DOSIMETRY

IRD 2000

DosiCal N Version

User's Manual

119206EN-J

MIRION TECHNOLOGIES Health Physics Division

Featuring: MGP INSTRUMENTS

Information

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Considering local regulation in force: person and equipment protection against electric shocks, Mirion Technologies (MGPI) SA recalls that ANY WORK ON A POWERED EQUIPMENT SHALL MANDATORILY BE PERFORMED BY QUALIFIED AND AUTHORIZED PERSONNEL.

Ionizing radiation of the sources used is dangerous for the worker whenever the protective measures are not strictly applied.
Although our equipment items are built in compliance with the most severe safety standards, the ionizing radiation source represents a danger when the worker is not qualified or not warned.
ANY HANDLING OF RADIOACTIVE SOURCES SHALL MANDATORILY BE PERFORMED BY QUALIFIED AND AUTHORIZED PERSONNEL.
Consequently, all precautions shall be taken to prevent any non-authorized or non-qualified person from using this equipment, endangering others and themselves.
Prior to any handling, those qualified and authorized to use this equipment shall get information on the protective measures set forth by the national standards in force.
Abandon or destruction of equipment containing a radioactive source is FORBIDDEN. If no longer required, the user must inform Mirion Technologies (MGPI) SA who will arrange to take the source back (according to the contract) and establish a certificate stating that the source has been taken back. In the event that the source is lost or stolen, the user must inform the appropriate authorities soon as possible.

Directive 2002/96/EC of the european parliament and of the council of january 2003 on waste electrical and electronic equipment (WEEE).
At the end of the product's useful life, please dispose of it at appropriate collection points provided in your country.

Revision Log

Index	Date	Written by	Description of modification	Modified pages
A	17/09/99	F. L'ELCHAT	Document created	First edition
B	01/12/2003	JF ACCRIS M. GUERIN	Annexe1: additional information: installation under Windows 2000 Updating of software Dosical information - REV 6016.	All
C	23/06/2004	M. GUERIN	New number 119206EN-C replacing 129209B Updating of software Dosical information - REV 6648.	
D	07/2007	L. GONTARCZYK F. BADEL	Updating of software Dosical information H Version DEV 15887	§ 2.3.1, § 4.1.2.2, § 4.1.2.3, § 4.1.3, § 4.1.3.2, § 4.1.4, § 4.1.3.3, § 4.1.3.4, § 4.1.5.1, § 4.2.1, p 37, p 38, § 4.2.2.2, § 5.3.3, § 0, § 5.6, § 1.1.1, § 10 §11.6.1
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G	02/09/2010	L. GONTARCZYK F. BADEL	Added options: - check threshold Alarm, - reiteration exposure, - set date and reset dosimeter historic. DEVN 18430	§ 3.4.3, § 4.1.1, § 4.1.6, § 4.1.7.1, 4.2.2.1, p 36, p 37, p 40, § 4.2.2.2, § 0, p 42, § 4.2.2.5, p48, p 49, p 88
H	24/01/2012	B. CLAIR	DEVS 20131 Added Continuous Test Mode, Windows 7 compatibility, DMC 3000 OPL, Update Installation proceeding.	§ 4.1.3.2 §5.2.3, §5.2.4 §7.2, §7.2.1, §7.5
J	2013-07-12	F. BRISSET	DEVN 21300 G3 compliance Back-scattering coefficient Chapter 11 added	§1.3 ; 2.4.1 ; 3.4.2.3 ; 3.4.3 ; 4.1.3.2 ; 4.1.3.4 ; 5.6 ; 5.7 ; 7.2 ; 9.1 ; 9.6 ; 10

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1. General

1.1 Purpose of this document

This document provides the information required to operate the irradiator.

1.2 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.

1.3 Reference documents

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

Civil version	**User Manual**	**MGP Designation**
	Dosimeter Reader	LDM 2000
	Compact dosimeters	■ DMC 2000S ■ DMC 2000X ■ DMC 2000XB ■ DMC 2000 GN ■ DMC 3000
Military Version	**User guide**	**MGP Designation**
	Dosimeter Reader	LDM 2000
	Compact dosimeters	SOR family

1.4 General Presentation of the IRD

The **D**osimeter **IRradiator** is an irradiator designed to check the physical nuclear and electronic response of the DMC 2000, SOR/R and SOR/T and DMC 3000 family of individual dosimeters. The basic principle used for the adjustment of dosimeter response is given in appendix 5, para.11 "*Basic principles for response adjustment of dosimeter"*, p.107.

Note:
For the list of types of dosimeters checked, see para. "12.4 Equipment Items", p.118.

It can be considered as an appropriate checking device, with adjustment if necessary, of the response of the dosimeters.

This concept has taken into consideration the following objectives:

- **Simplicity of use**:
  The manual operations are limited to insertion and removal of the dosimeters.
- **Reliable reproducibility**:
  The exposure conditions are reproducible and the data acquisition and calculations are done automatically.
- **Capability to quickly calibrate a large number of dosimeters**:
  Use of three exposure places simultaneously per irradiation module and the possibility to control two irradiation modules in parallel from the same computer, that is a check of 6 dosimeters.
- **Traceability**:
  The results are traceable from transfer standard dosimeters to the results related to the checked dosimeters.
- **No paper**:
  The result Data Base is integrated into the application.
- **Safety**:
  Very low dose rate levels on the surface of the device

1.5 Main Cases of Use

- The IRD is designed to equip technical sections of nuclear installations in charge of the preventive maintenance, at the industrial use, of the DMC 2000, SOR/R and SOR/T and DMC 3000 family dosimeters.

Recommendations:
The user must apply the texts in force relating to worker protection against radiation hazards.
The user must have obtained authorization for use from the Authority.
The user must have a radiation monitoring skilled person internal to his plant. This person shall check that worker protection is ensured

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2. Description of the IRD

2.1 Chapter content

This chapter has successively:

- detailed description of the irradiator and its components,
- functional description of the irradiator (synoptic),
- the various versions and options available

2.2 IRD

The IRD is composed of the following main sub-assemblies:

- one or two irradiation modules,
- one reader and its interface box,
- the DOSICAL software for control,
- connecting cables.

To use it, the following items are also required:

- a PC,
- a printer. (optional)
- As an option: reference dosimeters

2.3 Description of Each IRD Component

2.3.1 Irradiation Module

The module is the mechanical section which is intended to position the dosimeter opposite the irradiation source.

It mainly comprising:

- a radiological protection made of 5 cm of lead in all directions with a recess forming an irradiation beam.
- a source carrier, designated as « main source location », for the main source,
- The main source,
  The available versions are:
  - standard version:
    - permanent source 370 MBq (10 mCi) of Cs137.
  - military version:
    - removable source provided by the French Army.

Note:
Other radio-isotopes or other source activities available upon request.

- A movable carrier where the 3 dosimeters are installed, which allows:
  - In the open position, to insert and remove the dosimeters, (see Figure 2 or Figure 3)
  - In the closed position, the precise positioning of the dosimeters regarding the source and the direct exposure of the detector area to the beam generated by the source. (See Figure 1).
  - A removable plastic screen, only used for the XB dosimeters. During the measurements with the main source, this plastic screen is positioned within the dosimeter irradiation field whereas it must be removed from the dosimeter irradiation field for the measurements with the secondary source.

Note:
An electrical contact allows the detection of the closed position.

- This device includes a lead shield to shut the beam when the carrier is in the open position.
  - Air-charged springs ensure the lift of the carrier without any effort for the operator.
- A lockable shutter through the positioning of a locating wedge, with three positions available, that allows:
  - In the closed position (indexed handle in up position, shutter down): to mask the main source beam;
  - In the open position (indexed handle in down position, shutter up): to open the main source beam,
  - In intermediate position (indexed handle in intermediate position): to mask the main source beam and to expose the dosimeter placed in the middle position to the beam of a secondary source installed in the shutter.

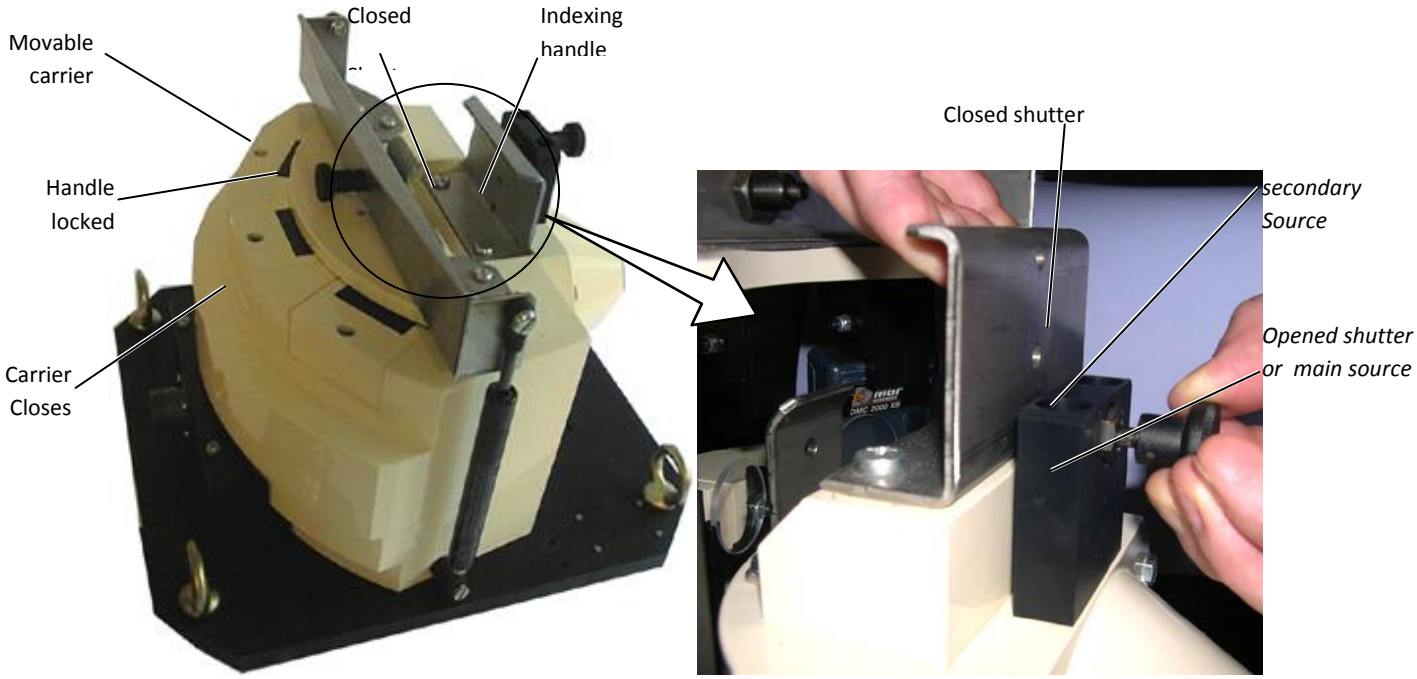

Figure 1 - View from the irradiator side and detail of the shutter in the open position

- a location, designated as secondary source carrier, for the secondary source, housed in the shutter,
- an optional secondary source:

The necessary proximity of the secondary source to the dosimeter, allows the calibration of only ONE dosimeter in the middle position (number 2)

  - Gamma source of low energy for all the dosimeter types.
  - Beta source to check the beta response of the DMC2000XB-type dosimeters.
- 3 antennas placed in the immediate proximity of the dosimeter antennas.
- A connector

