and the "**satellite**" mode.

The mode selection is normally set at the factory. However, it can be selected by using the DOSIMASS-DM software and a LDM reader.

Note :
that procedure is not explained in this document. Refer to the DOSIMASS- DM Software User's Manual..

3.1.1 Stand-alone Mode

This mode allows the DMC 2000-type dosimeters to be used alone, without any other equipment.

3.1.2 Satellite Mode

This mode allows the DMC 2000-type dosimeters to be used in a dosimetry application which includes other equipment (LDM, DOSIVIEW...).

3.2 Dosimeter Function Mode

Regardless of its operating mode ("stand-alone" or "satellite"), the DMC 2000 dosimeters (S, X, XB) have various function modes:

- dosimeter storage,
- pause,
- measurement,

3.2.1 Dosimeter Storage Mode

When in this mode, the **DMC 2000 dosimeter** is not operational and its power consumption is at a minimum.

Switching to this mode requires the use of DOSIMASS-DM software and a specific operation (Please contact us).

3.2.2 *Pause* Mode

When in this mode, the **DMC 2000 dosimeter**:

- periodically monitors (every 10 minutes):
  - the battery status
  - that the detector is functioning properly
  - initialization and calibration data integrity
- permanently displays the message " PAUSE " or a personalized message, or messages indicating any faults which may be detected.
- the historical management

In this mode the **"pass by data exchange"** function is operational.

Note :
*the personalized message displayed in the **pause** mode can be set using the DOSIMASS-DM Software. Refer to the corresponding user's manual..*

3.2.3 Measurement Mode: DMC 2000 S and DMC 2000 X

When in this mode, the **DMC 2000** dosimeter continuously performs:

- measurement
  - of the Hp(10) dose equivalent
  - of the dose equivalent rate
  - of the time spent in area
- management of the historical record
- audible signals
- periodic monitoring of: (every 10 minutes)
  - the battery status
  - the detector's operational status
  - the integrity of the initialization and calibration data

In this mode, the **"pass by data exchange"** function is operational.

Note : *the display units are:*

- *mSv (mSv/h),*
- *µSv (µSv/h)*,*
- *mRem (mRem/h), Rem (Rem/h)*
- *cGy (cGy/h)*

** From the 3.7 version and depending on the configuration*

3.2.3.1 DMC 2000 XB additional feature

In the measurement mode, the DMC 2000 XB simultaneously performs, additionally to the measurement of the Hp(10) « deep » dose equivalent and dose equivalent rate :

- the measurement of :
  - the Hp(0.07) shallow dose equivalent,
  - the Hp(0.07) shallow dose equivalent rate,
- the display of the Hp(0.07) dose, dose rate (if the dosimeter has been configured with this function), of the alarms.
- The management of the alarms and pre-alarms relative to the defined thresholds on the Hp(0.07) dose equivalent and dose equivalent rate.

3.2.4 Compatibility

All the functions of the DMC 90 and DMC 100 are possible with the DMC 2000-type dosimeters and, in particular, the use with dosimeter readers (LDM) and dosimeter calibrators equipped with the same, or new software. Please contact us for more information

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4. Start-up

To start up a **DMC 2000** dosimeter the following procedures must be performed:

- its initialization
- configuration (definition of alarm threshold values, dose rate display authorization, alarm rate authorization, alarm duration…)
- assignment to an individual (in satellite mode)
- It's activation

Note :
*during initialization, the **DMC 2000** dosimeter switches from the **dosimeter storage** mode to the **pause** or **measurement** mode (depending on the procedure used).*

4.1 Satellite Mode

In a centralized dosimetry system, the start-up procedure is performed by a central computer via a **LDM** reader.

It is described in the centralized dosimetry system operating manual

4.2 Stand-alone mode

For use in the stand-alone mode, the initialization and initial configuration are generally performed in factory.

Activation is carried out by using the selector button (refer to the section switching to the measurement mode page 29).

In addition, modification of some parameters can also be performed when in ***pause*** mode by using the selector button (refer to the chapter Setting Operating Parameters section In the Stand-alone Mode page 51).

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5. Operation in the Satellite Mode

5.1 Switching to Measurement Mode

Switching to the ***measurement*** mode primarily consists of activating the **DMC 2000** dosimeter. In other words, programming the dose equivalent measurement.

In a centralized dosimetry system, switching to the ***measurement*** mode is accomplished when passing by an LDM 2000 access control reader.

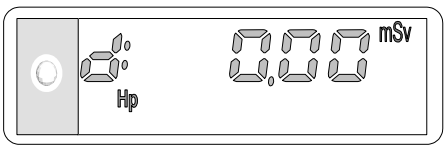
For additional information, refer to the operating manual for the centralized dosimetry system.

When switching to the ***measurement*** mode, the following functions are activated :

- the functional indicators flash
- an audible beep is generated
- the display is completely on during 1 second

Note : *: By using Dosimass-DM software, the audible beep can be replaced by a 3 seconds continuous alarm (only with V3.x review software and on entry)*

- the dose value is continuously displayed (in the unit selected during dosimeter configuration).



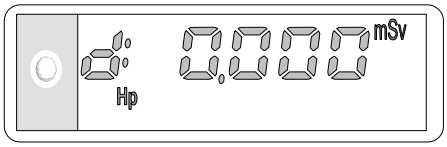
5.2 Operation in the Measurement Mode

5.2.1 Displaying the Dose Equivalent Measurement

When in the measurement mode, the **DMC 2000-type** dosimeters continuously measures the Hp (10) dose equivalent, as well as performing other operations (see section ***Measurement Mode***, page 8).

The display shows the dose value. The unit, format (fixed or floating point) and display resolution are selected during dosimeter configuration (factory configuration or using Dosimass-DM software).

Example:



Note :
when used in a centralized dosimetry system, the dose display can be concealed (refer to the operating manual for the centralized dosimetry system). In that case, only the "functional indicators" and faults are displayed.

5.2.2 Displaying the time mode or the remaining time before dose alarm or the wearer's name

These 3 displays are exclusive: only one function must be validated in the dosimeter.

If there is an error in configuration, the following priorities are defined:

1. wearer's name
2. remaining time to alarm
3. Clock

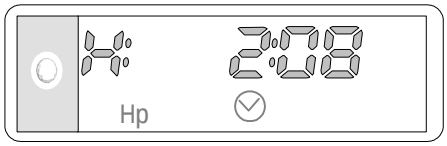
***Example**:*

- *If the dosimeter has been configured to show all three possible displays, only the « wearer's name » will be displayed.*
- *If « remaining time to alarm » and « clock » are requested, only « remaining **time to alarm** » will be displayed*
- *if « wearer's name » and « clock » are requested only the « wearer's name » will be displayed.*

5.2.2.1 Displaying the time mode

Note :
Only in V2.7 and later versions and if time display is configured.

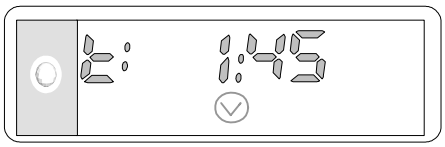
Briefly pressing the selector button displays the time on the display.



Note :
the displayed time is downloaded by the system upon area entry; this time is internal to the dosimeter. This display is unadvisable in stand-alone mode.

5.2.2.2 Displaying Remaining Time to Alarm

After a short press of the button, the time to alarm will be displayed



The time to alarm corresponds to the shortest of the time alarm or the time to reach the dose alarm point calculated based on the current dose rate.

The time to reach the dose alarm point is calculated as following :

- time duration before dose alarm =(dose alarm threshold – cumulative dose) / current dose rate.

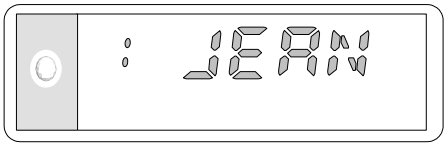
Note :

- *Only in firmware version V2.A and newer if the option is configured*
- *The time alarm can be enable or disable.*

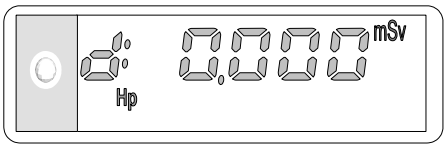
5.2.2.3 Displaying the wearer's name

Note :
Only in V2.9 and later versions and if wearer's name display is configured.

Upon area entry, the dosimeter displays:



for a 30-second time period.
After these 30 seconds, the following display is restored:

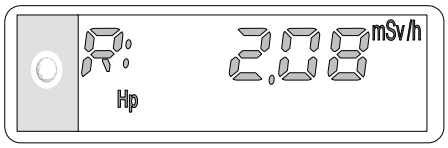


Briefly pressing the selector button displays the wearer's name on the display.

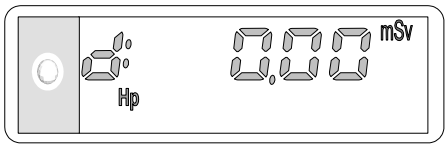
Note :
If the dosimeter is inactive, the display becomes "PAUSE".

5.2.3 Displaying the Dose Rate Measurement

Pressing and immediately releasing the selector button displays the dose equivalent rate value for 30 seconds. The unit, format (fixed or floating point) and display resolution are selected during dosimeter configuration.



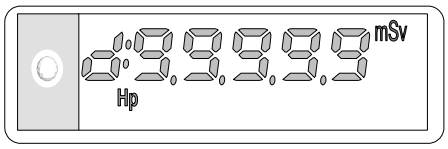
After 30 seconds, the dose equivalent value is displayed once again:



Note :
other display combinations of dose/rate are available. Please contact us.

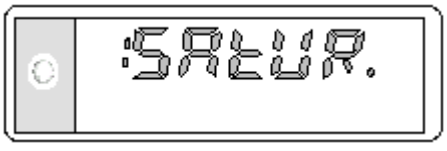
5.2.4 Dose equivalent saturation

When the dose equivalent exceeds the value 9999,999 mSv (999.9999 rem), the display reads as shown below:



5.2.4.1 Dosimeters integrating the 2.6 and over releases

Upon a saturation of the dose equivalent rate, the following alarm message is displayed, alternatively with the measurement value, to indicate a possible dose underestimation, due to saturation:



These messages warn that the dose measured by the dosimeter may be altered by this switching to saturation.

Saturation is handled independently for each measurement from the 3.7 version

5.2.5 DMC 2000 XB: Display of secondary measurements

By default, the primary measurements are:

- the Hp(10) « deep » dose equivalent and dose equivalent rate

The secondary measurements are:

- the Hs or Hp(0.07) « shallow » dose equivalent and dose equivalent rate

The display sequence of the measurements, between each press on the selector button is the following one :

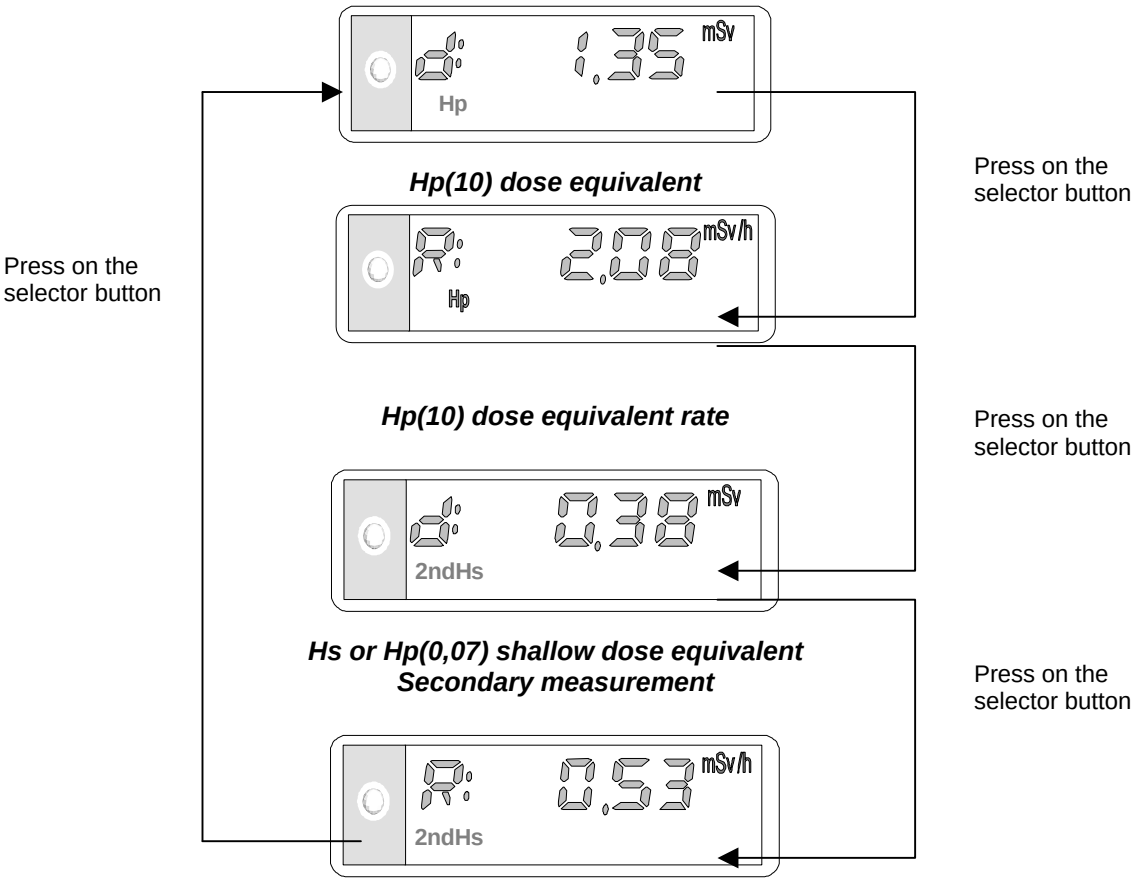
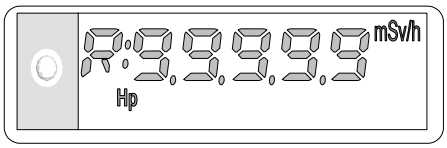


Figure 5 - Hs or Hp(0,07) shallow dose equivalent rate Secondary measurement

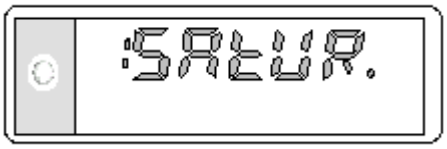
5.2.6 Dose Equivalent Rate Saturation

When the dose equivalent rate exceeds the value 9999 mSv/h (999.9 rem/h), the display reads as shown below:



5.2.6.1 Dosimeters integrating the 2.6 and over releases

Upon a saturation of the dose equivalent rate, the following alarm message is displayed, alternatively with the measurement value, to indicate a possible dose underestimation, due to saturation:



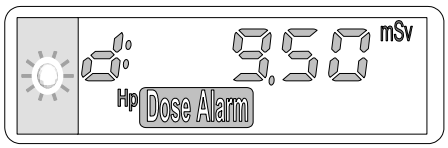
This message remains displayed in the dosimeter pause mode
(see « Operation in the Pause Mode », page 22).