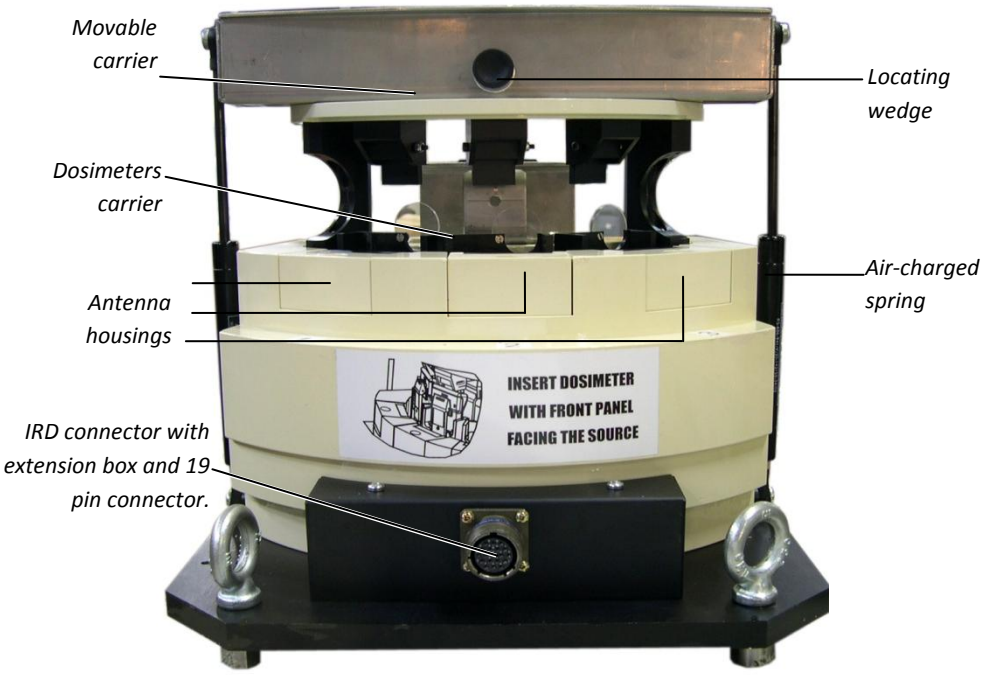

Figure 2 - Irradiator front view, dosimeter carrier lifted

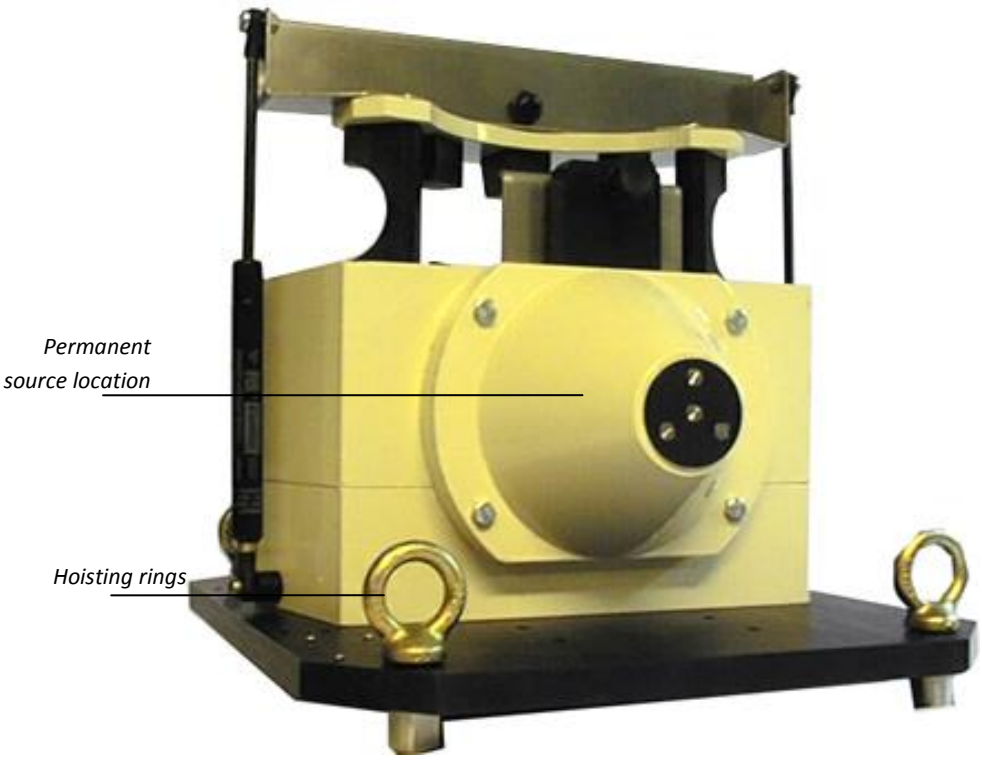

Figure 3 - Irradiator rear view, dosimeter carrier lifted

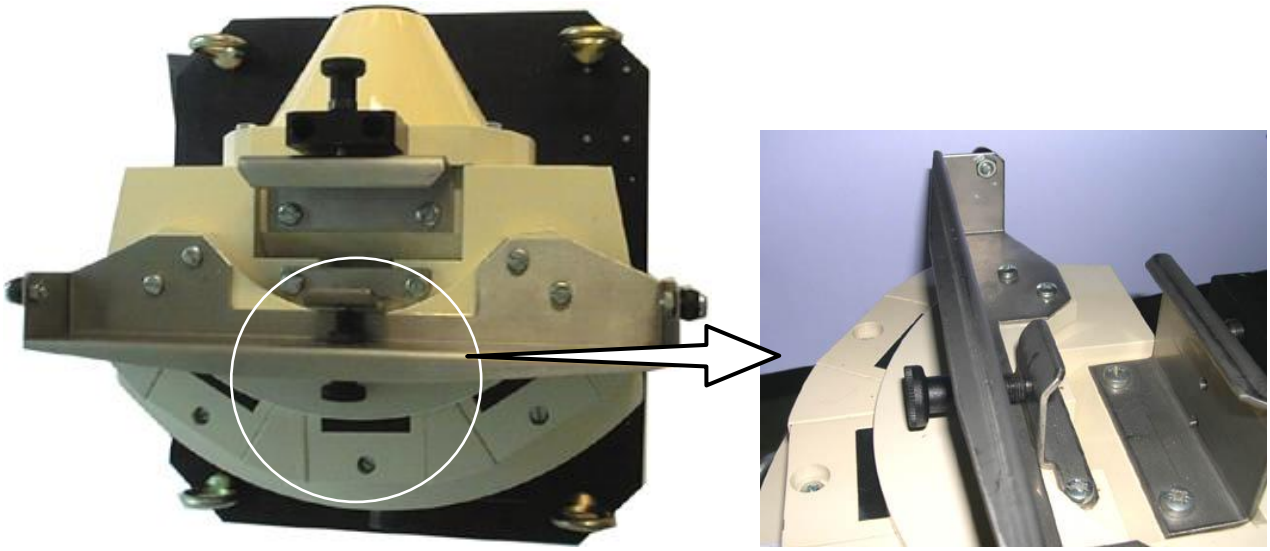

Figure 4 - Irradiator top view

- a cable to connect the 3 antennas and contacts to detect the dosimeter placement.
- markings for the 3 positions, the location of the shutter, the connector, the required source identification and the manufacturer information.
- hoisting rings to facilitate handling.

2.3.2 Reader and Irradiator Interface

The reader allows for information exchange between the PC and the dosimeters through a wireless link.

The reader is an LDM2000-type with the internal antenna removed or disconnected. The external antenna connector allows the connection to a multiplexing card of up to 8 external antennas. This card is located in an extension box attached below the reader.

Figure 5 - LDM 2000 with extension box- front view

Figure 6 - LDM 2000 with extension box- side view

Figure 7 - Connectors on the extension box, left view

Figure 8 - Power connector (right side of extension box)

The extension box is fitted with a power cord, one or two connectors per irradiation module and a connector to the control unit. One cord for the PC is included.

The reader has a display (not used in this application) and two signaling lights to indicate the transmission and reception of the « hand-free » messages.

2.3.3 Control Unit

The control unit is a personal computer equipped with Dosical Software fixed or portable with an available serial port to connect to the reader.

A printer to generate a hardcopy of the results as well as a large capacity hard disk are recommended

2.3.4 Reference Dosimeters

A set of 3 reference dosimeters whose response is well known and traceable to a national standard or client owned traceable source is required for the calibration. A spare reference dosimeter is desirable.

2.4 IRD configuration summary

	Main Source (S1)	Irradiation Module
Civil version	■ 10 mCi Cs 137	■ one only
Military version	■ army gamma source	■ one only

2.4.1 Standard Configurations

- ■ Carrier
- □ Dosimeters: type DMC 2000S, X, XB and SOR501,
- □ Dosimeters: type DMC 2000GN
- □ Dosimeters: type SOR313, SOR 480, SOR/T.
- □ Dosimeters type DMC 3000

- ■ Main Source
- □ internal, Cs137 370 MBq (10 mCi)
- □ without the source, with a pig to hold instruction source IF177 (French Army)

- ■ Number of modules
- □ 1 irradiation module
- □ 2 irradiation modules

- ■ Special Versions
- □ Secondary Source Sr 90 or other consult us
- □ Pig without the source consult us
- □ Other main sources consult us

- ■ Accessories
- □ Reference Dosimeters with certified calibration certificate, (COFRAC)
- □ PC compatible computer,
- □ Printer,
- □ Extension box/module connecting cable,
- □ Extension box/PC connecting cable:
  - standard serial link with SUB-D 9-contact connector

2.5 General Functional Description

- The dosimeters to be controlled are placed in an irradiation module containing, in its basic version, a permanent source placed on the main location.
- The dosimeters communicate with an LDM2000 dosimeter reader by means of "Hand-free" communication antennas through a reader extension box integrating a multiplexing card.
- The dosimeter reader transmits its information to the PC, control unit using a communication protocol managed by the LDMNet.
  The analysis and configuration of the checks are ensured by means of the DOSICAL software.
- The reader transmits the requests to the dosimeter after selecting the antenna of the location aimed at and then converts the message from the dosimeter to the PC.
- DOSICAL can thus activate the dosimeters, then, after a delay of exposure, read the dosimeter again.
- DOSICAL, via the reader, polls the status of the switch activated in order to check that the carrier is lowered and has not been raised again.
- The retained exposure time of each dosimeter is the shortest one.
  Each dosimeter has a waiting time delay, which enables the first one to be read again whereas the last one has not arrived to its exposure duration.
- The calibrations take place successively without any command from the operator:
  (the carrier lifting/lowering gives the beginning or end of the control)
- The dosimeter and switch polling can be extended to a second module.
  This way, the operation can be completely asynchronous,
  (each on its own timing), this allows loading and unloading one dosimeter while the other is being exposed.

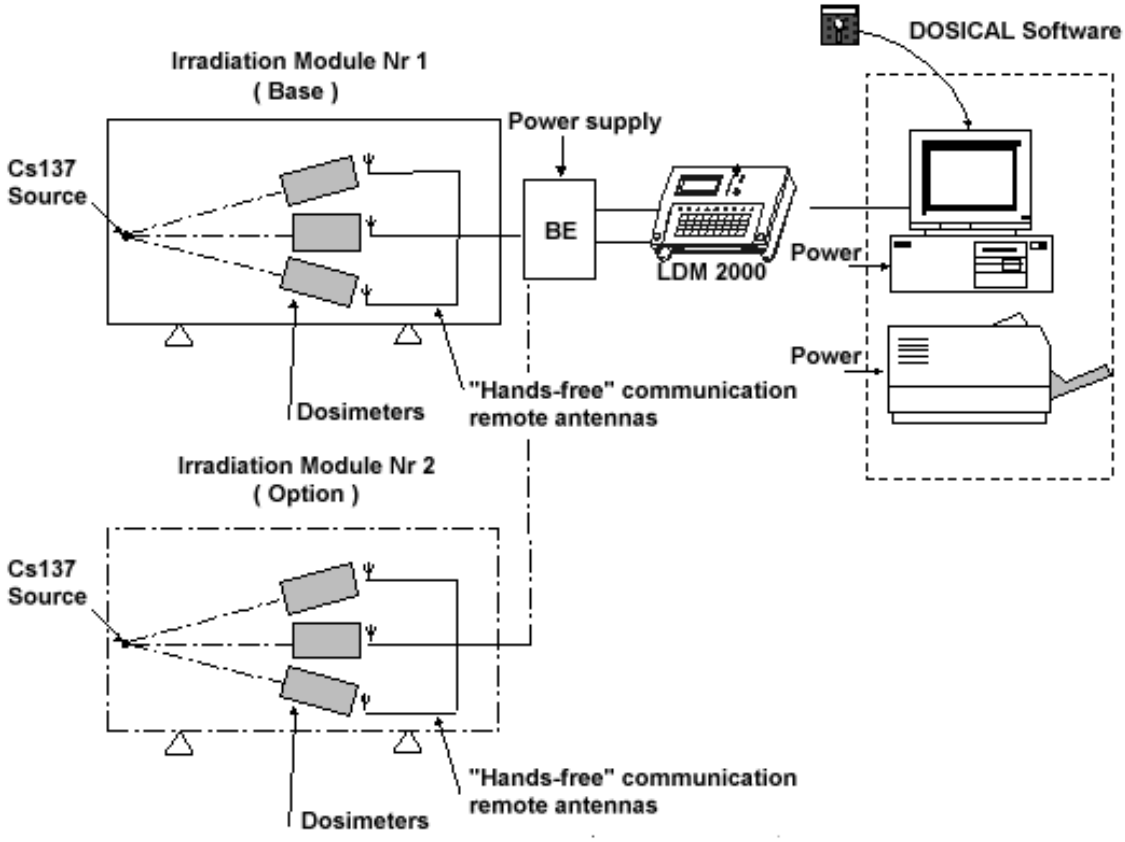

Figure 9 - Operating diagram

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3. Installation and start-up

3.1 Chapter content

This chapter contains in chronological order all the necessary operations needed to set up and use the IRD for the first time.