After a dose reset , this message is erased
(see **«**Setting Operating Parameters **»**, ***« Cumulative Dose***», page ***51***).

Saturation is handled independently for each measurement from the 3.7 version

5.2.7 Fault and Alarm Indicators

In the event of a fault or an alarm, additional messages alternate on the display every 2 seconds, and are displayed for 2 seconds (see the example of an alarm below):



If authorized, the alarm can be acknowledged by pressing the selector button (refer to the chapter Alarms, page 45)

Note :
- *The alarm messages are described later in the chapter: chapter Alarms, page 45)*
- *Dosimeter fault messages are described in the chapter Faults , page 63, which includes a troubleshooting guide.*

5.2.8 Viewing Alarm Thresholds

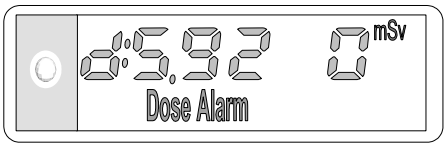
Settings for the alarm and pre-alarm thresholds can be viewed in the ***measurement*** mode by using the selector button.

To display the thresholds, press and hold the selector button for at least 8 seconds, **without releasing it.** The various thresholds are displayed in succession (every 2 seconds).

When the selector button is released, the dose equivalent is automatically displayed on the dosimeter.

The threshold display sequence is as follows:

- **“ Dose ” Alarm Threshold Display**

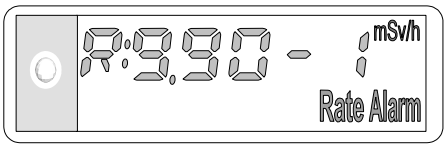


This value corresponds to the alarm threshold of the dose equivalent for the main measurement.

The display is shown in exponential form.

In the example above, the value of the rate corresponds to 5.92 mSv ($5.92.10^{0}$ mSv)

- **“ Rate ” Alarm Threshold Display**

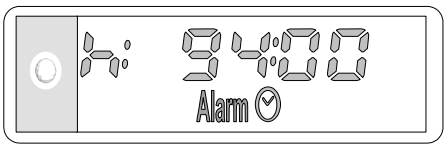


This value corresponds to the alarm threshold of the dose equivalent rate for the main measurement.

The display is shown in exponential form.

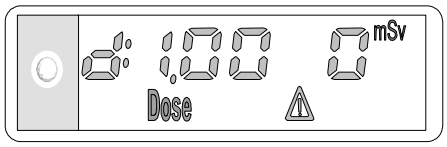
In the example above, the value of the rate corresponds to 0.990 mSv/h ($9.90.10^{-1}$ mSv/h)

- **“Time” Alarm Threshold Display**



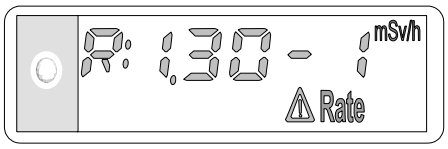
This value corresponds to the length of time alarm threshold (shown here: ***94 h***).

- **“ Dose ” Pre-Alarm Threshold Display**



This value corresponds to the pre-alarm threshold of the dose equivalent for the main measurement (shown here: ***1 mSv***).

- **“ Rate ” Pre-Alarm Threshold Display**



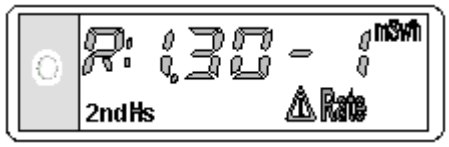
This value corresponds to the pre-alarm threshold of the dose equivalent rate for the main measurement (shown here: ***0.130 mSv/h***).

5.2.9 DMC 2000 XB : Hp(0.07) secondary measurement alarm and pre-alarm threshold display

The « dose » and « rate » alarm and pre-alarm thresholds relative to the Hp(0.07) secondary measurement can be consulted in the same way as the thresholds relative to the Hp(10) main measurement.

Their display is characterized by the symbol « 2^{nd} Hs » appearing in the lower left side of the display area:

Hp(0.07) measurement « dose » alarm threshold



Hp(0.07) measurement « rate » pre-alarm threshold

5.3 Switching to Pause Mode

Switching to the ***pause*** mode primarily consists of deactivating the **DMC 2000** dosimeter. In other words, suppressing the dose equivalent measurement.

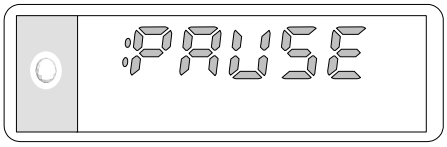
In a centralized dosimetry system, switching to the ***pause*** mode is accomplished when passing by a LDM 2000 access control monitor.

For additional information, refer to the operating manual for the centralized dosimetry system.

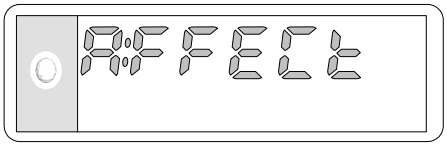
When switched to the ***pause*** mode, the display reads as shown below:

- the functional indicators flash
- one of the following messages can be displayed (depending on the dosimeter configuration: assigned or non-assigned...):

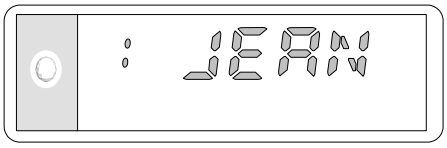
□ non-assigned dosimeter:



□ assigned dosimeter:



□ or (name of the wearer, depending on the dosimeter configuration)



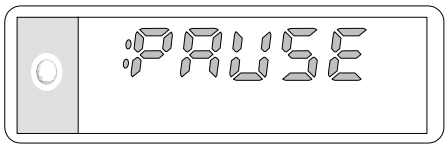
5.4 Operation in the Pause Mode

5.4.1 Normal Display

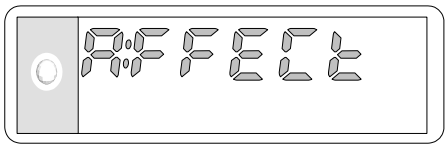
When the **DMC 2000** dosimeter is in the pause mode, it continuously performs the operations described in section ***"Pause Mode"***, page ***8***.

The display shows the message ***" PAUSE "*** or ***" affect " (or wearer's name)*** depending on whether or not it is assigned.

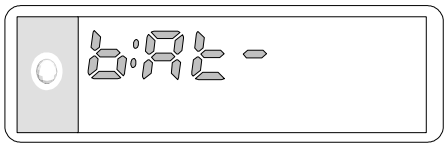
- non-assigned dosimeter:



- assigned dosimeter:



In the event of a fault, additional, alternating messages are displayed every 2 seconds (see the example below):



Note :
all dosimeter fault messages are described in the chapter Faults, page 63, which includes a troubleshooting guide.

5.4.2 Operation of the Selector Button

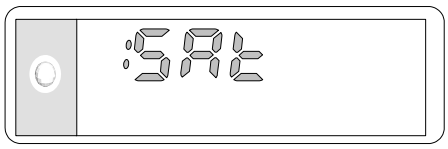
Using the selector button in the satellite mode allows additional information to be viewed on the **DMC 2000** dosimeter's display. This data and the corresponding displays are described below. Depending on the dosimeter's configuration, some data may not be displayed.

The different functions of the selector button are listed below:

- pressing the button:
  - displays the next data
- pressing and holding:
  - maintains the data on the display
- after 5 seconds without pressing:
  - normal display in the ***pause*** mode

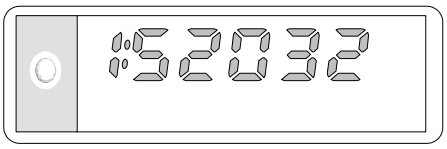
The following data is displayed in succession (by pressing the selector button):

- Display of operating mode
  For 2.6 and previous versions



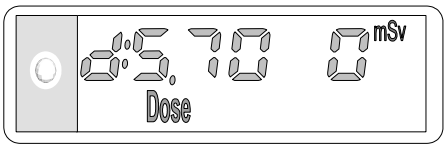
The message " Sat " indicates that the dosimeter is configured for use in a centralized dosimetry system.

- Display of dosimeter number
  For 2.7 and later versions



This data corresponds to the identification number specific to the dosimeter.

- **Cumulative Dose Display**

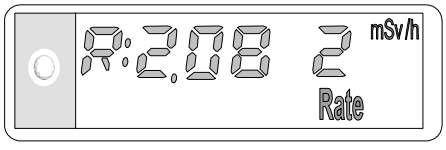


This data corresponds to the cumulative dose equivalent for the main measurement during the last time period in the ***measurement*** mode (i.e. since the last dose reset to zero, normally performed upon area entry, depending on the centralized dosimetry system's configuration).

The display is shown in exponential form.

In the example above, the value of the rate corresponds to 5.70 mSv ($5.70.10^0$ mSv).

- **Rate Display**

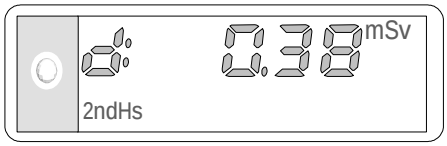


This data corresponds to the maximum dose equivalent rate for the main measurement during the last time period in the ***measurement*** mode.

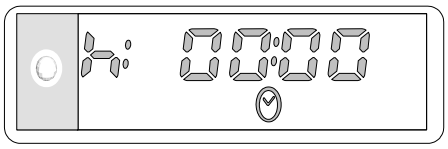
The display is shown in exponential form.

In the example above, the value of the rate corresponds to 208 mSv/h ($2.08.10^2$ mSv)

- **DMC 2000 XB: secondary measurement dose and secondary measurement rate**

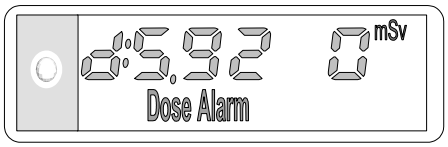


- **Duration Display**



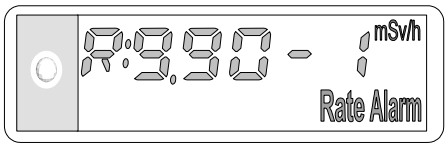
This data corresponds to the duration of the last time period in the ***measurement*** mode.

- **" Dose " Alarm Threshold Display**



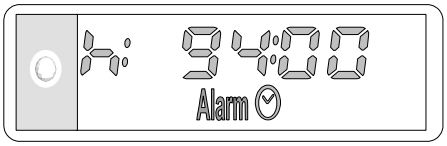
This data corresponds to the alarm threshold value of the dose equivalent for the main measurement (shown here: ***5.92 mSv***).

- **" Rate " Alarm Threshold Display**



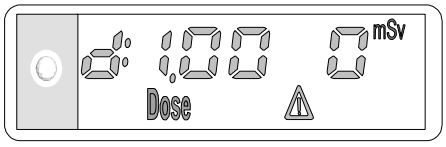
This data corresponds to the alarm threshold value of the dose equivalent rate for the main measurement (shown here: ***0.990 mSv/h***).

- **“ Duration ” Alarm Threshold Display**



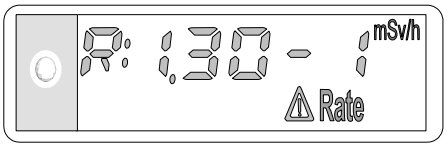
This data corresponds to the duration alarm threshold value (shown here: ***94 h***).

- **“ Dose ” Pre-Alarm Threshold Display**



This data corresponds to the pre-alarm threshold value of the dose equivalent for the main measurement (shown here: ***1 mSv***).

- **“ Rate ” Pre-Alarm Threshold Display**



This data corresponds to the pre-alarm threshold value of the dose equivalent rate for the main measurement (shown here: ***0.130 mSv/h***).

- **DMC 2000 XB : Hp(0.07) secondary measurement alarm and pre-alarm threshold display**

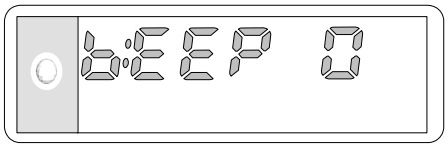
The « dose » and « rate » alarm and pre-alarm thresholds relative to the Hp(0.07) secondary measurement can be consulted in the same way as the thresholds relative to the Hp(10) main measurement.