3.2 Component Verification

Before starting any connections, verify that all the following components are available:

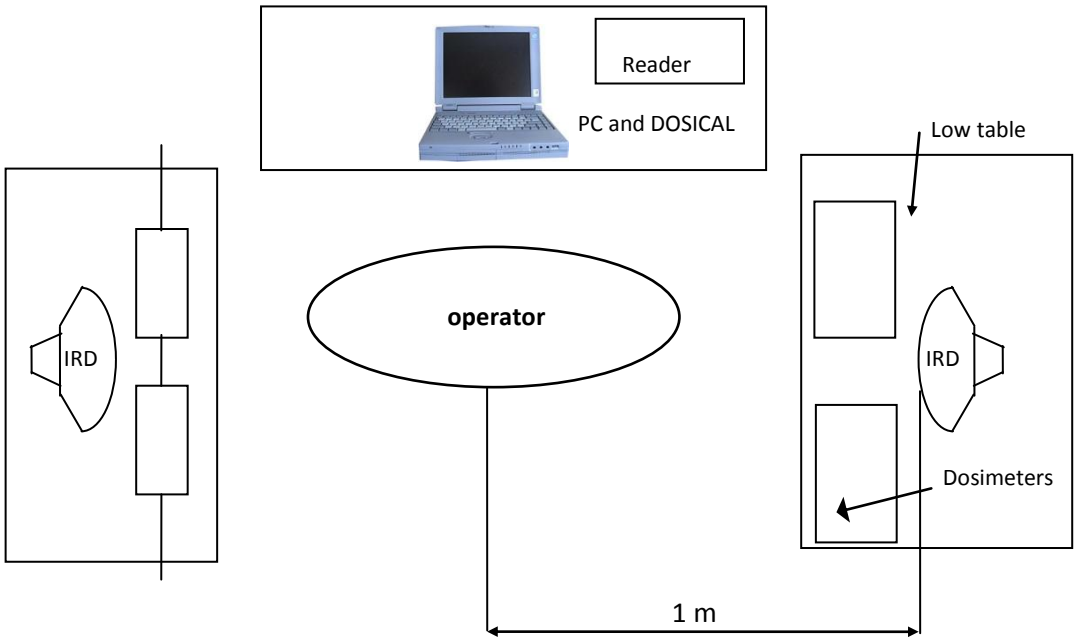
- the irradiation module(s),
- the LDM2000 Reader and its extension box,
- a PC with the software package (DOSICAL and other required software modules) installed (see the corresponding appendix),
- a printer,
- all the interconnection and power cables.

3.3 IRD Installation

It is recommended to create a work location reserved for the IRD 2000, in this mode the furniture can be set-up with the best ergonomic and lowest radiological risks possible.

It must be considered:

- the presence of an almost-permanent operator,
- the ergonomic use of the PC,
- the handling of the dosimeters (load and unload),
- the handling of the irradiation module (lowering the carrier),
- the orientation of the irradiation module to minimize the leak rate in the work area (see chapter " Physical Characteristics – standard version", p. 73).



The user must provide a 230V line for each subset (Extension box/LDM 2000, computer, printer).

3.4 First use

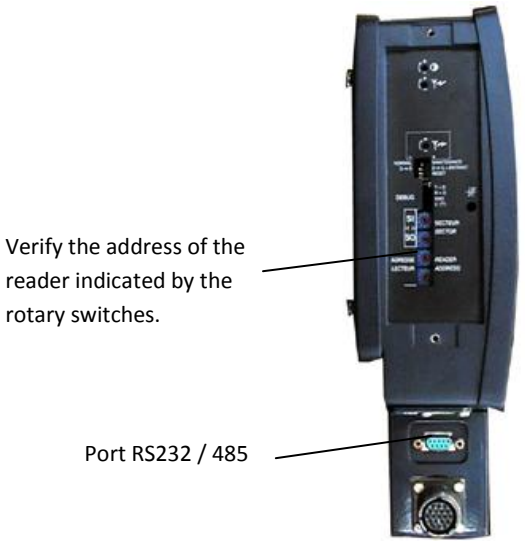
3.4.1 Software Package Installation

In order to reduce the volume of the document Appendix 1: Installation of the Software Package, page ***75***, describes all the installation and configuration procedures of the software modules required, according to the PC context (network card installed or not).

3.4.2 Hardware Installation

The hardware installation consists in connecting the PC to the dosimeter reader, setting up and establishing the communication between them.

3.4.2.1 Connection of PC to LDM2000 reader



The connection between the PC and the reader consists in connecting the serial port COM of the PC to the *RS232/485* port in the reader (see figure above) with a standard serial communication cable type DTE / DCE.

- Verify there is power in the LDM2000 (the green LED flashes)

For more information about this cable, contact MGP Instruments.

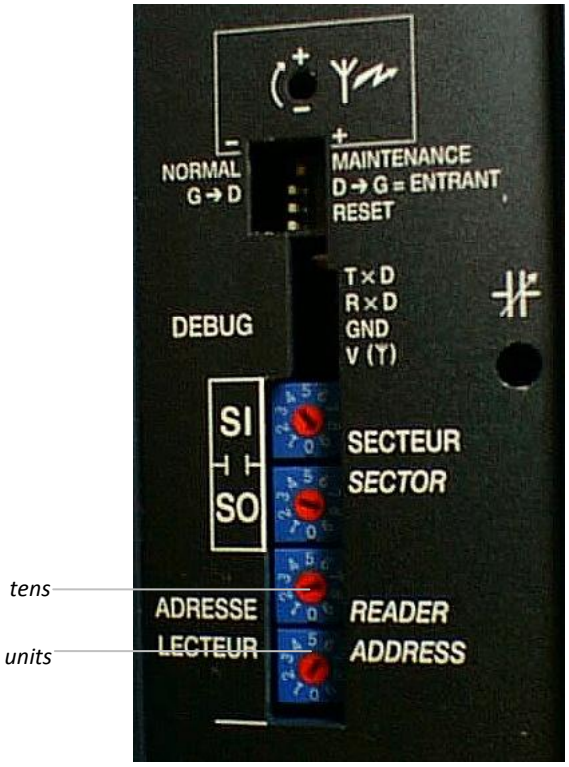
3.4.2.2 Address selection in the LDM2000

Each LDM2000 Reader is identified by an address from **00** to **99**. This address is used in a networked centralized dosimetry system.

In the case of the use with the DOSICAL software, this address must be set to **« 01 »**.

To program this address (see figure below):

- Remove the protective plate on the side of the reader by removing the two attaching screws,
- Using a small screwdriver, set:
  - the **unit number** with the lower wheel to « **1 »**,
  - the **tens number** with the upper wheel to « **0 »**,



3.4.2.3 *Powering the LDM2000 Reader*

- Power on the reader
- In the case of a LDM2000 use, verify the following message:

*
HELLO
ACZ AUS

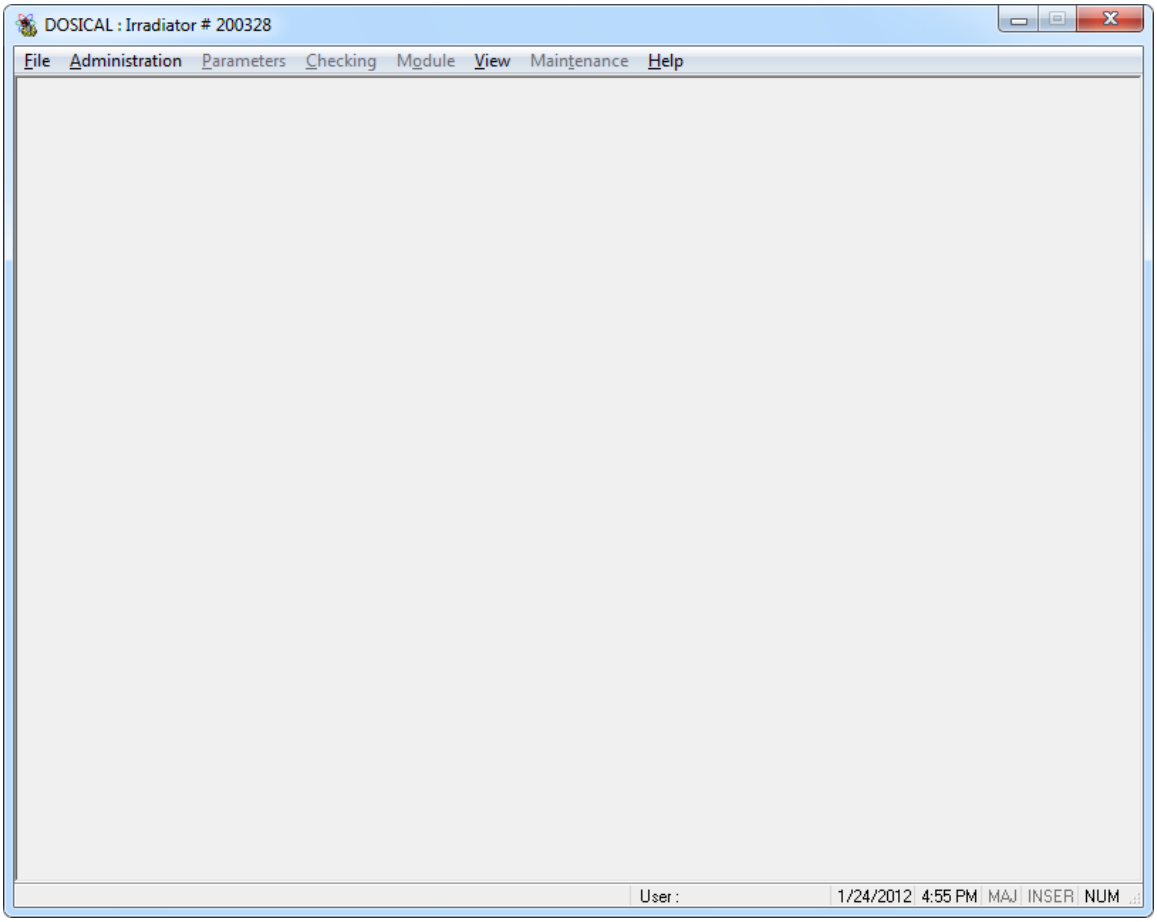
The normal operating status is defined in the following paragraph.

Meaning of this display:
A C Z: the LDM2000 reader is in "Access Control" mode
A U S: the LDM2000 reader is in "Secure Stand-Alone" mode: performs access control activities based in local parameters and stores locally information on entries/exits.

Refer to LDM2000 user's manual #115373, for complementary information ,

3.4.3 DOSICAL Start-up

- Turn the PC power ON:
  - The start-up screen of DOSICAL (see below) will appear



After launching the DOSICAL software, the LDM2000 display will show the following:

*
HELLO
SLV SAT

Meaning of this display:
S L V: the LDM2000 reader is in "Configuration" mode
S A T: the LDM2000 reader is in "SATellite" mode: this indicates that the connection between the reader and the PC is stable.
See , for complementary 'information, the LDM2000 technical manual Number 115373

If « ***SAT*** **»** is not displayed on the bottom right of the display, the connection between the reader and the PC is not correct.