Their display is characterized by the symbol « 2nd Hs » appearing in the lower left side of the display area:

Hp(0.07) measurement « dose » alarm threshold

Hp(0.07) measurement « rate » pre-alarm threshold

- **Audible Alarm Operating Mode Display**



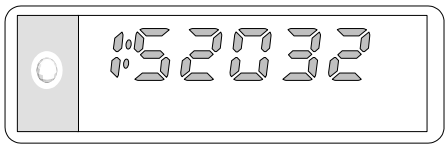
This value corresponds to the function which indicates the ambient rate to the user by an audible signal which is independent of the display:

- ***" BEEP.0 "*** : no audible signal for dose increments
- ***" BEEP.1 "*** : 1 beep every 100 µSv (10 mrem)
- ***" BEEP.2 "*** : 1 beep every 10 µSv (1 mrem),
- ***" BEEP.3 "*** : 1 beep every 1 µSv (0.1 mrem),
- ***" BEEP 4 ":*** 1 beep every 8 pulses (0.074 µSv) or 1beep/s per 267µSv/h approx. **(1)**
- ***" BEEP 5 ":*** 1 beep every 4 pulses (0.037 µSv) or 1beep/s per 133µSv/h approx. **(1)**

Note : (1) *: these configurations are not recommended more especially for the X and XB versions*

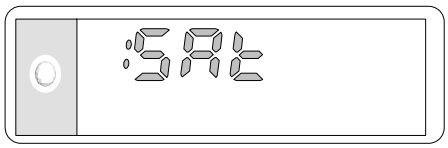
- **Dosimeter Number Display**

- **Display of dosimeter number**
  For 2.6 and previous versions



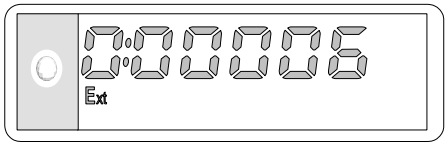
This data corresponds to the identification number specific to the dosimeter.

- **Display of operating mode**
  For 2.7 and later versions



The message ***" Sat "*** indicates that the dosimeter is configured for use in a centralized dosimetry system.

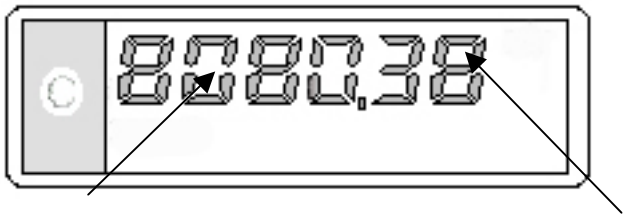
- **External Probe Number Display**



This value corresponds to the identification number specific to the extremity probe, if the dosimeter has a probe.

The message ***" FFFFFF "*** indicates that the dosimeter does not have an extremity probe.

- Display of the program checksum and calibration checksum



Checksum programme (4 characters) ***Checksum calibration (2 characters)***

These data are displayed from the 3.7 version, if the function has been validated. It represents the checksum calculated by the dosimeter.

The calibration checksum corresponds to the checksum of the internal and external calibration's parameters.

Checksums are controlled at each autotest and on change of status Program checksum in the V3.7 version is B1F4.

Calibration checksum is different from a dosimeter to another.

The standards checksums are displayed by the Dosimass software (N version or superior) during a reading writing of a dosimeter, if the checksum function has been validated.

5.4.3 "Pass-By" Reading

This "pass by" reading allows dosimeter information to be transmitted to the centralization system by simply passing by an **LDM** reader**.**

At a minimum, the following information is transmitted:

- the dosimeter number
- the cumulative dose equivalent
- any recorded alarm or fault information

For additional information, refer to the operating manual for the centralized dosimeter system.

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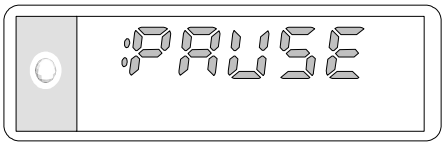
6. Operation in the Stand-alone Mode

6.1 Switching to the Measurement Mode

Switching to the ***measurement*** mode primarily consists of activating the **DMC 2000** dosimeter. In other words, programming the dose equivalent measurement.

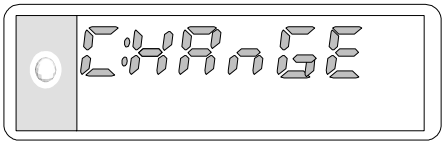
It is performed from the **pause** mode, as explained below.

- the display as it appears in the ***pause*** mode is shown below:

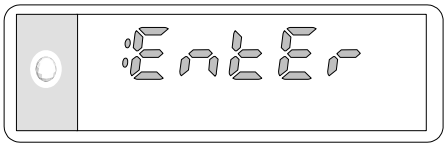


The “functional indicators” on the display indicates the dosimeter is functioning.

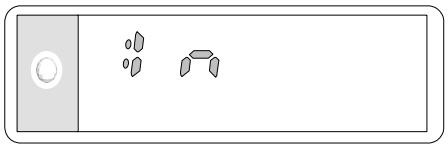
- the following message is displayed when the selector button is pressed:



- after approximately 3 seconds, the following message is displayed:



- while this message is displayed, press and immediately release the selector button
- the following message appears briefly on the display:



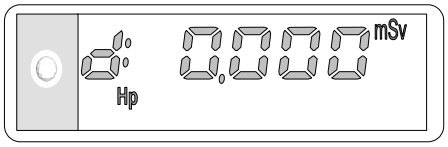
along with this message, there is an audible “beep”, a light “flash” on the red LED diode located next to the display, and a display test which activates all areas of the display.

The dosimeter is now operational (***measurement*** mode):

- the functional indicators are flashing
- the dose value appears on the display. The unit, format (fixed or floating point) and display resolution are selected during dosimeter configuration.

Note : *By using Dosimass-DM software, the audible beep can be replaced by a 3 seconds continuous alarm (only with V3.x review software and on entry).*

Example of a display:



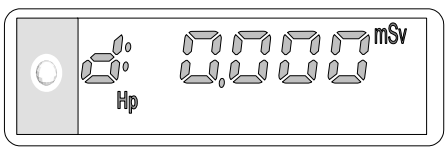
6.2 Operation in the Measurement Mode

6.2.1 Displaying the Dose Equivalent Measurement

When in the measurement mode, the **DMC 2000** dosimeter continuously measures the Hp (10) dose equivalent, as well as performing other operations (see section *Measurement* Mode: DMC 2000 S and DMC 2000 X, page 8).

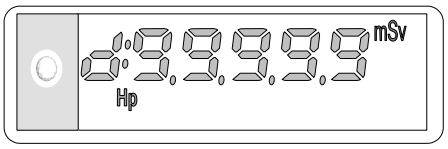
The display shows the dose value. The unit, format (fixed or floating point) and display resolution are selected during dosimeter configuration.

Example of a display:



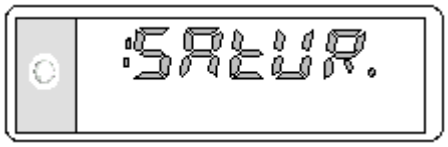
6.2.2 Dose Equivalent Saturation

When the dose equivalent exceeds the value 9999.999 mSv (999.9999 rem), the display reads as shown below:



- **Dosimeters integrating the 2.6 and over releases.**

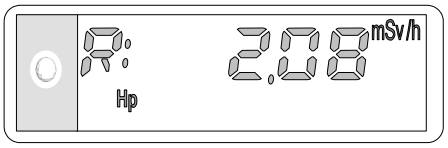
When a saturation on the dose equivalent rate is detected, the dose display is the preceding one and the following alarm message is displayed alternatively with the dose.



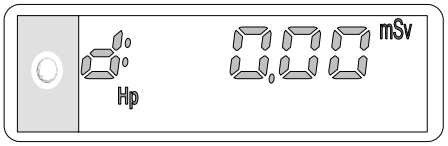
These messages warn that the dose measured by the dosimeter may be altered by this switching to saturation.

6.2.3 Displaying the Dose Rate Measurement

Pressing and immediately releasing the selector button displays the dose equivalent rate value for 30 seconds. The unit, format (fixed or floating point) and display resolution are selected during dosimeter configuration.



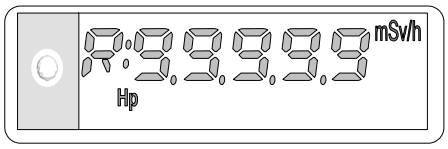
After these 30 seconds, the dose equivalent value is then displayed again:



Note :
other alternating displays of dose/rate are available. Please contact us.

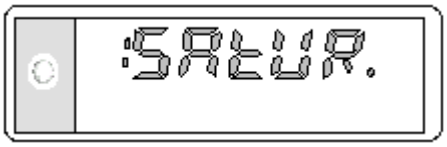
6.2.4 Dose Equivalent Rate Saturation

When the dose equivalent rate exceeds the value 9999 mSv/h (999.9 rem/h), the display reads as shown below:



6.2.4.1 Dosimeters integrating the 2.6 and over releases

Upon a saturation of the dose equivalent rate, the following alarm message is displayed, alternatively with the measurement value, to indicate a possible dose underestimation , due to saturation:



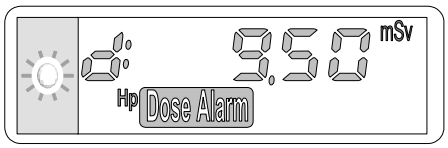
This message remains displayed in the dosimeter pause mode
(see « Operation in the Pause Mode », page 22).

After a dose reset , this message is erased
(see « Setting Operating Parameters», « Cumulative Dose», page 51)

Saturation is handled independently for each measurement from the 3.7 version

6.2.5 Fault and Alarm Indicators

In the event of a fault or an alarm, additional messages alternate on the display every 2 seconds, and are displayed for 2 seconds (see the example of an alarm below):



If authorized, alarm acknowledgment is accomplished by pressing the selector button (refer to the chapter Alarms, page 45)

Note :
- *the alarm messages are described later in the chapter Alarms, page 45)*
- *dosimeter fault messages are described in the chapter Faults , page 63, which includes a troubleshooting guide.*

6.2.6 Viewing Alarm Thresholds

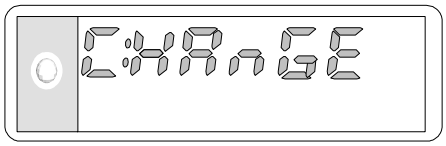
Settings for the alarm and pre-alarm thresholds can be viewed in the ***measurement*** mode by using the selector button.

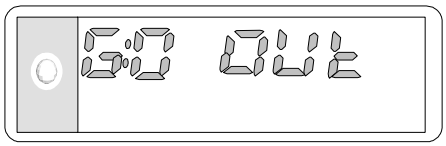
To display the thresholds, press and hold the selector button for at least 8 seconds, **without releasing it** while the thresholds are alternately displayed (every 2 seconds).

When the selector button is released, the dose equivalent is automatically displayed on the dosimeter.

The threshold display sequence is as follows:

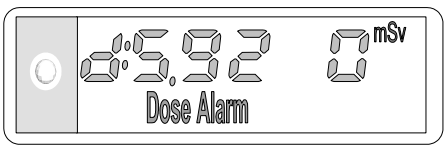
- after approximately 10 seconds, the following 3 messages are displayed. To avoid inadvertently switching to pause mode, do not release the selector button:





the following thresholds are then displayed:

- **“ Dose ” Alarm Threshold Display**

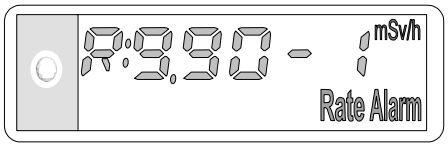


This value corresponds to the alarm threshold of the dose equivalent for the main measurement.

The display is shown in exponential form.

In the example above, the value of the rate corresponds to 5.92 mSv ($5.92.10^0$ mSv)

- **“ Rate ” Alarm Threshold Display**

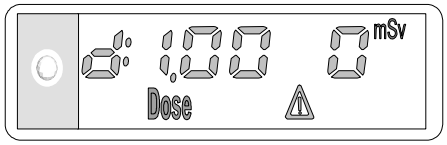


This value corresponds to the alarm threshold of the dose equivalent rate for the main measurement.

The display is shown in exponential form.

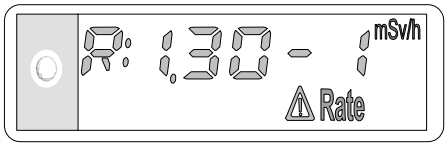
In the example above, the value of the rate corresponds to 0.990 mSv/h ($9.90.10^{-1}$ mSv/h)

- **“ Dose ” Pre-Alarm Threshold Display**



This value corresponds to the pre-alarm threshold of the dose equivalent for the main measurement (shown here: ***1 mSv***).

- **“ Rate ” Pre-Alarm Threshold Display**



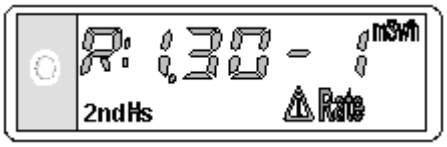
This value corresponds to the pre-alarm threshold of the dose equivalent rate for the main measurement (shown here: ***0.130 mSv/h***).

- **DMC 2000 XB : Hp(0.07) secondary measurement alarm and pre-alarm threshold display**

The « dose » and « rate » alarm and pre-alarm thresholds relative to the Hp(0.07) secondary measurement can be consulted in the same way as the thresholds relative to the Hp(10) main measurement.

Their display is characterized by the symbol « 2^{nd} Hs » appearing in the lower left side of the display area:

Hp(0.07) measurement « dose » alarm threshold



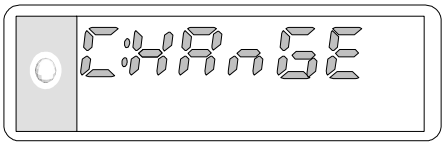
Hp(0.07) measurement « rate » pre-alarm threshold

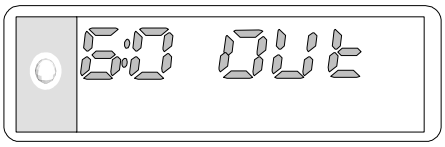
6.3 Switching to Pause Mode

Switching to the ***pause*** mode primarily consists of deactivating the **DMC 2000** dosimeter. In other words, suppressing the dose equivalent measurement.