In this case, ensure the installation of all cables is correct and check the following:

- COM port of the PC used to connect to the LDM2000 is well set in DOSICAL

- The reader physical address is set to **01**
- The cable is a serial cable of the DTE/DCE communication type

The user then accesses a selection of functions, differing according to the user profile which has been assigned to him by the DOSICAL administrator.

Appendix 2, page97, details the user profiles and the administration of the access levels by DOSICAL.

The next chapter describes the parameter setting to be performed upon a first operation of DOSICAL and the DOSICAL operating functions in its current use.

4. Typical use of an irradiator

4.1 First Use

Upon completion of the hardware and software installation, perform the following upon a first use:

- Enter the general parameters and nomenclatures.

For complementary information see in this chapter:" ***General Parameters****", p 23*

- *section "Nomenclature", p 27*
- *section "Nomenclature of the Reference Dosimeters p 28*
- *section "Nomenclature of the Sources p 30*
- *section "Nomenclature of the Modules, p.31*
- *section "Nomenclature of the irradiator", p. 32*

- Check whether a valid calibration exists and, if applicable, perform it.

Note:
For additional information on calibration, see chapter "Maintenance", section "Calibration", page. 51

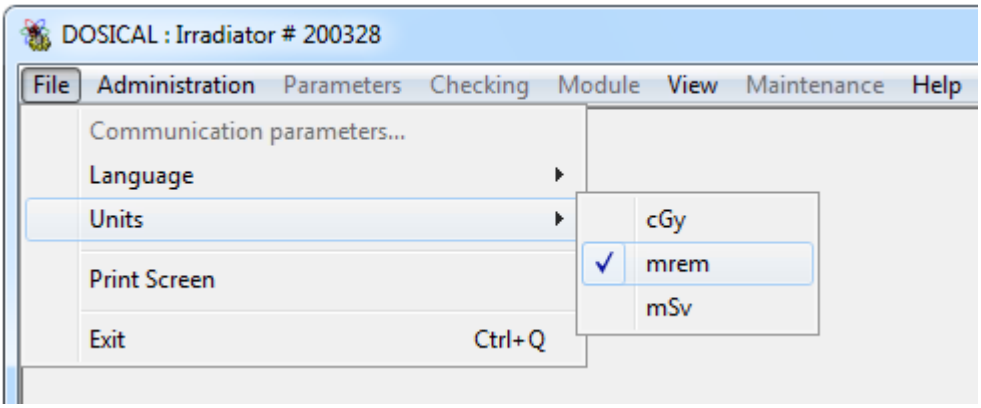
Then proceed to the operator level standard operations (in this chapter, see "***Opening of Check Session***", page ***34***).

Upon the next uses, the operator directly accesses the standard operations.

4.1.1 Main screen

Upon completion of the software initialization phase, the **main window** appears, and comprises:

- a menu bar comprised of 8 menus:
  - the « **File** » menu,
  - the « **Administration** » menu,
  - the « **Parameters**» menu
  - the « **Checking**» menu,
  - the « **Module** » menu,
  - the « **View**» menu,
  - the « **Maintenance**» menu,
  - the « **Help** » menu,



4.1.2 File menu settings

4.1.2.1 Communication parameters

The general parameters must be entered to access the software functions.

Default values are loaded upon installation and the user can customize them.

The "File" menu "Communication parameters" sub-menu, accessible at all levels, is used to access the DOSICAL/irradiator communication parameters:

- Communication port used,
- Communication speed (38 400 bauds by default),
- Data bits (8 by default),
- Parity (« None» by default),
- Stop bits (1 by default).

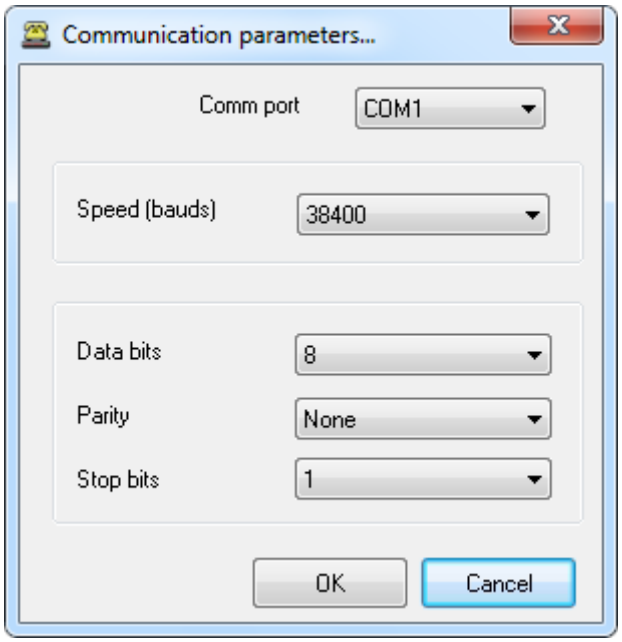


Figure 10 - DOSICAL "Communication parameters" screen

This information is recorded in the *ini* file through the "OK" button.

4.1.2.2 Language

The « File » menu « Language » submenu, accessible at all levels, is used to change the DOSICAL language.

4.1.2.3 Units

The « File » menu « Units » submenu, accessible at all levels, is used to select the working unit which will be used in all the DOSICAL screens.

4.1.2.4 Print screen

We may at any time, print the current screen of DOSICAL by clicking "Print Screen" menu "File".

4.1.3 Parameters

The « Parameters » menu is used to access the « general parameters » and « targets » configuration. It is also used to access the four nomenclature management screens (see p. 27).

4.1.3.1 General Parameters

The general parameters must be entered to access the software functions.

Default values are loaded upon installation and the user can customize them.

4.1.3.2 Entering General Parameters

Access to the general parameters file is obtained from the "General Parameters" sub-menu of the "File" menu in DOSICAL. This access is only for users with the « MANUFACTURER » level and the « SUPERVISOR » level. Enables to access to general parameters:

- Of the irradiator:
  - Maximum number of authorized modules.
  - Range of efficiency's coefficient for DMC 2000 & 3000
  - Efficiency coefficient limits (points out a dosimeter as invalid if during a calibration the new coefficient is outside this range).
  - Exposure delay of a basic measurement.
  - Number of exposures performed upon a check.
  - Checking the triggering of the dose alarm.
- Of the dosimeters:
  - Customization of the displayed message on dosimeter check in progress, correct check or incorrect check (in the case of a correct check, the desired display may be a text or the desired date for the next check).

- Configuration files applied to the dosimeters upon completion of correct or incorrect check. For each type of dosimeter, a file can be selected in case of correct check and a file in case of incorrect check. This function is activated by checking the box corresponding to the dosimeter type and check result.

■ Respectively for the main source location (permanent source) and the secondary source location:

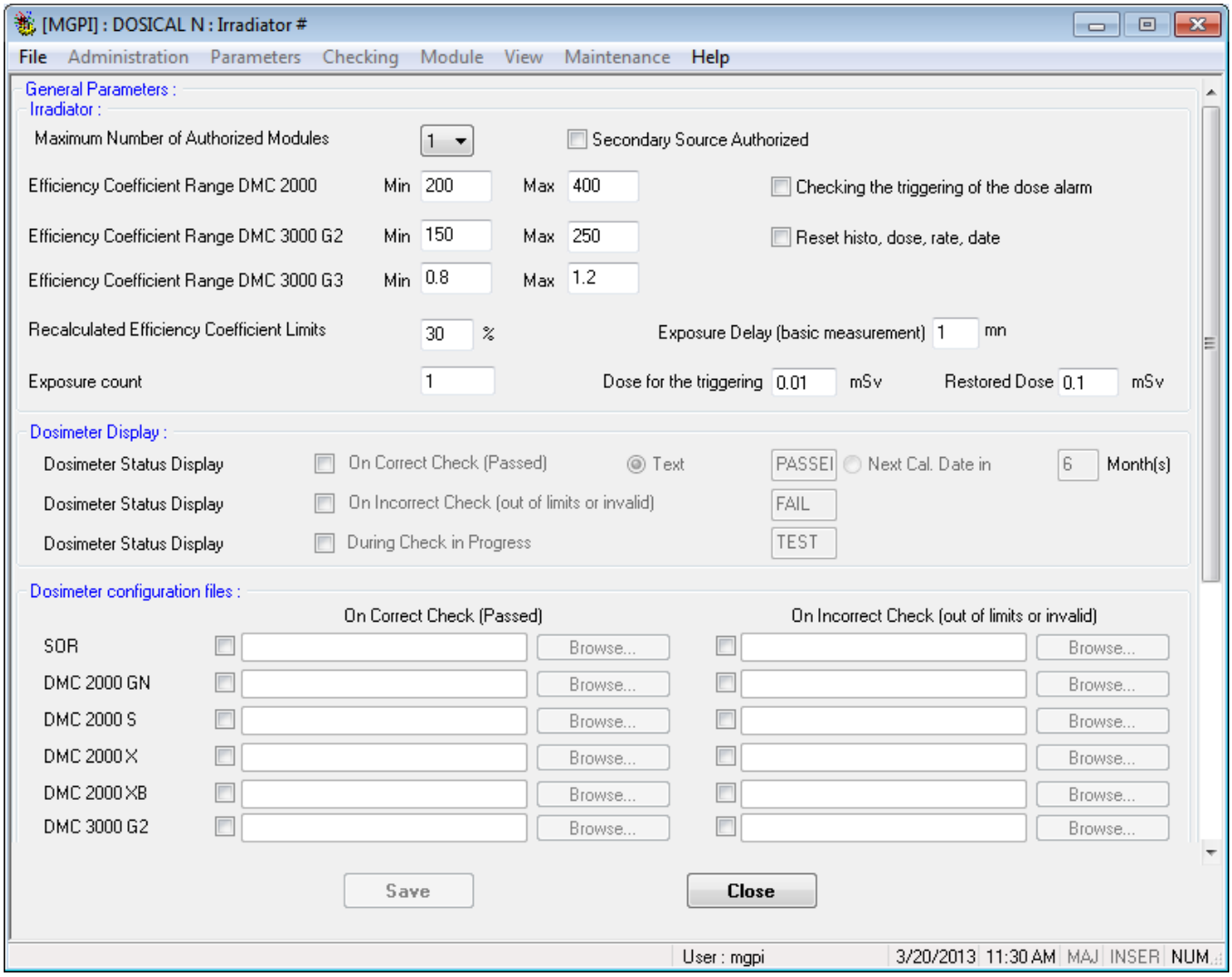
- Target exposure dose, for main source and secondary source.
- Acceptance Interval of a check (admitted tolerance)

■ Command lines launched

- Command lines launched at the end of each check session or at the end of each dosimeter check, is the option is validate
- Command lines launched at the end of each calibration session or at the end of each dosimeter calibration is the option is validate.

■ Miscellaneous

- Check written time in the dosimeter after control: GMT or local time of the machine
- Reset dosimeter historical (historical contains just two changes of state of the dosimeter: Pause to run and run at pause)
- Reset dosimeter, dose, dose rate and date. Historical contains just two changes of dosimeter's state: setting "run", setting "pause" and the low dose measured during this transition.