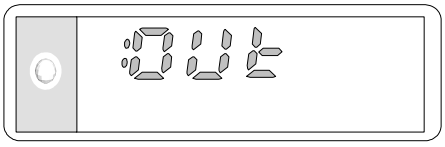
To switch to the ***pause*** mode when using the DMC 2000 in the stand-alone mode, press the selector button and follow the procedure listed below:

- the selector button should be held pressed in for approximately 10 seconds. The following messages are displayed in succession:





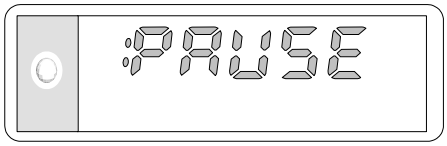
- when this “go out” message is displayed, **immediately** release the selector button. The following messaged is displayed briefly:



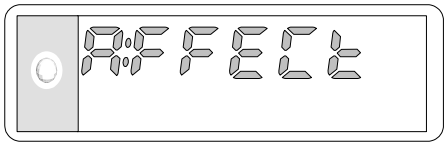
The dosimeter is now in the ***pause*** mode. The display indicates the following:

- the functional indicators are flashing
- one of the following messages can be displayed (depending on the dosimeter configuration: assigned or non-assigned...):

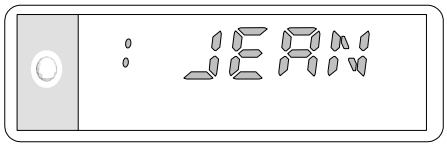
□ non-assigned dosimeter:



□ assigned dosimeter:



or (name of the wearer, depending on the dosimeter configuration)



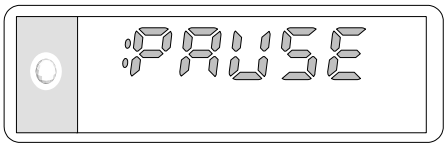
7. Operation in the Pause Mode

7.1 Normal Display

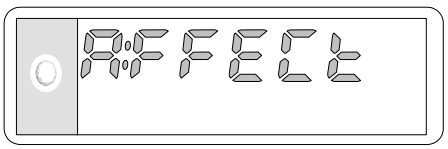
When the **DMC 2000** dosimeter is in the ***pause*** mode, it continuously performs the operations described in section *Pause* Mode, page 8.

The display shows the message ***" PAUSE "*** or ***" affect " (or wearer's name)*** depending on whether it is assigned or not:

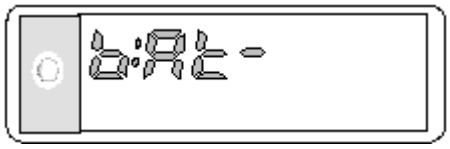
- non-assigned dosimeter



- assigned dosimeter:



In the event of a fault, additional, alternating messages are displayed every 2 seconds for a 2-second duration (see the example below):



Note :
all dosimeter fault messages are described in the chapter Faults, page 63, which includes a troubleshooting guide.

7.1.1 Operation of the Selector Button

Using the selector button in the **stand-alone mode** allows for:

- activating or deactivating the **DMC 2000** dosimeter (switching from the ***pause*** mode to the ***measurement*** mode and conversely)
- displaying the necessary information for the user on the **DMC 2000** dosimeter's display,
- modifying the alarm thresholds if necessary.

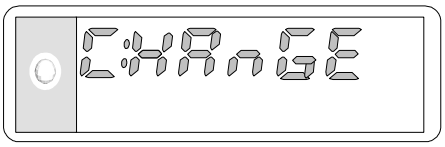
This information and the corresponding displays are described hereafter. Depending on the dosimeter's configuration, some data can be concealed.

The different functions of the selector button are listed below:

- pressing the button:
  - displays the next data,
- pressing and holding:
  - maintains the data on the display,
- after 5 seconds without pressing:
  - normal display in the ***pause*** mode.

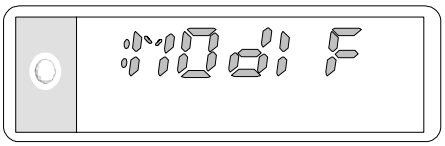
The following data are displayed in succession (by pressing the selector button):

- **Access to Dosimeter Activation**



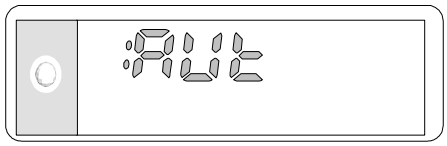
This message provides access to the dosimeter activation procedure (see section Switching to the Measurement Mode, page *29*)

- **Access to Parameter Modification**



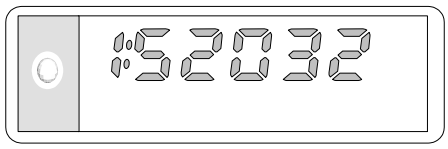
This message provides access to the modification procedure for some parameters (see section Modifying Parameters, page 55).

- **Display of operating mode**
  For 2.6 and previous versions



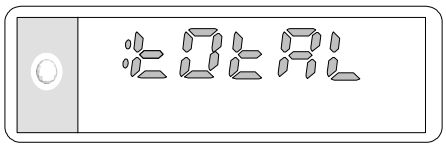
The message " ***Aut*** " indicates that the dosimeter is configured for use in stand-alone mode.

- **Display of dosimeter number**
  For 2.7 and later versions



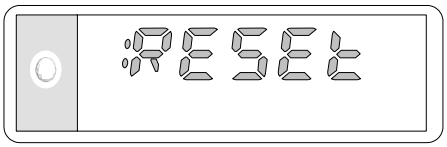
This data corresponds to the identification number specific to the dosimeter..

- **Dose Recording Mode Display**



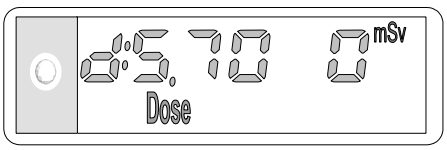
The message ***" total "*** indicates that the dosimeter is cumulating the dose equivalent values after each use of the dosimeter.

or



The message ***" reset "*** indicates that the dosimeter resets to zero each time it is switched into the ***measurement*** mode, with the dose equivalent value previously cumulated.

- **Cumulative Dose Display**

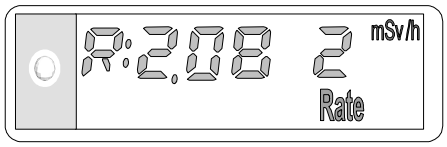


This data corresponds to the cumulative dose equivalent for the main measurement during the last time period in the ***measurement*** mode (i.e., since the last dose reset to zero - since the last area entry if ***"reset"*** mode, or upon the first area entry if ***"total"*** mode).

The display is shown in exponential form.

In the example above, the value of the dose corresponds to 5.70 mSv ($5.70.10^0$ mSv).

- **Rate Display**

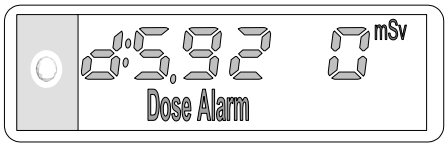


This data corresponds to the maximum dose equivalent rate for the main measurement during the last time period in the ***measurement*** mode.

The display is shown in exponential form.

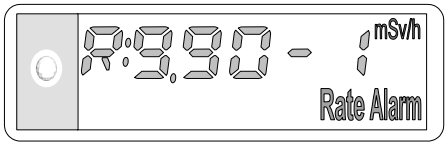
In the example above, the value of the rate corresponds to 208 mSv/h ($2.08.10^2$ mSv).

- **" Dose " Alarm Threshold Display**



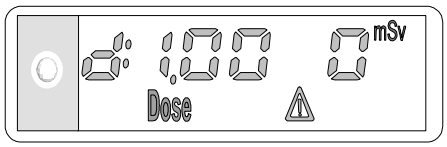
This data corresponds to the alarm threshold value of the dose equivalent for the main measurement (shown here: ***5.92 mSv***).

- **" Rate " Alarm Threshold Display**



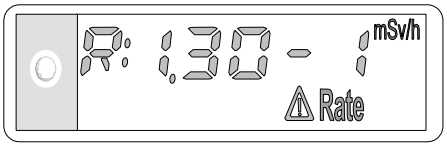
This data corresponds to the alarm threshold value of the dose equivalent rate for the main measurement (shown here: ***0.990 mSv/h***).

- **" Dose " Pre-Alarm Threshold Display**



This data corresponds to the pre-alarm threshold value of the dose equivalent for the main measurement (shown here: ***1 mSv***).

- **“ Rate ” Pre-Alarm Threshold Display**

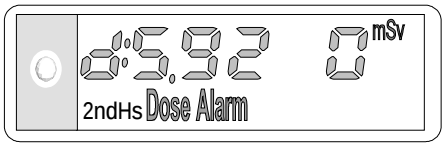


This data corresponds to the pre-alarm threshold value of the dose equivalent rate for the main measurement (shown here: ***0.130 mSv/h***).

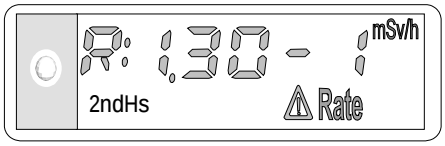
- **DMC 2000 XB: Hp(0.07) secondary measurement alarm and pre-alarm threshold display**

The « dose » and « rate » alarm and pre-alarm thresholds relative to the Hp(0.07) secondary measurement can be consulted in the same way as the thresholds relative to the Hp(10) main measurement.

Their display is characterized by the symbol « 2nd Hs » appearing in the lower left side of the display area:



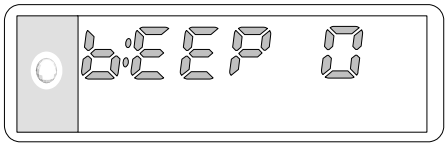
Hp(0.07) measurement « dose » alarm threshold



Hp(0.07) measurement « rate » pre-alarm threshold

Note : *The Hp(0.07) or Hp(10) measurements can be indifferently in main or secondary measurement depending on the dosimeter’s configuration.*

- **Audible Alarm Operating Mode Display**



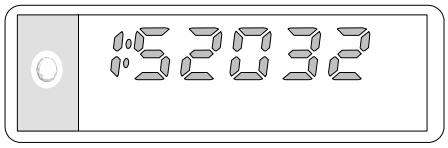
This data corresponds to the function which indicates the ambient rate to the user by an audible signal which is independent of the display:

- ***" BEEP.0 "*** : no audible signal for dose increments,
- ***" BEEP.1 "*** : 1 beep every 100 µSv (10 mrem)
- ***" BEEP.2 "*** : 1 beep every 10 µSv (1 mrem),
- ***" BEEP.3 "*** : 1 beep every 1 µSv (0.1 mrem),
- ***" BEEP 4 ":*** 1 beep every 8 pulses (0.074 µSv) or 1beep/s per 267µSv/h approx. **(1)**
- ***" BEEP 5 ":*** 1 beep every 4 pulses (0.037 µSv) or 1beep/s per 133µSv/h approx **(1)**

Note : (1) *these configurations are not recommended more especially for the X and XB versions*

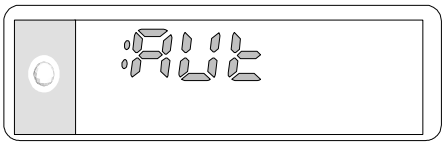
- **Operating Mode Display**

- **Display of dosimeter number For 2.6 and previous versions**



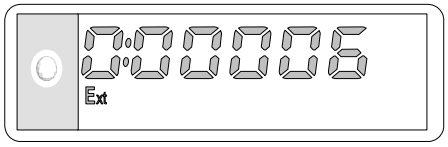
This data corresponds to the identification number specific to the dosimeter.

- **Display of operating mode For 2.7 and later versions**



The message " ***Aut*** " indicates that the dosimeter is configured for use in stand-alone mode.

- **External Probe Number Display**



This data corresponds to the identification number specific to the extremity probe, if the dosimeter has a probe.

The message ***" FFFFFF "*** indicates that the dosimeter does not have an extremity probe.

- Display of the program checksum and calibration checksum

Checksum programme (4 characters) ***Checksum calibration (2 characters)***

These data are displayed from the 3.7 version, if the function has been validated. It represents the checksum calculated by the dosimeter.

The calibration checksum corresponds to the checksum of the internal and external calibration's parameters.

Checksums are controlled at each autotest and on change of status Program checksum in the V3.7 version is B1F4.

Calibration checksum is different from a dosimeter to another.

The standards checksums are displayed by the Dosimass software (N version or superior) during a reading writing of a dosimeter, if the checksum function has been validated.

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8. Alarms

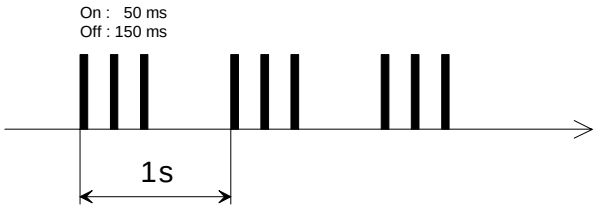
The **DMC 2000** dosimeter generates audible and visual alarms when thresholds which have been pre-determined during configuration are exceeded. In the ***measurement*** mode these alarm indicators are:

- an audible alarm emitted by the dosimeter buzzer
- a flashing message or symbol on the display
- 3 flashes (short flashes by the indicator light) emitted during the alarm, at a rate of 3 quick light flashes per second (if the dosimeter has been configured with this function)

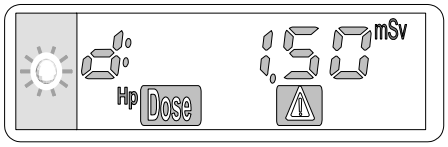
Note :
- *in the event of simultaneous alarms, all corresponding messages and symbols are displayed*
- *the audible alarms and alarm displays can be disabled when configuring the **DMC 2000-type** dosimeters; this function can be configured in factory or modified using the DOSIMASS maintenance software or the DOSIVIEW access control software connected to a LDM reader (refer to the centralized dosimeter system user's manual).*

8.1 Dose Pre-Alarm

- cause:
  - pre-alarm threshold for dose equivalent exceeded
- audible alarm (see below):



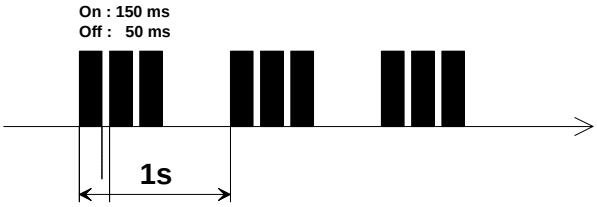
- display:
  - the message " *Dose* " and the "warning" symbol flash. The dose is still displayed (see below) :



- acknowledgment: this silences the alarm, but does not change the display
  - to acknowledge the dose pre-alarm, press and hold the selector button for at least 3 seconds.