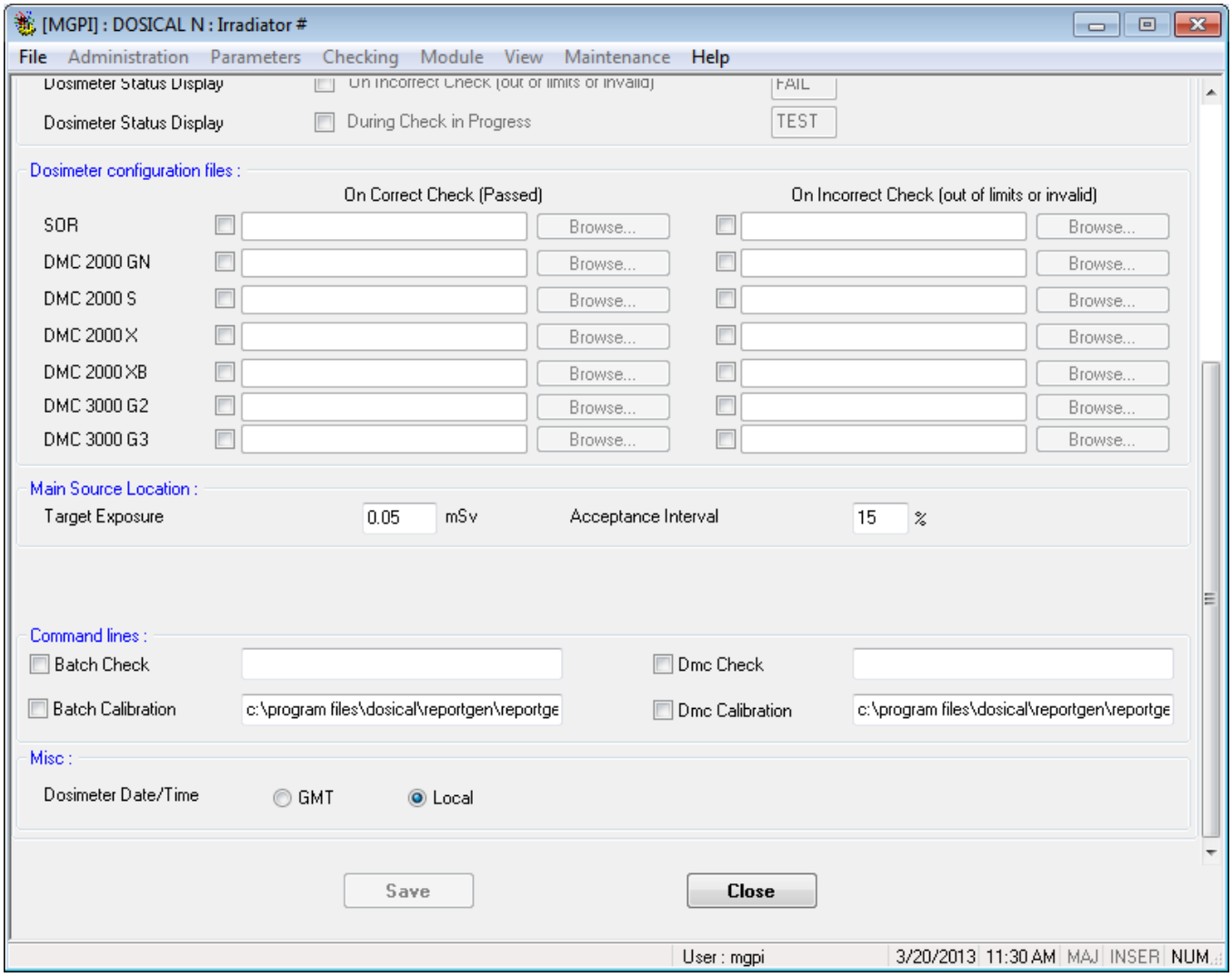


Figure 11 - Dosical "General parameters" screen, typical values

This information is stored in the data base by pressing the "Save" button, in the lower right corner of the general parameters screen.

To exit the general parameters, press the "Close" button, in the lower right corner of the general parameters screen.

4.1.3.3 Targets

The targets must be defined to allow for software running.

Default values are loaded upon installation and the user can customize them.

4.1.3.4 Target Information

The DOSICAL « Parameters » menu « Targets » submenu, only accessible at the « SUPERVISOR » and « MANUFACTURER » levels, is used to access the target configuration.

The desired target must be selected for each dosimeter type.

This screen is used also to set the coefficient for backscattering effect on SOR, DMC2000S and DMC2000GN V4. By default all the backscattering coefficients are set to 1.07

Note :
In the case of an XB type dosimeter, there are 4 targets to be completed. They are defined according to the magnitude (Hp or Hs) and location used (main or secondary).

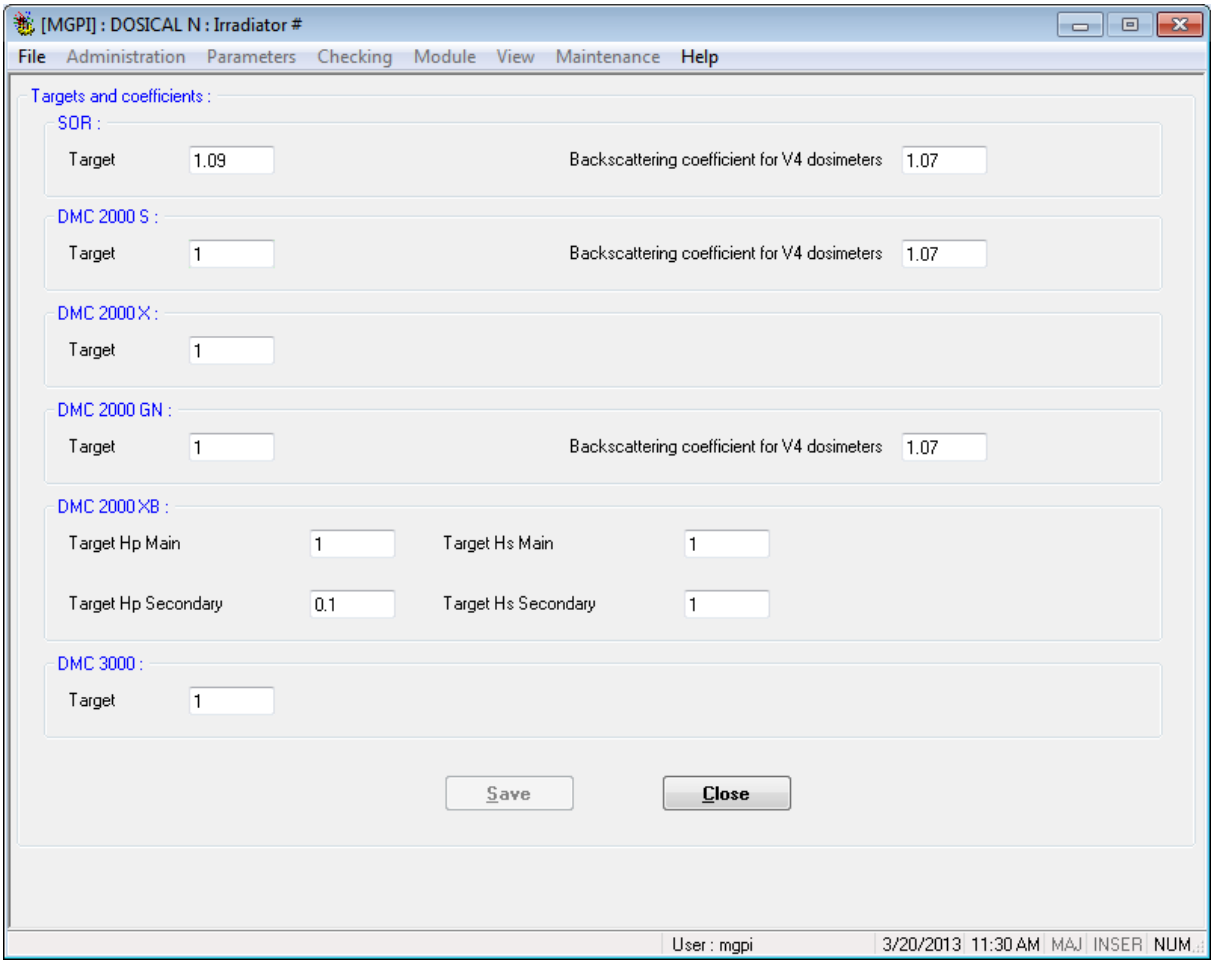


Figure 12 - DOSICAL "Targets" screen, typical values

This information is stored in the database through the "Save" button at the bottom of the screen.

To exit the general parameters, press the "Close" button, at the bottom of the general parameters screen.

4.1.4 Nomenclature

The nomenclature data must be entered to access the software functions.

The nomenclatures enable the permanent information related to the following to be stored:

- the reference dosimeters,
- the source(s),
- the irradiation module(s),
- the irradiator.

The items of information identified "valid" are those used by default.

Different configurations, not used momentarily or old and identified "invalid", can however be stored.

CAUTION:
The nomenclature entering order SHALL MANDATORILY BE
- ***SOURCE***
- ***MODULE***
- ***IRRADIATOR***

The irradiator integrates the module, which integrates the source

NOTE:
One or more items can be deleted in each one of the four screens (reference dosimeters, sources, modules, irradiator) by selecting the complete line involved (by clicking the box to the left of the line) and by pressing the « Del. » key. This deletion is however possible only when the item is not used elsewhere.

4.1.5 Nomenclature of the Reference Dosimeters

The nomenclature stores all the successive reference exposures of all the reference dosimeters

4.1.5.1 Access to Reference Dosimeter Nomenclature Management Function

Access to the reference dosimeter nomenclature function is gained from the "Reference Dosimeter" sub-menu of the "File" menu in DOSICAL. This access is only for users with the « MANUFACTURER » level and the « SUPERVISOR » level.

It is in the form of a table whose lines (record in a data base) identify a given reference dosimeter in a single way through the following information:

- Dosimeter Serial Number,
- Reference Exposure Date,
- Reference Exposure Identification, (Cs137 Hp or Sr90 HS for example)
- Measurement type (Hp or Hs dose equivalent),

- Dosimeter Response to the test,
- Check Declared Uncertainty,
- Dosimeter Validity or Invalidity.
- Dosimeter Response = read_dose / reference_dose.

After each reference exposure of a dosimeter, record a new line by validating it and invalidating the previous records.

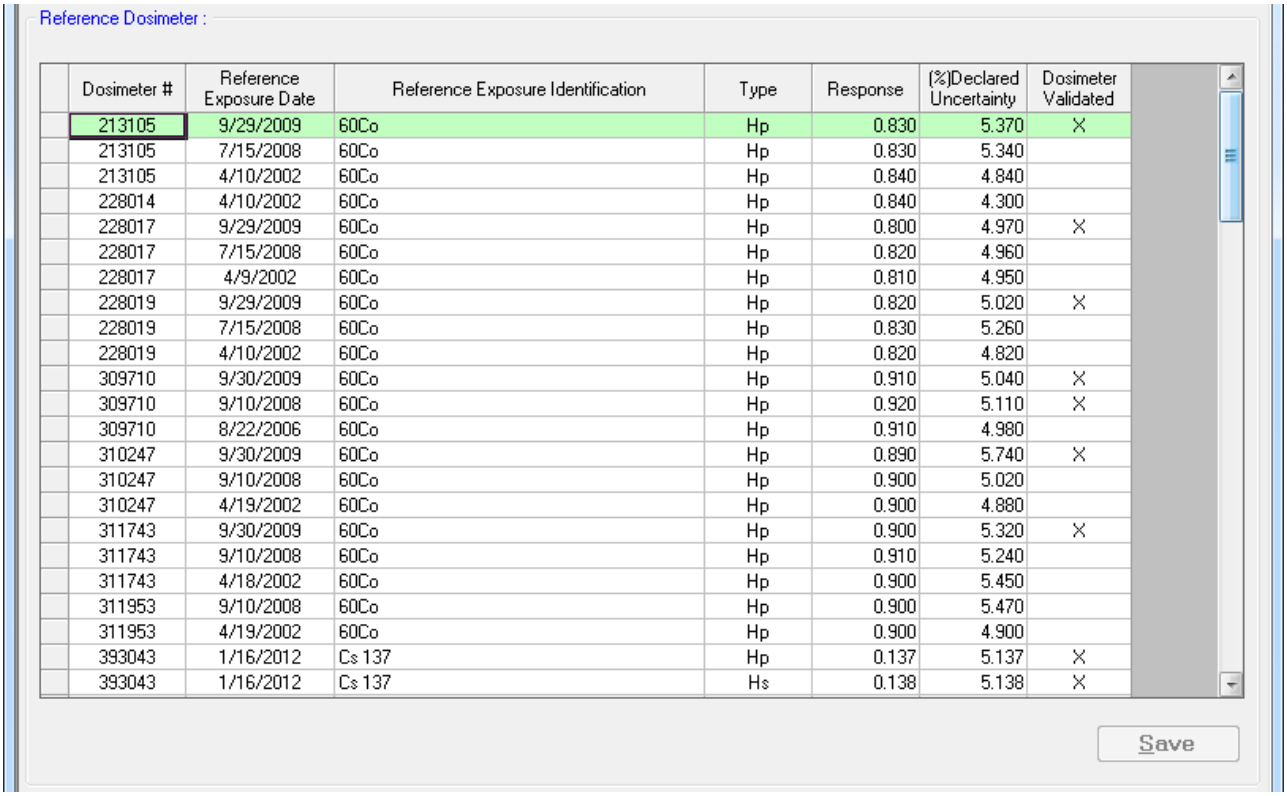


Figure 13 - DOSICAL « Reference Dosimeter » Nomenclature Screen

The isotope type to which the response refers, e.g.: Cs 137 or Sr 90, must be specified in the magnitude part.