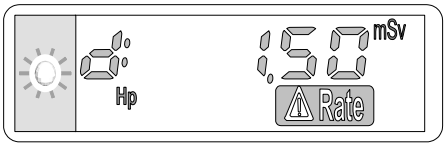
8.2 Rate Pre-Alarm

- cause (only in the ***measurement*** mode):
  - pre-alarm threshold for the dose equivalent rate exceeded
- reason of disappearance: rate < 1/2 rate prealarm threshold
- audible alarm (see below):



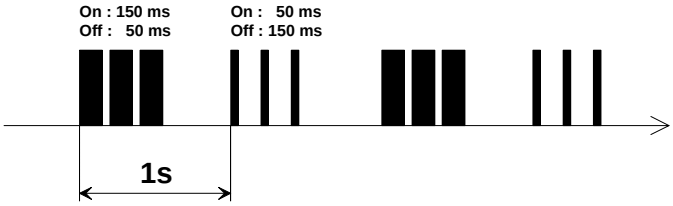
Note :
For firmware version V2.A and newer, it is possible to configure the rate alarm to remain energized until the dosimeter is turned to PAUSE. Acknowledgement of the pre-alarm is still possible.

- display:
- the message " *Rate* " and the "warning" symbol flash. The dose is still displayed (see below):

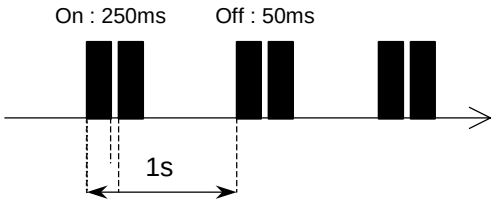


- acknowledgment: this silences the alarm, but does not change the display
- to acknowledge the dose pre-alarm, press and hold the selector button for at least 3 seconds.

Note :
In the event a rate pre-alarm occurs at the same time as a pre-alarm or a dose alarm, the audible alarm indication is as follows:

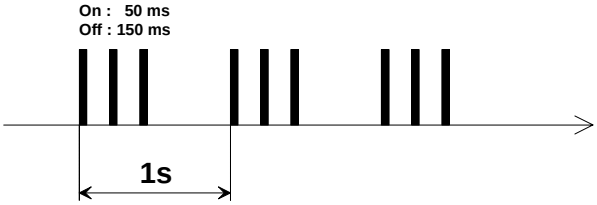


From the V2.8 versions, the rate pre-alarm and alarm rhythm can be modified through a configuration. This rhythm becomes: 2 long beeps/s

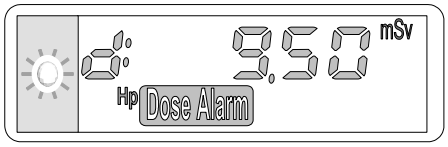


8.3 Dose Alarm

- cause (only in the ***measurement*** mode):
- dose equivalent alarm threshold exceeded
- audible alarm (see below):



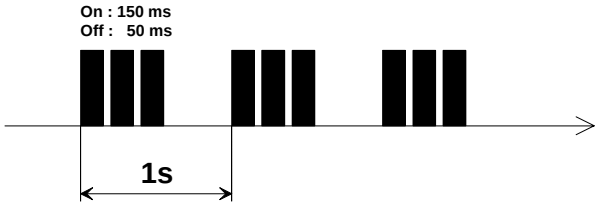
- display:
- the message " *Dose Alarm* " flashes. The dose is still displayed (see below):



Note :
the dose alarm cannot be acknowledged.

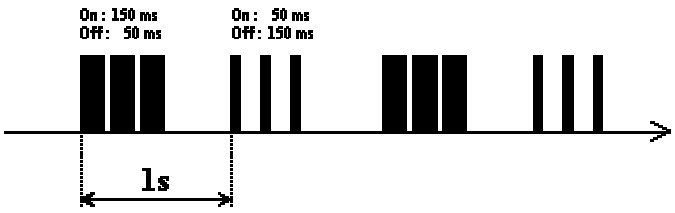
8.4 Dose Rate Alarm

- cause (only in the ***measurement*** mode):
- dose equivalent rate alarm threshold exceeded
- reason of disappearance: rate < 1/2 rate prealarm threshold
- audible alarm (see below):

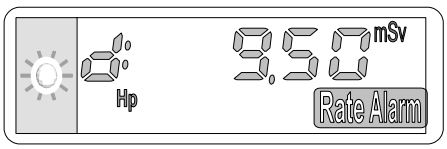


Note :
For firmware version V2.A and newer, it is possible to configure the rate alarm to remain energized until the dosimeter is turned to PAUSE.

In the event a rate alarm occurs at the same time as a pre-alarm or a dose alarm, the audible alarm indication is as follows:



- display:
  - the message " *Rate Alarm* " flashes. The dose is still displayed (see below):



Note :

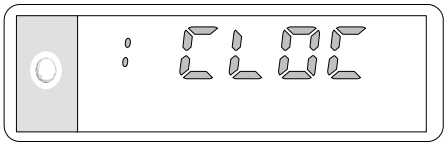
- *the dose rate alarm cannot be acknowledged.*
- *in **Satellite mode**, the **dose and dose rate** alarm thresholds are set to the high measurement range value.*

8.5 Duration alarm

- cause:
  - alarm threshold exceeded

Note :
the time alarm threshold can be factory - programmed or by using a LDM dosimeter reader and the DOSIMASS-DM maintenance software. This threshold cannot be adjusted in the stand-alone mode.

- audible alarm: one beep every second
- display:
  - the message " *CLOC* " and the measurement alternate on the display (see below) :



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9. Setting Operating Parameters

9.1 In the Satellite Mode

When the DMC 2000 dosimeters are in this mode, all operating parameters can be modified.

Modifying parameters in this mode requires the use of an LDM reader connected to DOSIVIEW, the centralized dosimeter software, or DOSIMASS-DM software, the dosimeter maintenance software (refer to the corresponding user's manual).

9.2 In the Stand-alone Mode

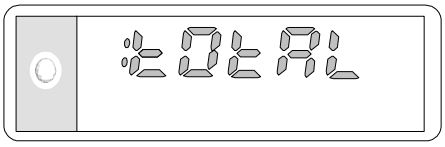
When the DMC 2000 is in this mode, the main operating parameters can be directly modified by the user by simply using the selector button. No other equipment is required.

This can only be done in the ***pause*** mode.

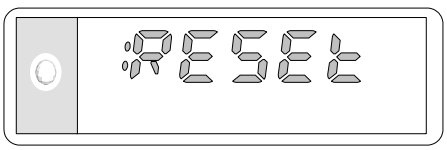
9.3 Modifiable Parameters

The parameters which can be modified are described below in the order in which they appear on the display when the selector button is pressed. However, depending on the dosimeter configuration, some parameters may not be displayed.

9.3.1 Cumulative Dose



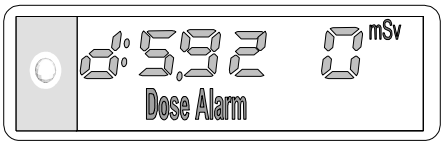
or



This parameter allows the absorbed dose to be cumulated (or reset to zero) during each dosimeter usage period.

- the message ***" total "*** indicates that the dosimeter is cumulating the dose equivalent values after each use of the dosimeter.
- the message ***" reset "*** indicates that the dosimeter resets to zero each time it is switched into the ***measurement*** mode.

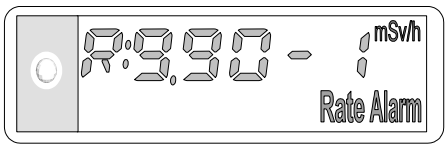
9.3.2 Gamma " Dose " Alarm Threshold



This parameter corresponds to the absorbed dose value above which an alarm will be triggered.

This value can be set from 0.01 x 10^{-2} to 9.99 x 10^{+3} mSv.

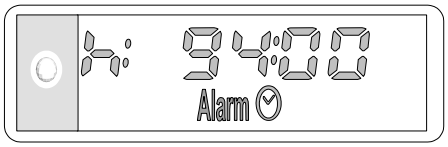
9.3.3 Gamma " Rate " Alarm Threshold



This parameter corresponds to the dose rate value above which an alarm will be triggered.

This value can be set from 0.01 x 10^{-2} to 9.99 x 10^{+3} mSv.

9.3.4 " Time " Alarm Threshold

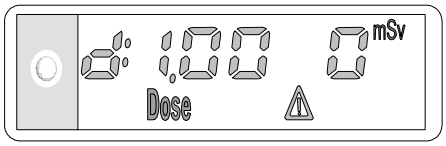


This parameter corresponds to the time period operating in the ***measurement*** mode after which an alarm will be triggered.

This value can be set from 0 hr. 01 min. to 99 hr. 59 min.

If this value is set to **00 hr. 00**, the ***time*** alarm will not be triggered.

9.3.5 Gamma " Dose " Pre-Alarm Threshold

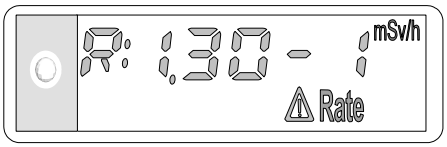


This parameter corresponds to the absorbed dose value above which a pre-alarm will be triggered.

This value can be set from 0.01 x 10^{-2} to 9.99 x 10^{+3} mSv ; it should always be lower than the dose equivalent alarm threshold.

If this value is set to **0** (**0.00.10^{0}**), the ***dose*** pre-alarm will not be triggered.

9.3.6 " Rate " Pre-Alarm Threshold

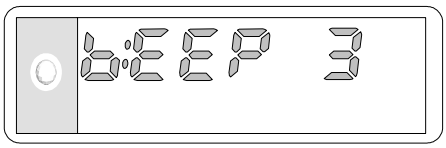


This parameter corresponds to the dose rate value above which a pre-alarm will be triggered.

This value can be set from 0.01 x 10^{-2} to 9.99 x 10^{+3} mSv ; it should always be lower than the dose rate alarm threshold.

If this value is set to **0** (**0.00.10^{0}**), the ***rate*** pre-alarm will not be triggered***.***

9.3.7 Audible Alarm Indications



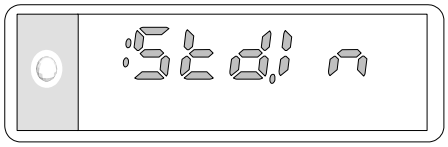
This parameter provides an indication of the ambient rate to the user by an audible signal which is independent of the display.

- "BEEP.0" : no audible signal for dose increments
- "BEEP.1" : 1 beep every 100µSv (10 mrem)
- "BEEP.2" : 1 beep every 10 µSv (1mrem)
- "BEEP.3" : 1 beep every 1 µSv (0.1 mrem)

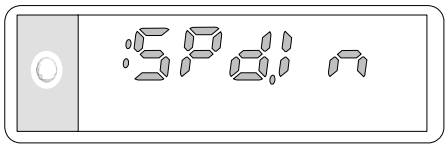
- "BEEP 4" : 1 beep every 8 pulses (0.074 µSv) or 1 beep/s per 267 µSv/h approx. **(1)**
- "BEEP 5" : 1 beep every 4 pulses (0.037 µSv) or 1beep/s per 133µSv/h approx **(1)**

Note : *(1)These configurations are not recommended more especially for the X and XB versions.*

9.3.8 "Emergency Start-Up" Operating Mode



or



The ***emergency start-up*** mode can be activated with this parameter.

- the message ***" Std.In "*** indicates that the ***emergency start-up*** mode is disabled ("**St**an**d**ard **In**").
- the message ***" SPd.In "*** indicates that the ***emergency start-up*** mode is enabled ("**SP**ee**d In**").

Note :

- *after each emergency start-up, the* **emergency start-up** *mode is disabled on the V1.x and V2.x software. According to the configuration and if no alarm has triggered the emergency start is automatically reset on the software V3.x versions.*
- *For further information on this operating mode, refer to the section Emergency Start-Up, page 61).*

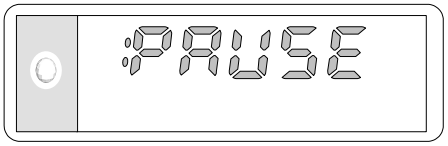
9.4 Modifying Parameters

In the ***stand-alone*** mode, the various operating parameters of the DMC 2000 dosimeter can be modified by the user by using the selector button.

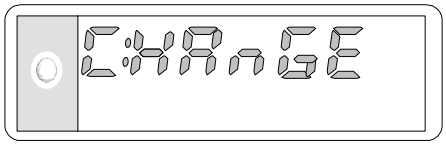
Note :
*in **satellite** mode, any parameter modification requires the use of a LDM reader and the centralized dosimetry system software or Dosimass-DM software (refer to the corresponding user's manuals).*

9.4.1 Accessing the Modification Mode

This is accomplished by following the procedure described below. Begin in the ***pause*** mode.