For a same reference dosimeter, only two valid responses can be obtained at a time. An Hp response and an Hs response.

When calibration is achieved on the Sr 90 secondary source in Hs, it is necessary to invalidate the Hs response to Cs 137 and create an Hs response to Sr 90, and vice versa, when Hs/Cs 137 calibration is necessary, invalidate the Hs response to Sr 90 and create an Hs response to Cs 137.

- For an XB dosimeter, there will be 3 declarations:
  - an Hp response to Cs 137
  - an Hs response to Cs 137
  - an Hs response to Sr 90.

As there could be only one response for a same dosimeter and a same magnitude (Hp or Hs), the date recorded for the Hs response to Cs 137 must be different of that entered for the Hs response to Sr 90.

Before any computerized calibration and for XB dosimeters, check that the displayed response of the reference dosimeters corresponds to the isotope to be measured Cs 137 or Sr 90.

4.1.6 Nomenclature of the Sources

CAUTION:
The module calibration function and the dosimeter check function ARE NOT ACCESSIBLE
if the nomenclature of the sources has not been entered.

4.1.6.1 Access to Source Nomenclature Management Function

Access to the reference dosimeter nomenclature file function is done from the "Sources" sub-menu of the "**Parameters**" menu in DOSICAL. This access is only for users with the « MANUFACTURER » level and the « SUPERVISOR » level.

It is in the form of a table whose lines (record in a data base) identify a given source in a single way through the following information:

- Source Serial Number,
- Radionuclide constituting the Source,
- Radionuclide Name,
- Activity Decay Period expressed in years,
- Activity on the recording date in MegaBecquerels (MBq),
- Source Location:
  - Main,
  - Secondary
- Creation Date of the record attached to the described source.

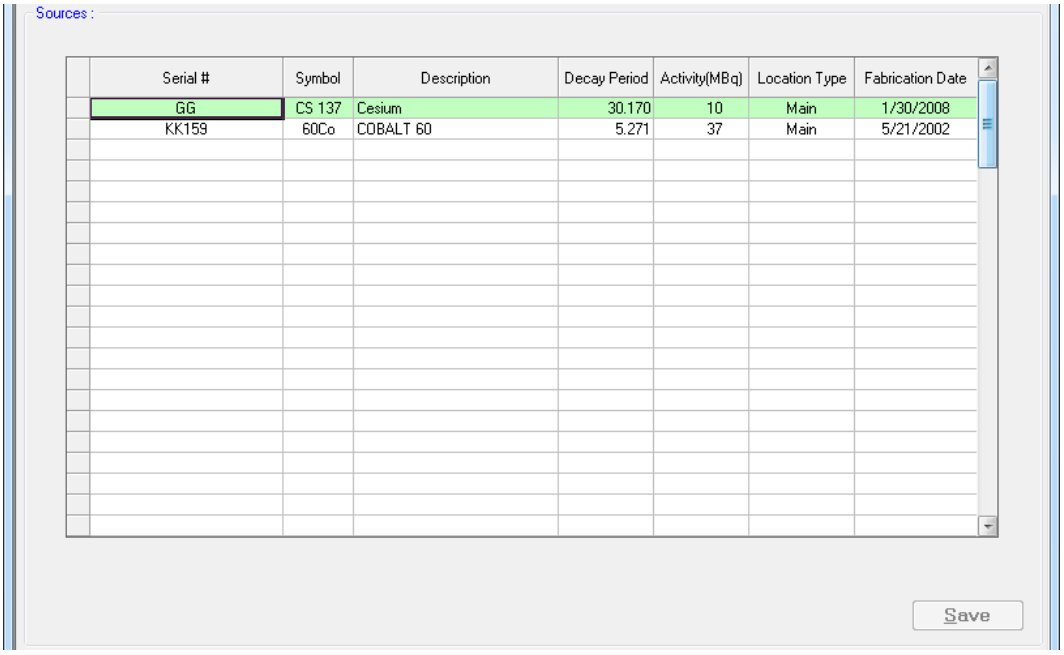


Figure 14 - DOSICAL "Sources" Nomenclature screen

4.1.7 Nomenclature of the Modules

The nomenclature maintains a list of the modules managed by the software.

The software checks that the number of valid modules coincides with the number entered in the general parameters.

The invalid modules are the modules that have been once managed by the software and that have been replaced by the manufacturer.

4.1.7.1 Access to Module Nomenclature Management Function

Access to the module nomenclature function is gained from the "Modules" sub-menu of the "**Parameters**" menu in DOSICAL. This access is only for users with the « MANUFACTURER » level and the « SUPERVISOR » level. Enables to access to irradiator modules nomenclature.

It is in the form of a table whose lines (record in a data base) identify a given module in a single way through the following information:

- Module Serial Number,
- Caption Number,
- Permanent Source Serial Number,
- Existence of a secondary source location,
  - In that case, Secondary Source location Serial Number,
- Creation Date of the record attached to the described module.

- Module validity
- Comment

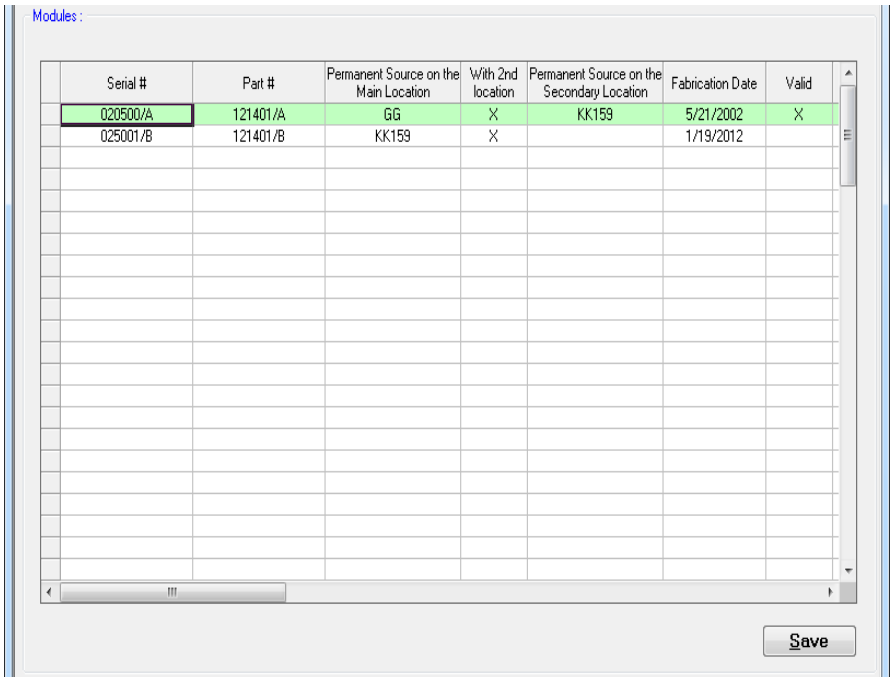


Figure 15 - Screen "Modules" of DOSICAL

4.1.8 Nomenclature of the irradiator

The nomenclature keeps a trace of the irradiators managed by the software.

The software checks the validity of one irradiator at one time.

The invalid irradiators are irradiators that have been once managed by the software or that have been replaced by the manufacturer..

4.1.8.1 Access to Irradiator Nomenclature Management Function

Access to the irradiators nomenclature function is gained from the sub-menu "Irradiators" of the "File" menu in DOSICAL. This access is only for users with the « MANUFACTURER » level and the « SUPERVISOR » level.

It is in the form of a table whose lines (record in a data base) identify a given irradiator in a single way through the following information:

- Irradiator Serial Number,
- Module A Serial Number,
- 2nd module (B) Serial Number, if 2 modules option selected,
- Creation Date of the record attached to the described irradiator,
- Validity of the irradiator.

- Comments

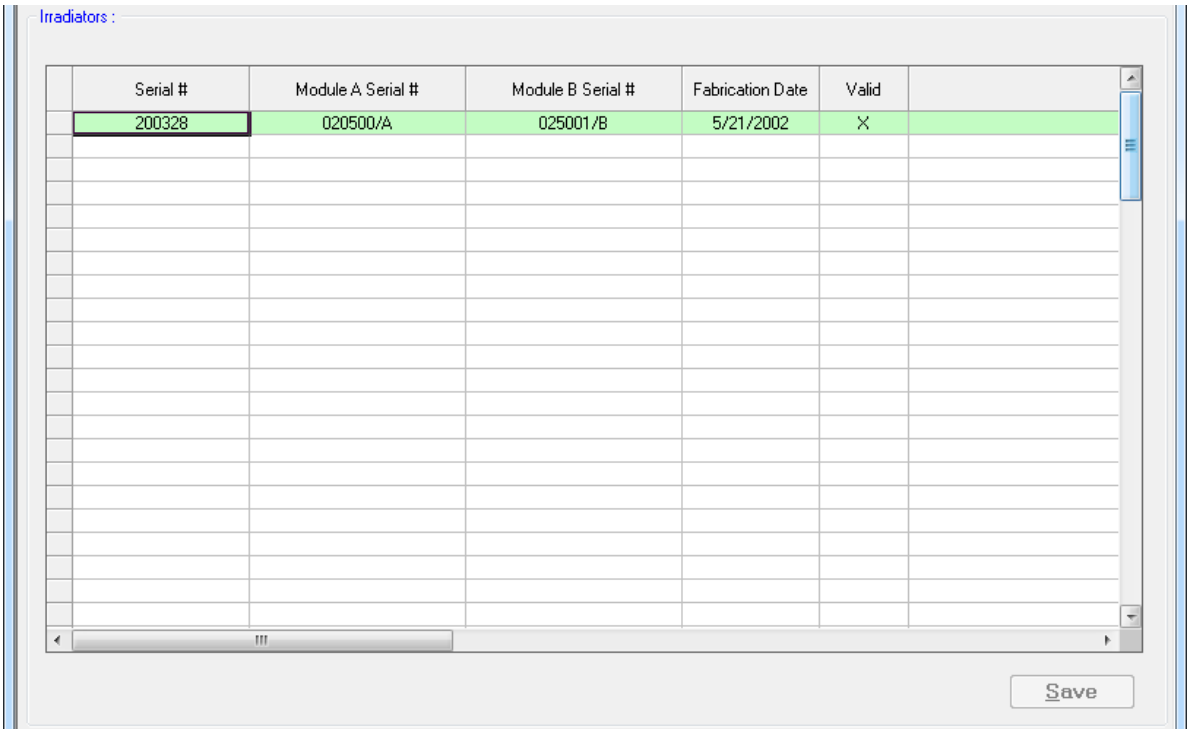


Figure 16 - « Irradiators » Nomenclature screen

- Choose 1 or 2 modules:
  - The irradiator can be configured with 2 modules, only if the number of authorized modules listed in the general parameters is set to 2.
  - When the user wants to configure the irradiator with only one module, he can select module A or module B.

NOTE:
The user has the possibility to configure an irradiator with 2 modules where one does not have a secondary source location:
For module calibration or dosimeter check, if the user selects the secondary source location, only the module equipped with a secondary source location will be proposed (primary source hidden).

4.2 Operations Allowed at Operator Level

Assuming that on start-up the irradiator has been configured *(see chapter "*Installation and start-up*", p.* ***15*** and that a valid calibration has been completed (*see chapter "*Maintenance*", section "****Maintenance Help Functions****", p.* ***51***).

The operations that a skilled operator must perform are:

- Check without calibration,

- Check with calibration,
- Consultation of the data base,
- Computerized calibration (validation not included).

4.2.1 Session Notion

The checks with or without calibrations are grouped in sessions.

One session is a series of checks done under identical conditions with the same label, i.e., with no change to the following parameters: label, check without/with calibration, dosimeter lot identification, operator identification, source location type, magnitude type, dosimeter check type, module type, source type.

The selection, in the **"Checking"** menu , of the "Check with or without calibration" sub-menus, implies the following:

- Opening of a session,
- Or to continue a session in progress, if DOSICAL has not detected any changes.

4.2.1.1 Opening of Check Session

All dosimeter Checks (with or without calibration) are automatically associated with the session in progress.

The opening of a session is done by providing the following information:

Information	Source / signification
Lot Identification	Free Text
Source Location	Choice: main or secondary
Magnitude of response to reference exposure	"Hp" or "Hs" or both (for an XB dosimeter)
Dosimeter type	Selection of the dosimeter type in the scrolling list

Next you select one or two irradiation modules.

DOSICAL associates automatically an opening date and records the main common characteristics:

- Target Exposure Dose,
- Acceptance Interval,
- with or without calibration.

The information relative to the session in progress are displayed.

If the operator modifies one or more fields, a new session is opened.

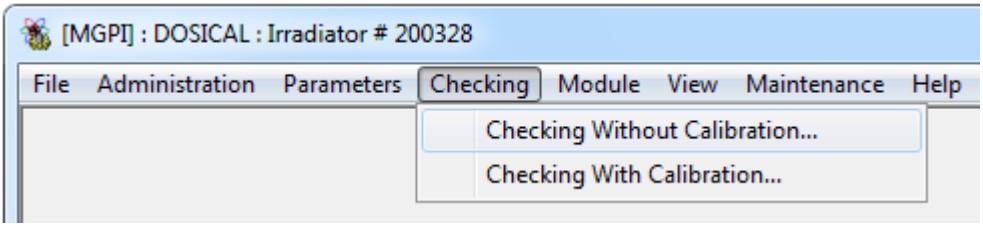
The absence of information in the obligatory fields, or the absence of validation, cancels the session opening.

Once a new session is opened, it becomes the current session and the previous session is closed.

4.2.2 Dosimeter Check Functions

Access to these functions is obtained from the menu "**Checking**" of DOSICAL:

- « Checking Without Calibration... »,
- « Checking With Calibration...»,



4.2.2.1 Dosimeter Check Function without Calibration

This function allows the verification of a dosimeter lot without adjusting their response.

Access to this function is gained from the "Checking without calibration" sub-menu of the "File" menu in DOSICAL. This check is thoroughly controlled by DOSICAL.

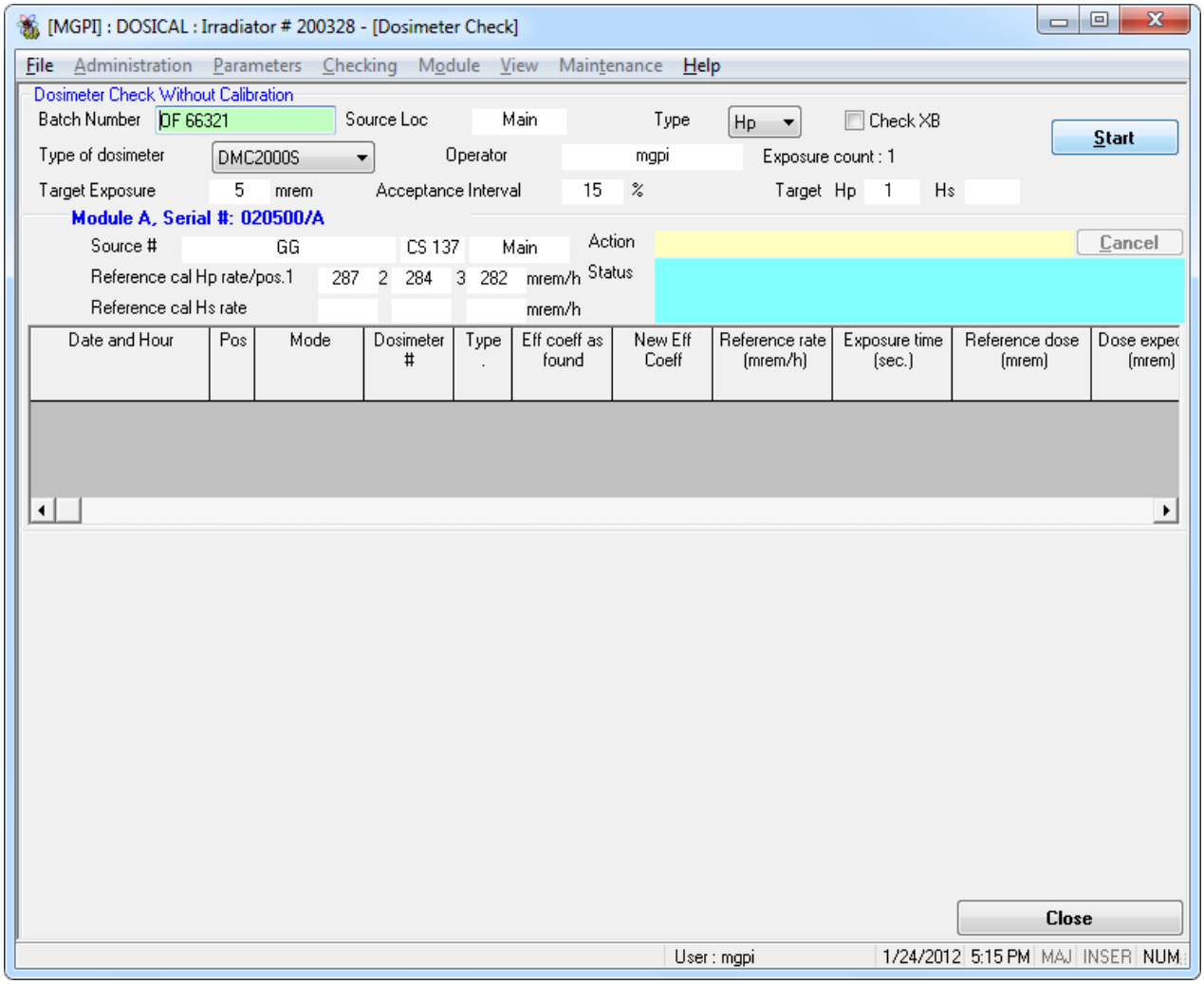


Figure 17 - Start up screen of a normal dosimeter check without calibration

This screen is divided in several fields:

- Standard session characteristics,
- System Check Dialog with the operator, top right:
  - "Action" zone: instruction, in red color, for the attention of the operator,
  - "Status" zone: report of the actions of the system in progress.
  - Results of the previous cycle (to allow the storage during hidden time)
- commands:
  - "Start": launch the check
  - "Abort": calibration in progress, quit the function,
  - "End of session": close the check session.

Note:

The screen has been built to allow splitting the display if two modules are used.

- To start up the check, click on the button « Start », on the top right of the screen.

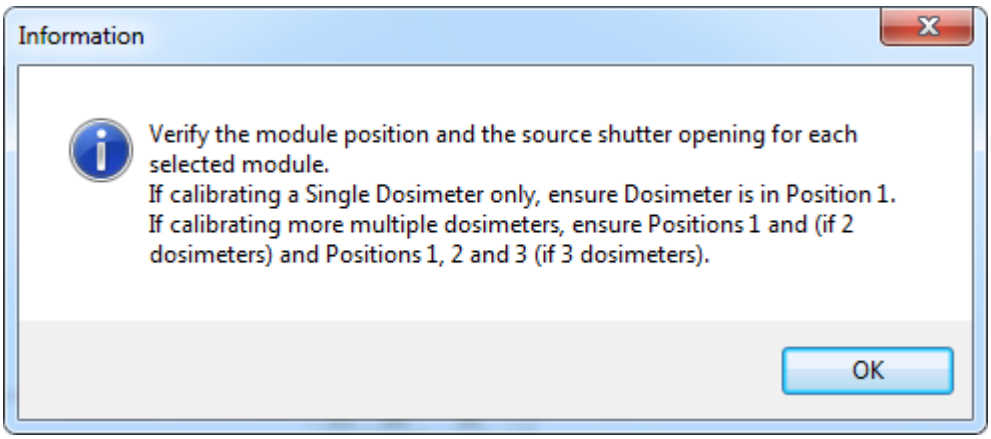


Figure 18 - System Message for the first check

Verify that the IRD shutter is in the 'open' position: handle in the low position, shutter lifted to allow the beam from the main source to pass

- As regards XB dosimeters and Cs 137 main source,
  - check that the plastic screen is **positioned** within the dosimeter irradiation field.
- As regards XB dosimeters and Sr 90 secondary source,
  - check that the plastic screen is **removed** from the dosimeter irradiation field.

- Insert the dosimeters in the carrier with their front facing the source, against the stop above each housing.

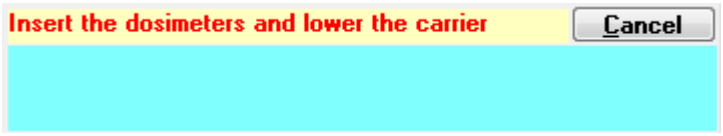


Figure 19 - Operator Dialog: Insertion of the dosimeters

The dosimeter carrier is fitted with a spring to ensure the dosimeter stays in place during the check.

The concept of the dosimeter carrier is a compromise between the reproducibility requirements and the ease to install and remove the dosimeters.

Note

The dosimeter can be in "active" or in "pause" mode.
If in « active » mode, its dose value and its status will be erased.

The dose alarm threshold can be modified by DOSICAL. If the case occurs, the alarms are audible during the check.

Caution:

For the DMC 2000 XB dosimeter with a secondary source, only the 2nd position will be available

<u>Warning</u>: It is imperative to use a carrier appropriate at the type of dosimeter used.

Otherwise, the dosimeters will be wrongly positioned in the IRD, which has the effect of producing measures, and therefore an improper calibration.

For dosimeters type :

DMC 2000 S, X, XB : DMC 2000 carrier.

DMC 2000 GN : DMC 2000 GN carrier.

SOR/R and SOR/T : SOR carrier.

DMC 3000 : DMC 3000 carrier and turn to position 1 "DMC3000" the switch on the extension box .

- Move the carrier down until locking

Figure 20 - Operator Dialog: Dosimeter identification

DOSICAL checks that the present dosimeters are of the same type as that of the session (selected in the « Dosimeter type » scrolling list). If at least one of the dosimeters is not of the selected type, the check then stops with an error message.

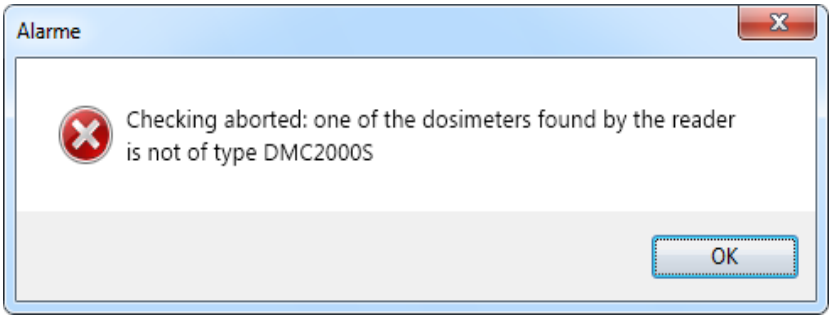


Figure 21 - Typical error message if the type of a dosimeter is different of that selected

DOSICAL then starts the exposure and displays the time delay countdown.

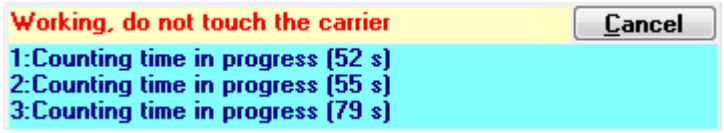


Figure 22 - Operator Dialog: Delay counting for each dosimeter

Any opening of the carrier causes the calibration in progress to be aborted and a message is given to the operator.