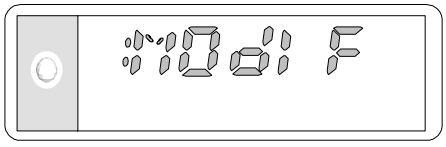


Press and release the selector button once and the display changes to:

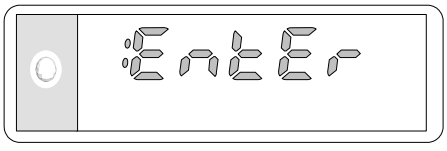


Press and release the selector button a second time and the DMC 2000 dosimeter is now in the ***parameter modification*** mode.

First, the message below will be displayed for a few seconds.

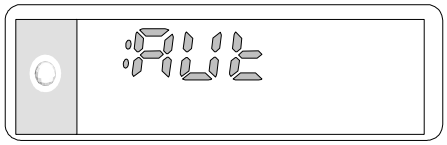


then the following message is displayed:



When this message is displayed, **immediately** press the selector button to access the parameters to be modified.

The following message, which cannot be changed, is displayed:



The modifiable parameters can now be accessed by simply pressing and releasing the selector button.

The parameters are then displayed in the order as outlined in the section Modifiable Parameters, page 51.

9.4.2 Procedures for Modifying Parameters

Parameter modification is performed in the ***modification*** mode. The preceding section describes how to access this mode.

The procedure is the same for all modifiable parameters (an example is described in detail in the section ***"Example for Setting Parameters"***, page ***57***).

There are three steps in setting parameters:

- **Step " P "**

This step is identified by the flashing **" P "** displayed to the left of the "functional indicators". It allows all modifiable **parameters** to be accessed.

- pressing and releasing enters the current parameter and takes you to the next one
- pressing and holding the selector button takes you to the next step

- **Step "d"**

This step is identified by the flashing **"d"** displayed to the left of the "functional indicators". It allows you to access each **digit** of the current parameter.

- pressing and releasing allows you to access the next digit
- pressing and holding the selector button takes you to the next step

Note :
this step is not included for the "general" parameters such as "RESET" or "TOTAL".

- **Step " I "**

This step is identified by the flashing **" I "** displayed to the left of the "functional indicators". It allows modification of the selected digit of the current parameter by **increments**.

- pressing and releasing changes the value by 1 increment
- pressing and holding the selector button takes you to the next step

Note :
for "general" parameters, pressing and releasing the selector button allows selection of the available values (for example: " RESET " or " TOTAL")

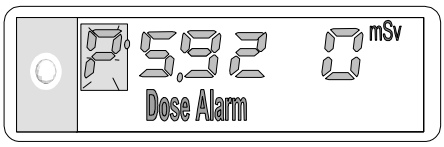
Steps **" I "** and **"d"** are displayed after step **" P "**, but not in any particular order (either **" I "** or **"d"**).

The DMC 2000 dosimeter automatically switches back to the ***pause*** mode after 10 seconds of inactivity on the selector button.

9.4.3 Example for Setting Parameters

- Access the modification mode as described in the section "Accessing the Modification Mode", page 55
- Go to the parameter you want to modify:
  - by successively pressing and releasing the selector button

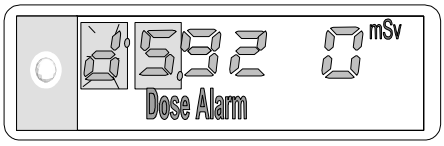
Example shown: dose alarm threshold



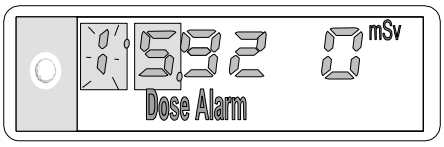
the parameter is displayed and is preceded by a flashing **" *P* "** (parameter setting mode is active)

- **To access** the digit you want to change:
  - press and hold the selector button until the flashing **"*d*"** is displayed (the digit which can be changed is flashing)
  - press and release the selector button until the digit you want to change is flashing

*In the example shown, the digit to be modified flashes as soon as the **"d"** is displayed:*

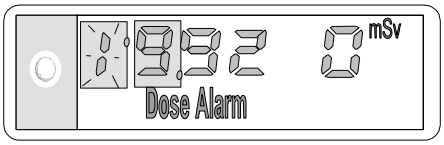


- **To change** the value of the selected digit
  - press and hold the selector button until the flashing **" I "** is displayed

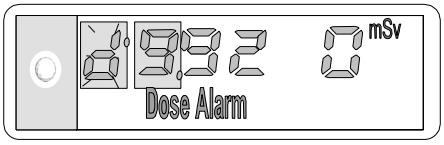


- increment the digit to the desired value by pressing and releasing the selector button until this value is reached

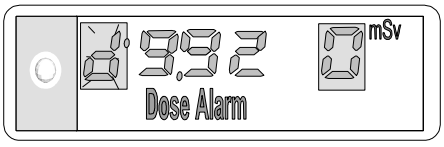
In the example shown, the selector button must be pressed 4 times in order to obtain the value "9" :



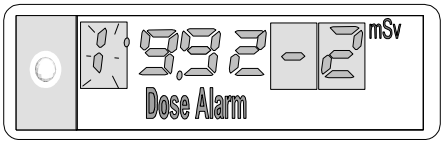
- **To access** the next digit:
- press and hold the selector button until the flashing **"*d*"** is displayed
- access the other digits you want to change by pressing and releasing the selector button



In the example shown, the selector button must be pressed 3 times to access the exponent:

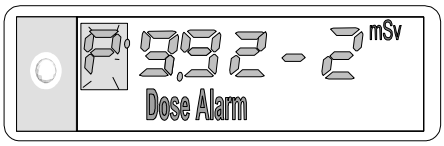


- **To change** the value of the newly selected digit:
- press and hold the selector button until the flashing **" I "** is displayed
- increment the digit to the desired value by pressing and releasing the selector button until this value is reached



in the example shown, the selector button must be 4 times in order to obtain the value "-2" :

- **Validating** the new values:
- press and hold the selector button until the flashing **" P "** is displayed



- **Modifying** other parameters:
  - press and release the selector button to access the next parameter to be modified
  - repeat the steps as described above for the “dose alarm” parameter
- Return to the ***pause*** mode*:*
  - wait approximately 10 seconds before using the selector button.
    The dosimeter automatically returns to the ***pause*** mode.

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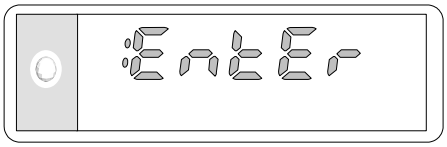
10. Other functions

10.1 Emergency Start-Up

The DMC 2000 dosimeters can be started up using a simplified and quick procedure.

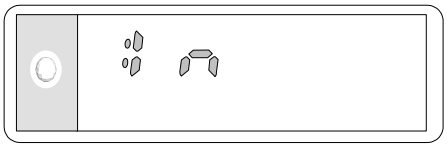
For this function, the "*emergency start-up*" operating mode must be enabled (refer to the chapter Setting Operating Parameters, section ""**Emergency Start-Up**" Operating Mode *page 53*).

When the "***emergency start-up***" operating mode is enabled, the following message is displayed:



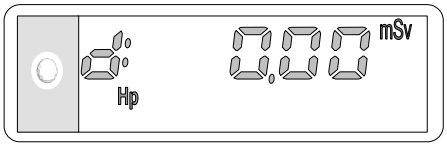
Simply pressing once on the selector button immediately switches the DMC 2000 dosimeter to the ***measurement*** mode:

The following message is displayed briefly:



then the dosimeter switches to the ***measurement*** mode:

- the "functional indicator" is flashing
- the display indicates the value of the dose



Note :

- *as soon as the dosimeter switches back to the **pause** mode, the "**emergency start-up**" **operating mode** is **disabled** on the software V1.x and V2.x. To enable this mode again, the parameters must also be set again. (refer to the chapter Setting Operating Parameters, section "Emergency Start-Up" Operating Mode, page 53).*
- *As soon as the dosimeter switches back to the pause mode, according to the configuration and if no alarm has triggered, the "emergency start-up" operating mode is automatically reset on the software V3.x versions.*

10.2 Historical function

The **DMC 2000-type** dosimeters have a "historical" function which allows:

- recording and storage of the change in the cumulative Hp(10) or Hp(0.07) dose by intervals (750 historical intervals of 10 s, 1 min. 10 min. 1 hr or 24 hr depending on the dosimeter's configuration)
- recording and dating of significant events such as:
  - alarms, pre-alarms:
    - DMC 2000 XB case: recording and storage of the alarm exceeding for the Hp(10) "deep" and Hp(0.07) "shallow" dose measurements.
  - acknowledgment of pre-alarms
  - assignment and storage of identifier code
  - task code
  - change in operating mode (***pause*** and ***measurement***)
  - dosimeter fault
  - saturation
  - passing by an LDM 2000 access control reader with storage of the reader number

In order to provide this function, the **DMC 2000** dosimeter is equipped with a clock which is set during configuration (refer to the centralized dosimetry system user's manual).

Note : *on dosimeters with V3.x review and depending on the "extended history" configuration , the dose recording is done on the cumulative Hp(10) and Hp (0.07) doses. The numbers of histogram intervals are up to 3800. With the "extended history" configuration every parameters change are saved in the histogram.*

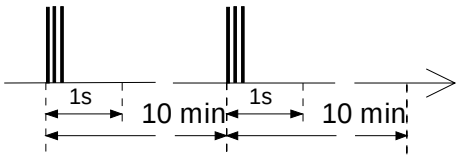
11. Faults

This section includes a troubleshooting guide which describes the dosimeter fault messages. Dosimeter faults are indicated by:

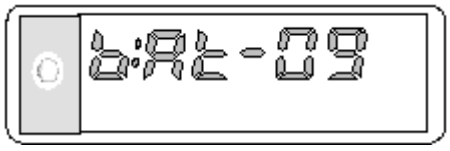
- An audible signal emitted by the dosimeter buzzer
- Display of the current message, alternating with a fault message every 2 seconds, and lasting 2 seconds

11.1 Battery Low

- Cause:
- Battery discharged; the remaining battery life in the ***measurement*** mode is 10 hours
- 3 audible pulses every 10 minutes:

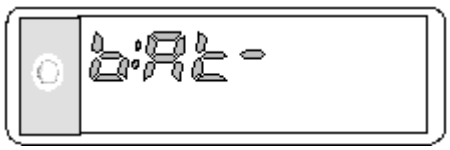


- Display:
- If the dosimeter is in the ***measurement*** mode, the message " *Bat-0X* " alternates on the display with the normal message (with X = number of remaining battery life hours, between 0 and 9):



From the V3.7 version, if the life time can't be calculated, the dosimeter will display: "**bAt -** ∗∗"

- If the dosimeter is in the ***pause*** mode, the message " *Bat-* " alternates on the display with the normal message. This message is displayed for 72 hours, then the dosimeter automatically switches to a reduced consumption mode during which all functions cease.

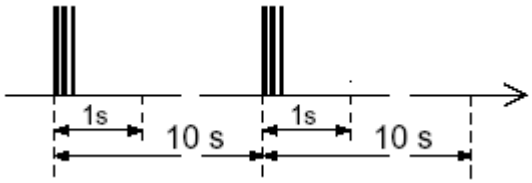


In this mode, the remaining battery life is not indicated.

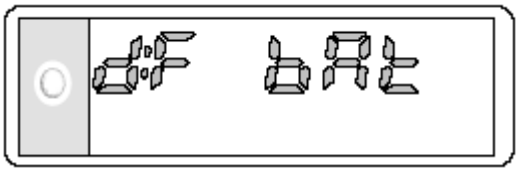
- Corrective action:
- Change the battery

11.2 Battery Absent

- Cause:
- Battery totally discharged or battery removed
- 3 audible pulses every 10 seconds:



- Display:
- The display reads " *DF BAT* " and the "functional indicators" are no longer present



- The indicator light flashes 3 times every second. The dosimeter completely stops after 3 minutes. The audible pulses cease and the display goes blank.

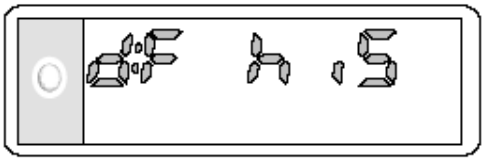
However, all data (parameters, dose, operating time…) is saved in the E2PROM memory and can be accessed once the battery is replaced.

- Corrective action:
- Change the battery

11.3 Historical Fault

- Cause:
- Problem in the integrity of the historical data. This can occur after the battery has been handled (removed or changed).
- Display:

- The display reads " *DF HIS* "

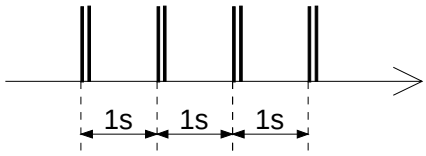


- Corrective action:

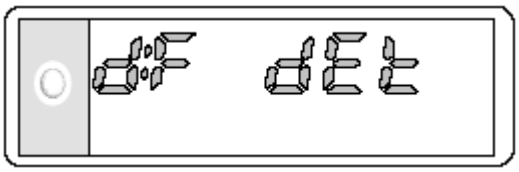
Activate the dosimeter with historical initialization (making sure to have previously deactivated it)

11.4 Detector Fault

- Cause:
- Physical, internal problem related to the dosimeter's detection circuit
- 2 audible pulses every second (only if the dosimeter is in the ***measurement*** mode):



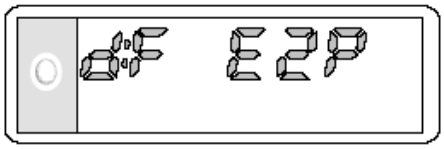
- Display:
- The display reads " *DF DET* "



- Corrective action:
- Return dosimeter to MGP Instruments

11.5 E2PROM Fault

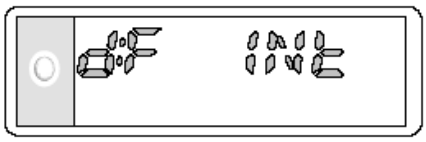
- Cause:
  - Problem accessing data saved in E2PROM memory
- Display:
  - The display reads " *DF E2P* ".



- Corrective action:
  - Take out the battery and then put it back in
  - If the fault persists, return the dosimeter to MGP Instruments.

11.6 Initialization Fault

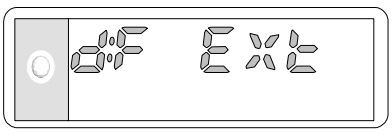
- Cause:
  - Dosimeter Data Integrity Problem
- Display:
  - The display reads " *DF INT* ".



- Corrective action:
  - re-initialize the dosimeter or have it re-initialized

11.7 External calibration fault

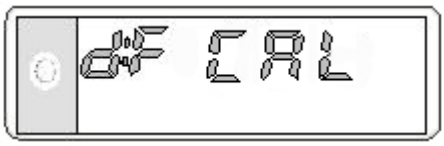
- Cause:
  - Problem in the integrity of dosimeter data
- Display:
  - The display reads " *DF EXT* "



- Corrective action:
  - Re-calibrate the dosimeter or have it re-calibrated

11.8 Calibration fault

- Cause:
  - Problem in the integrity of dosimeter data
- Display:
  - The display reads " *DF CAL* ""

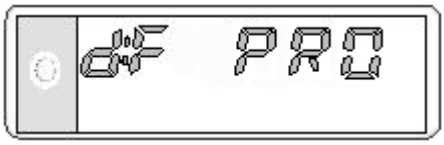


- Corrective action:
  - Re-calibrate the dosimeter or have it re-calibrated

Note :
This fault replaces the 2 calibration faults (internal and external) only if the checksum function has been validated (3.7 version or superior)

11.9 Program fault

- Cause:
  - Problem in the integrity of dosimeter data
- Display:
  - The display reads " *DF PRO* "

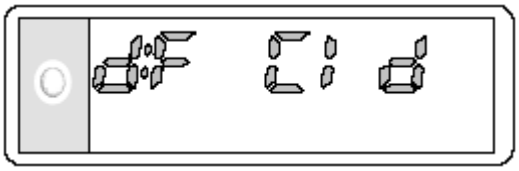


- Corrective action: :
  - Send back the dosimeter to MGP Instruments after sale service.

Note : *This test is handled only if the checksum version has been validated (3.7 version or superior)*

11.10 Integrated Circuit Fault

- Cause:
  - Fault in the component used for the nuclear pulse count
- Display:
  - The display reads “ *DF CId* ”.



- Corrective action:
  - Return the dosimeter to MGP Instruments

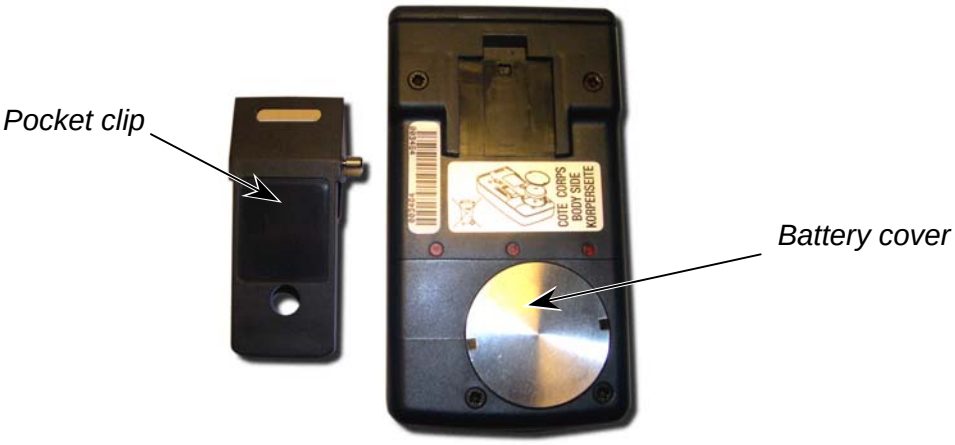
12. Maintenance

12.1 Changing the battery

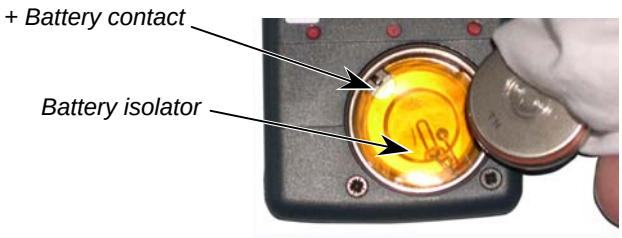
Note :
MGP recommends the use of RENATA or TOSHIBA trademarks for the batteries and not to leave the dosimeter without battery more than one hour.
We recommend you to replace the battery in less than one hour in an area without humidity (preferably in an air conditioned room).

To change the dosimeter battery follow the steps below.

- Switch the dosimeter to mode *pause,*
- remove the clip, using a screwdriver,
- using the key provided (or if unavailable, using a screwdriver), unscrew (counterclockwise) the battery cover shown below:



- take off the battery cover and remove the battery, the “battery absent” alarm is triggered,
- verify that the battery isolator is located at the bottom of the battery housing and doesn’t cover the + battery contact,
- take a piece of cotton cloth to handle the battery, in order to avoid the superficial oxidation of the battery housing,
- insert a new battery in the housing (with the “+” side of the battery places towards the back of the dosimeter),



- place the battery cover and press it until the dosimeter starts up (beep and activation of the display),
- screw (clockwise) the battery cover back on using the key.

12.2 Manual calibration method

12.2.1 Hp (10) calibration (DMC2000 S,X,XB)

- Expose the dosimeter with a Gamma source (Cs137) to a minimum dose of 500µSv that is the expected dose and read on the dosimeter display the “Read dose” deep dose
- Look up the old deep dose calibration factor “K1p OLD” using Dosimass software, on the “calibration” screen, internal detector parameters
- Determine the new calibration factor “K1p NEW” using the following equation :
- K1p NEW = K1p OLD x Read dose / Expected dose
- Turn off the dosimeter and set the calibration factor K1p to the new value “K1p NEW” using Dosimass software

12.2.2 Hp (0.07) calibration (DMC2000 XB)

- Redo the same procedure as Hp(10) calibration for Hp(0.07) measurement and change K1s using a Gamma source (Cs137)
- K1s New = K1s OLD x Hp(0.07) Read dose / Hp(0.07) Expected dose
- Expose the dosimeter with a Beta source (Tl 204 or Kr 86 preferably, otherwise Pm 147) to a minimum dose of 500µSv that is the expected dose and read on the dosimeter display the “Read dose” shallow dose
- Look up the old shallow dose calibration factor “K3s OLD” using Dosimass software, on the “calibration” screen, internal detector parameters
- Determine the new calibration factor “K3s NEW” using the following equation :
- K3s NEW = K3s OLD x Read dose / Expected dose
- Turn off the dosimeter and set the calibration factor K3s to the new value “K3s NEW” using Dosimass software

- Expose the dosimeter with a Sr/Y90 source and verify the response of the dosimeter is inside the limits.

Note : *Changing K1s will not affect the deep dose and vis et versa*
If heavy materials are near the Gamma source, they will affect (increase) the shallow dose with Compton electrons emitted (you can use plastic sheet to avoid this emission)
In factory, the Hp(10) response at Cs is 1±10% (1), Hp(0.07) at Cs is 1±10%(1), Hp(0.07) response at Tl = 1±40% (1), Hp(0.07) response at Sr/Y90 = 1±40% (1)
(1) of which extended uncertainly about the response (K = 2)= ±5%

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13. Technical Characteristics

13.1 Physical Characteristics

- radiation detected:
  - **DMC 2000 S** : X and γ from 50 keV
  - **DMC 2000 X** : X and γ from 20 keV
  - **DMC 2000 XB** : X and γ from 20 keV, β from 60 keV.
- quantity measured:
  - individual Hp(10) “deep” dose equivalent
  - the corresponding dose equivalent rate
  - and, only in the DMC 2000 XB case:
    - individual Hp(0.07) “shallow” dose equivalent,
    - the corresponding Hp(0.07) dose equivalent rate
- measurement range:
  - dose equivalent: 1µSv to 10 Sv
  - dose equivalent rate: from background to 10 Sv/h
- display range:
  - dose equivalent: 1µSv to 10 Sv
  - dose equivalent rate: 10µSv/h to 10 Sv/h (for 1µSv/h to10µSv/h range, please contact MGP Instruments)
- measurement error:
  - dose equivalent: better than $\pm$ 20 % over the entire measurement range
  - dose equivalent rate:
    - better than $\pm$ 30 % from 0.5mSv/h to 5m Sv/h
    - better than $\pm$ 20% from 5mSv/h to 10 Sv/h
- energy response: **DMC 2000 S**
  - Hp(10): better than $\pm$ 20 % from **60 keV** to **1,3 MeV** (ref. ^{137}Cs)
  - Hp(10): better than $\pm$ 20 % - at 6MeV(ref. ^{137}Cs)
- energy response: **DMC 2000 X**
  - Hp(10): better than $\pm$ 30 % from **20 keV** to **1,3 MeV** (ref. ^{137}Cs)
  - Hp(10): better than $\pm$ 20 % at 6MeV (ref. ^{137}Cs)

- energy response: **DMC 2000 XB:**

X and Gamma radiation:

- Hp(10) and Hp(0.07): better than ± 30 % from **20 keV** to **1,3 MeV** (ref. ^{137}Cs)
- Hp(10): better than ± 20% at 6 MeV(ref. ^{137}Cs)

Beta radiation:

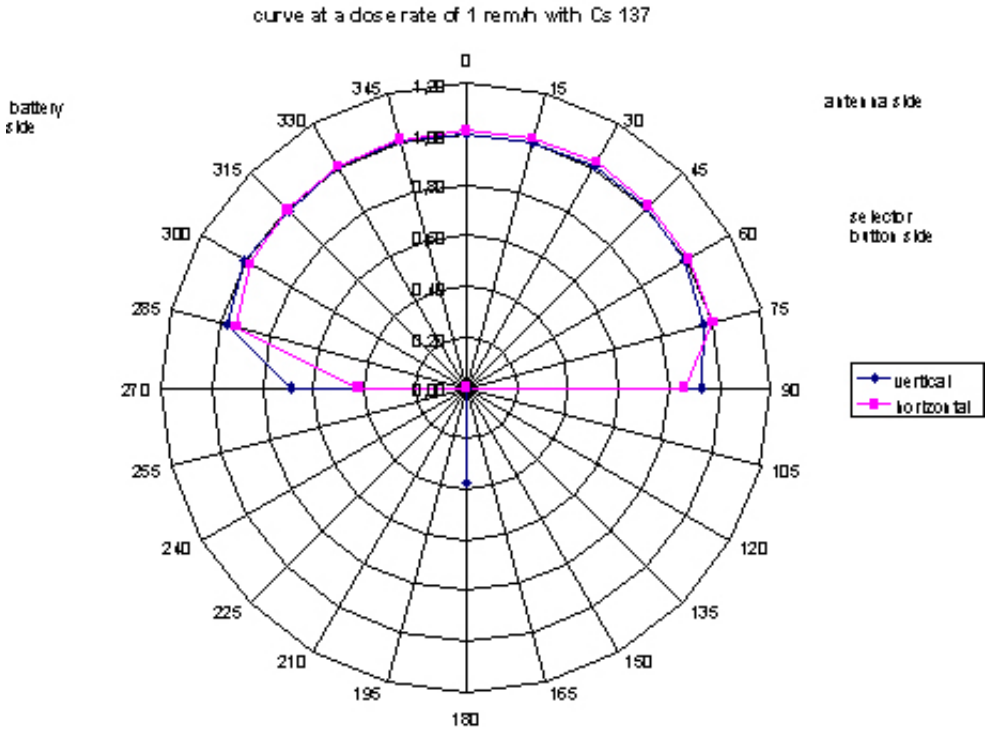
- Hp(0.07): better than ± 30 % for an average energy higher than **60 keV** (ref. ^{137}Cs)

- isotropy:
- **DMC 2000 S**: better than ± 20 % with ^{137}Cs and better than ± 50 % with X filtered 60 keV in relation to the conventionally established deviations (IEC 1283) for angles between - 75 % and + 75 %
- DMC 2000 X and XB: complies to the IEC 61256 Ed 1 standard.

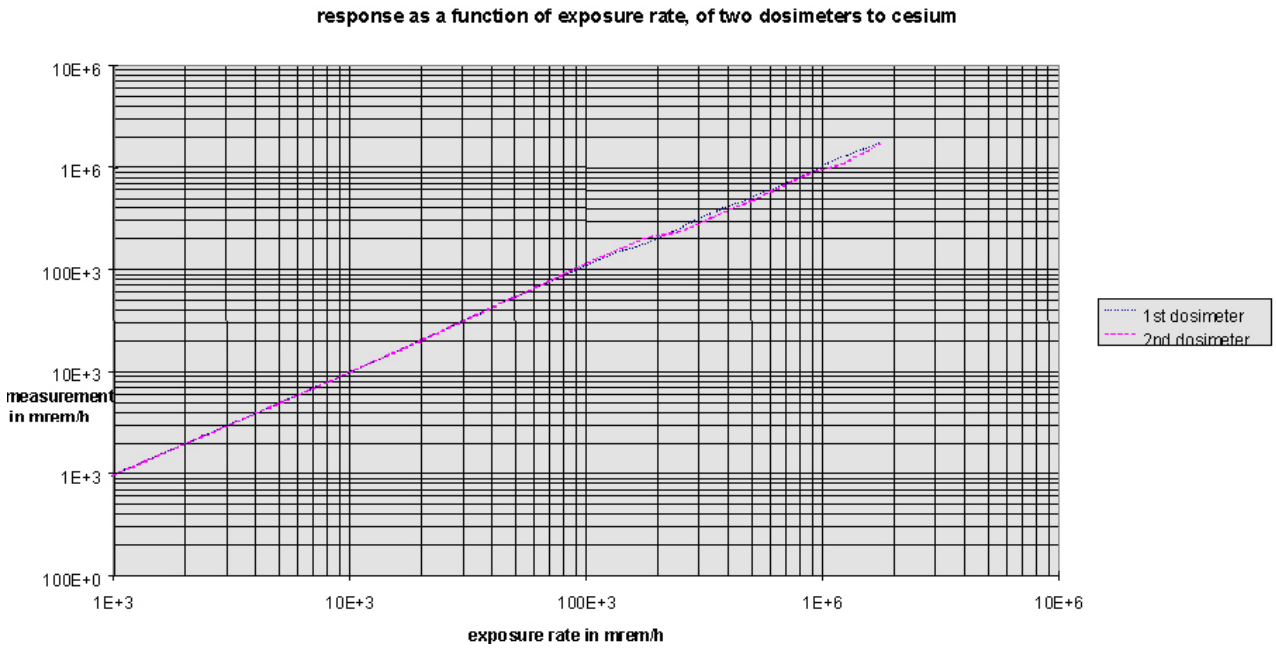
- Factory calibration as per internal COFRAC procedure 127023 :
- Cs137, 25 mSv/h : < +/- 10% (1)
- Am241, 35 mSv/h : < +/- 15% (S) and +/- 20% (X, XB) (1)

Note : *(1) of which extended uncertainty about the response (k=2) = ±5%*

13.2 Isotropic Graph



13.3 Linearity Graph



13.4 Functional Characteristics

- Indicators:
  - LCD display (6 alphanumeric characters + symbols)
  - indicator lights (red light-emitting diode)
  - selector button for acknowledging pre-alarms and viewing the rate
  - buzzer: sound level 85 dBA at 30 cm (12”) typical
- Alarms:
  - precision: the alarm is triggered when the measured value reaches the corresponding alarm threshold value
  - dose alarm: 2 thresholds (alarm and pre-alarm); adjustable over the entire measurement range (only the pre-alarm can be acknowledged)
  - dose rate alarm: 2 thresholds (alarm and pre-alarm); adjustable over the entire measurement range (only the pre-alarm can be acknowledged)
  - acknowledgment is accomplished by pressing and holding the selector button for at least 3 seconds
- Checks:
  - periodic detector tests (every 10 min)
  - data integrity test
  - periodic battery tests (every 10 min)
  - battery presence test with audible alarm for 3 min in the event of no battery
  - component test (integrated circuit, E2PROM)

- Memory:
  - data storage in E2PROM for more than 10 years,
  - historical record of dose increments and events,
  - 750 history events at programmable intervals 10 s, 1 min, 10 min, 1h or 24 h (1).

Note : *(1)3.800 steps if extended mode validated on software V3.x version*

13.5 Electrical Characteristics

- Power Source:
  - battery $LiMnO_2$ / 3V / CR 2450 RENATA or TOSHIBA
    RENATA
    - ref : CR2450N.CU, delivered in individual blister 10 by box.
    - ref. CR2450N.IB, no stainless version, delivered in plate of 25.

Note : *It is **FORBIDEN** to use stainless steel version.*
We recommend batteries with Nickel surface treatment marked XY-N where XY are used to identify the batch.

  - lifetime:
    - **DMC 2000 S**: typically, **1 year** of normal use (without excessive alarming) under reference conditions (20 ± 5 °C),
    - **DMC 2000 X and XB**: typically, **9 months** of normal use (without excessive alarming) under reference conditions (20 ± 5 °C) can put the dosimeter in the ***storage*** mode for more than 3 years with reduced power consumption.

13.6 Mechanical Characteristics

- Dimensions:
  - Width: 48 mm; 1.89 in.
  - Height: 86.5 mm; 3.41 in.
  - Depth: 9 mm; .35 in. (17 mm; .67 in. at the display)
- Weight: 56 g; 1.98 oz.
- Drop resistant (up to 25 drops) from a height of 1.5 m (4’9”) onto an oak board
- protection index: DMC2000: IP 67 (1 meter),
  DMC2000X & XB: IP 53.

13.7 Conditions of Use

- operational from -10 to +50 °C with a lower than ± 20 % variation in the dose equivalent measurement ,
- storage temperature - 31°C to + 71°C (without battery).

13.8 Link to LDM 2000 Reader

- Pass-by Data Exchange for activation, deactivation, in motion data acquisition, reading and writing:
  - Normal range of 1.2 m (3’9”) for pass-by readings (2.4 m (7’8”) for the LDM 2000 equipped with external antenna)
  - Range < 0.5 m for configuration (1’6”)

13.9 Storage

In the event the dosimeter will not be used for a prolonged period of time, putting the dosimeter in storage reduces its power consumption to a minimum (***dosimeter storage*** mode).

In this mode, messages are no longer displayed.

The **LDM 2000** Reader is required to put the dosimeter in the storage mode. This procedure is described in the DOSIVIEW dosimeter system user’s manual.

Note : *in order to minimize the battery self-discharge, it is recommended to avoid dosimeter storage at temperature higher than 25°C*

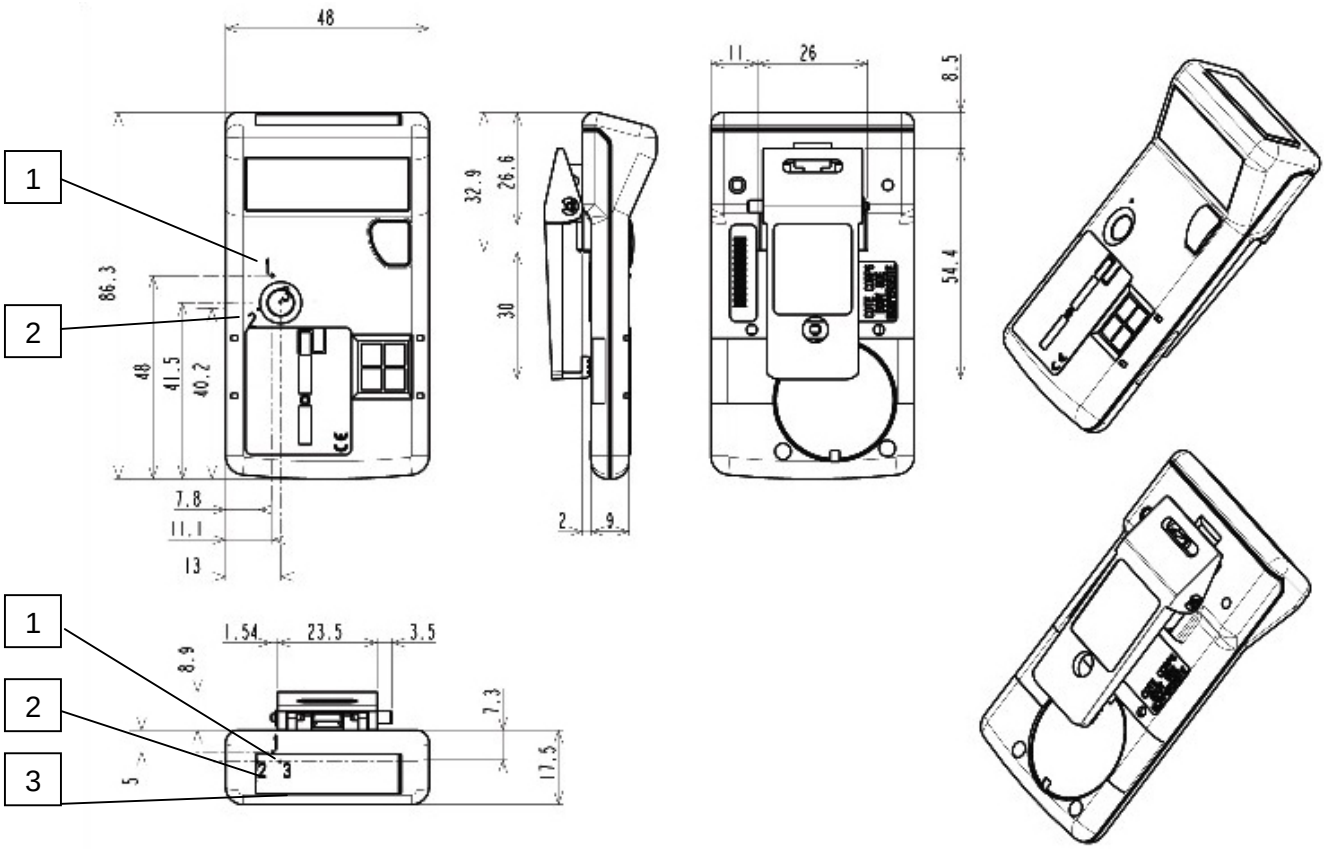
13.10 Environment

In accordance with European regulation (Directive DEEE 2002-96-CE), dosimeters must not thrown out with non-sorted local waste, but must be seletively collected.

The batteries must not be recharged or thrown in fire.

13.11 Detectors location

- Detectors are indicated 1,2 and 3 :
  - Detector 1 is used for Gamma > to 50 KeV
  - Detector 2 is used for Gamma and X > to 20 KeV
  - Detector 1 is used for Beta



14. Replacement parts

The spare parts listed below can be ordered from MGP Instruments.

For special orders or for parts not listed below, contact MGP Instruments' Customer service department.

Name	MGP Instruments Reference Number
Battery (x10) ref RENATA CR2450N.CU	52 061
Battery Cover (with O'ring)	115 657
O'ring (x100) (for Battery Cover)	117 392
Key for changing battery	161 907
Clip assembly (x10)	117 392
Battery insulator (x100)	117 393

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15. Appendix 1

Connector for teledosimetry, alarm transmission, external probe

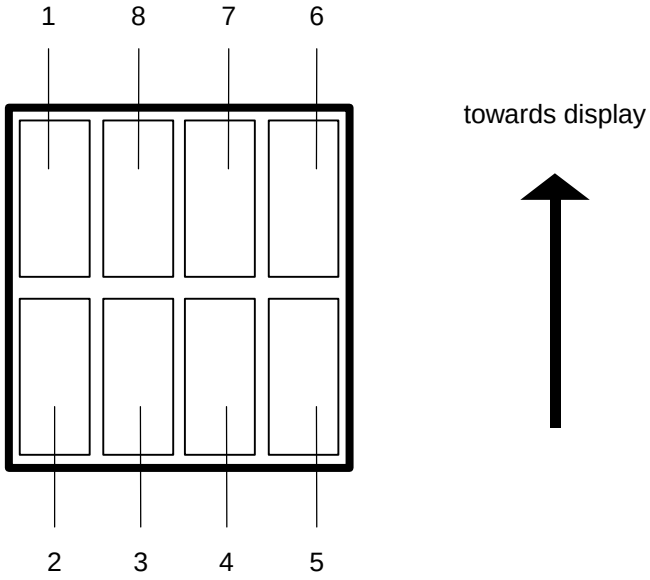
The DMC 2000 connector allows connection to:

- a teledosimetry system
- an alarm transmission device
- an external probe

This appendix describes the various functions of the connector inputs/outputs.

The functions of the various inputs/outputs of the connector depend on the dosimeter operating mode. They are described below.

Please contact MGP Instruments for further information..



- 1 : ground
- 3, 5 : teledosimetry connection (WRM)
- 2, 4, 6, 7, 8 : exterior probe or alarm transmission device

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16. Glossary

IEC :

International Electrotechnical Commission (standardization organization)

Infrared Mode

Means of infrared communication used mainly for the exchange of data between a DMC-X family dosimeter and an LDM101 reader.

Hands Free Mode

Means of wireless low frequency communication used mainly for the exchange of data between a DMC-2000 family dosimeter and an LDM2000 and LDM-2XX readers.

LDM101

Dosimeter reader model101: is a reader that operates in the infrared mode only and can be used as an interface reader to configure and manage of DMC100, DMC90, DM9X, and DMC-2000S dosimeters

LDM210

Dosimeter Reader model 210: Dosimeter reader that operates in the hands free mode used as an RS-232 interface for the configuration of the DMC-2000 family dosimeters and for access control in a centralized dosimetry

LDM220

Dosimeter Reader model 220: Dosimeter reader that operates in the hands free mode used as a USB interface for the configuration of the DMC-2000 family dosimeters and for access control in a centralized dosimetry

LDM230

Dosimeter Reader model 230: Dosimeter reader that operates in the hands free mode used as a PCMCIA interface for the configuration of the DMC-2000 family dosimeters and for access control in a centralized dosimetry

LDM2000

Dosimeter Reader model 2000: Dosimeter reader that operates in the hands free mode used as an interface for the configuration of the DMC-2000 family dosimeters and for access control in a centralized dosimetry system

“Stand-alone” Mode:

This operating mode allows the DMC 2000 dosimeter to be used separately, without using any other equipment.

“Dosimeter Storage” Mode:

In this mode, the DMC 2000 dosimeter is not operational and its power consumption is at a minimum (for more information refer to section Dosimeter Storage Mode, page 8)

LDM 2000 Reader:

Pass-by Data Exchange Reader for DMC 2000 dosimeters which allows them to be configured and used in a centralized dosimetry system.

“Measurement” Mode:

In this mode, the DMC 2000 dosimeter continuously measures the dose and the rate, performs periodic checks and activates alarms when applicable. The pass-by data exchange function is active (for more information, refer to the section Measurement Mode, page 8).

Pass-by Data Exchange Function:

This function allows the DMC 2000 dosimeter to communicate with the LDM 2000 without physical contact.

“Pause” Mode:

In this mode, the DMC 2000 dosimeter performs periodic checks and activates alarms when applicable. The pass-by data exchange function is active (for more information, refer to the section Pause Mode, page 8).

“Satellite” Mode:

This satellite mode allows the DMC 2000 dosimeter to be used in a centralized dosimetry system.

WRM : Wireless Transmission System (Wireless Remote Monitor)

RETURN REMARKS

In order to improve updating of this manual, send us your comments and corrections by electronic mail to the following address:

documentation@mgpi.com.fr

Your "Return Remarks" will help us to satisfy you.
Thank you

References to be recalled with the "Return Remarks":

- Title, reference and index of manual.
- Chapter, paragraph and page concerned.

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