Figure 23 - Operator Dialog: Acquisition of dosimeter exposure measurements

During data acquisition, if DOSICAL detects that the efficiency coefficient of a dosimeter differs from the last coefficient known in the database for this dosimeter and this magnitude, it then displays an information message.

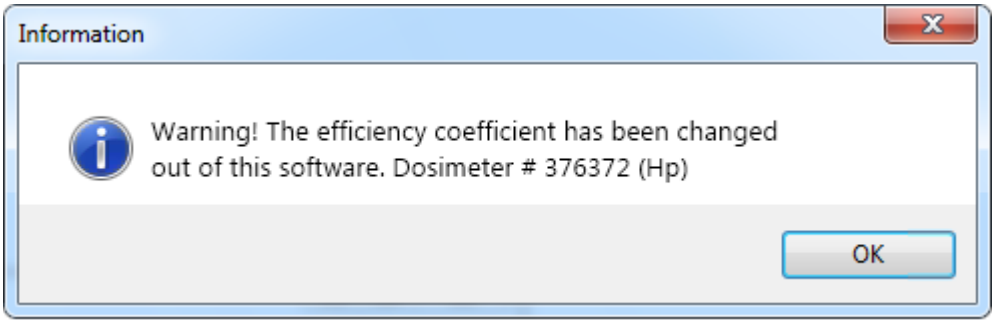


Figure 24 - Information Message: Efficiency coefficient modified out of DOSICAL

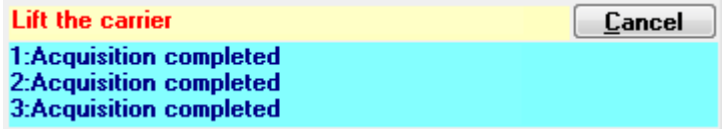


Figure 25 - Operator Dialog: End of dosimeter exposure data acquisition.

- After the message "Lift the carrier", pull the latch that unlocks the carrier: then it automatically lifts up with the push of the air-charged springs.
- Remove the dosimeters and store them according to the displayed results.

The results are automatically recorded into the data base

NOTE:
The final status of the dosimeter is the "Pause" mode with a specific display in case the results are not acceptable (according to the configuration chosen).

The previously stored dose and maximum dose rate values are lost. The thresholds and, in general, the dosimeter configuration are left unchanged by the check.

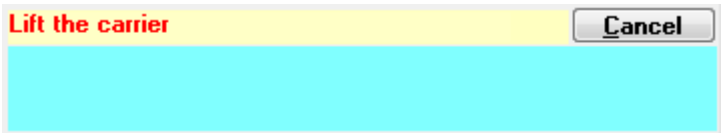


Figure 26 - Operator Dialog: End of Check

Next reload three other dosimeters and restart the same sequence.

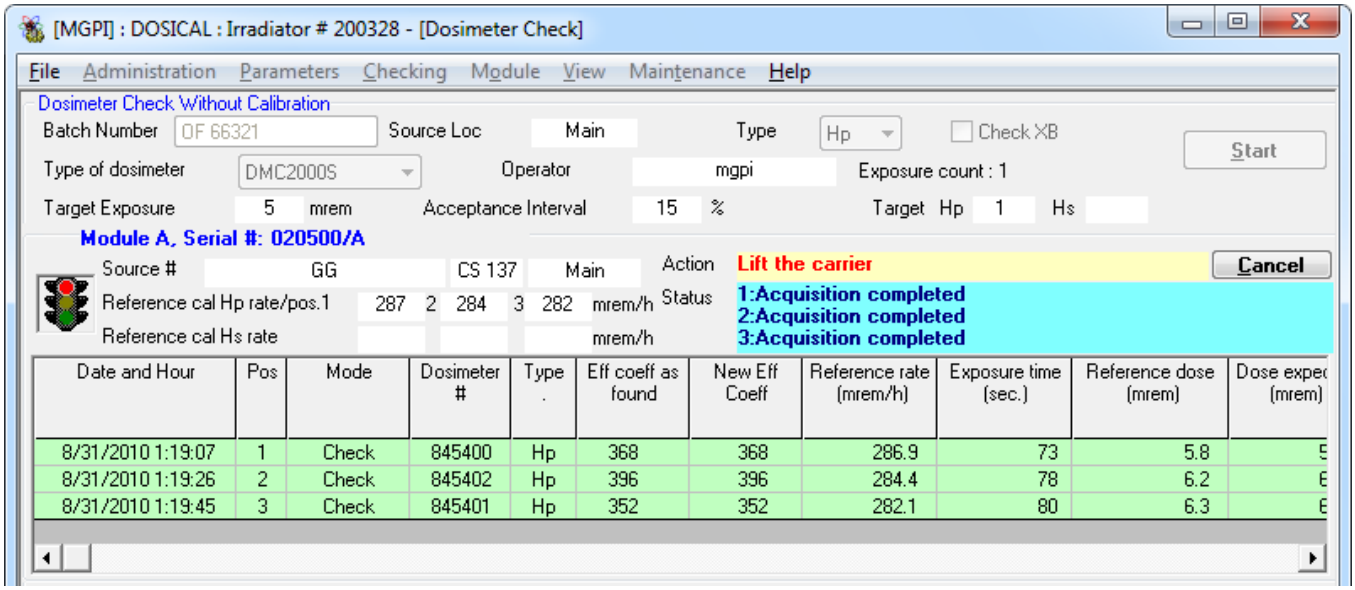
CAUTION:
The dosimeters can be inserted into or removed from the irradiator only when the carrier is fully open.

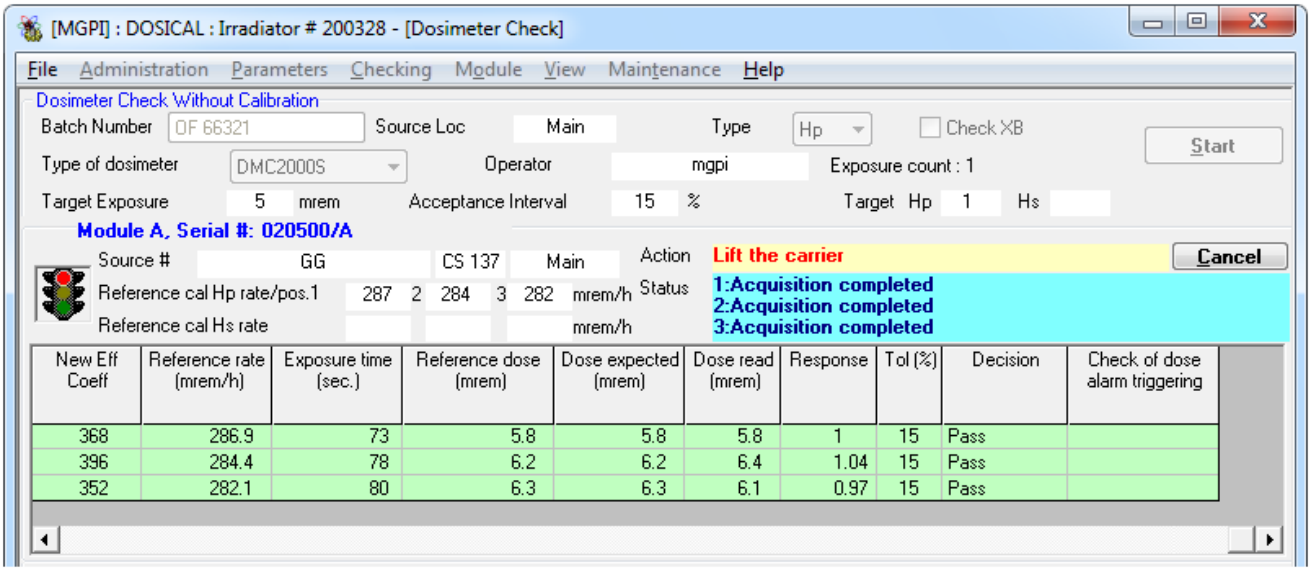
4.2.2.2 Error Message

If some dosimeter's parameters are out of range, Dosical displays the following message: "**Received message corrupted**".

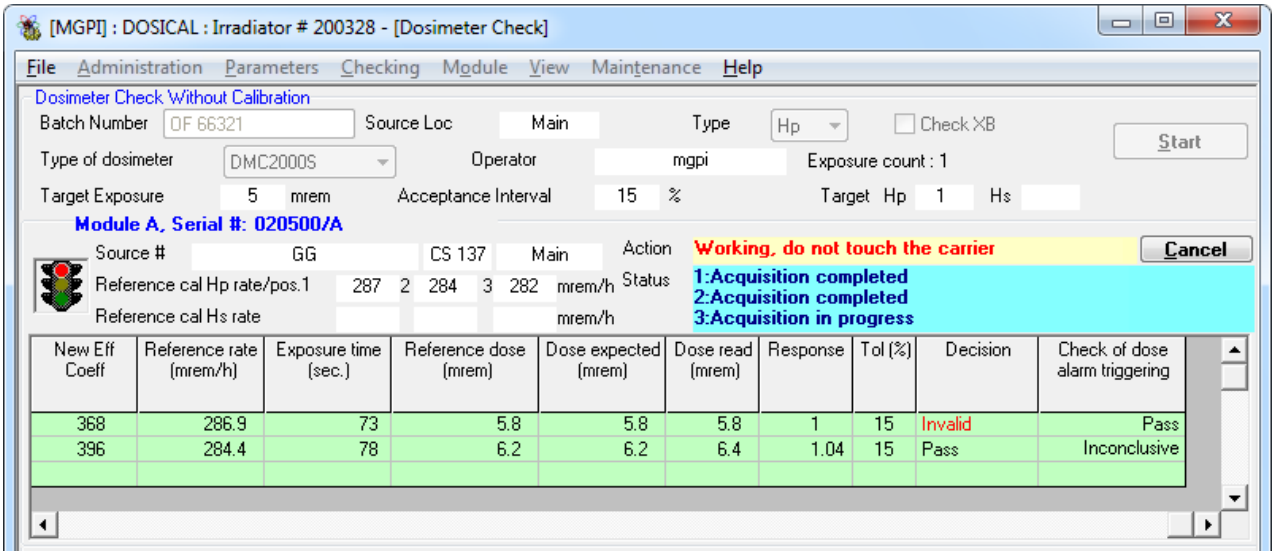
Note:
This is not due to an Hand-free exchange problem. In this case, contact MGPI specifying the message content.

4.2.2.3 Results Screen for a Check without Calibration





Screen example with "**check alarm**" parameter authorized.



Note:
Only the display area of this screen can be stretched, for the other, the use of the horizontal scroll bar is needed.

For an XB dosimeter, there will be two magnitudes measured, Hp and Hs.

To abort the check:

- Click on the button « Abort », on the right of the « Action » - « Status » zones

To exit the session:

- Click on the button « End of Session », on the bottom right of the screen

The results of a check can be:

- pass: response falls within the acceptance interval.
- fail: response is outside the acceptance interval but is within the interval authorizing a calibration.
- invalid: response is outside the interval authorizing a calibration.

4.2.2.4 Dosimeter Check Function with Calibration

This function allows the verification of a dosimeter lot and adjust the response of those which are outside the acceptable limit.

The response after the adjustment is verified again. The adjustment is done by modifying the "efficiency coefficient". The values after and before the adjustment are provided.

Access to this function is obtained from the "Checking with calibration" sub-menu from the **"Checking"** menu of DOSICAL. The two successive checks are entirely controlled by DOSICAL.

The same screen as in normal check is used, with the result table presenting the results of the 2 checks instead of one per equipment.

The procedure is identical to the "check without calibration" case.

DOSICAL automatically stores the two checks and the efficiency coefficient change.

- 1: If at least one dosimeter is out of tolerances upon completion of the first check, all remain in place, the dosimeter(s) involved only being recalibrated and rechecked. If no dosimeter is out of tolerances upon completion of the first check, the sequence then ends.
- 2: If the procedure is cancelled while rechecking a dosimeter, an information message box will be displayed at the next calibration of this dosimeter.
- 3: After a calibration, if the response is accepted (result: PASS), the calibration date is set into the dosimeter.
- 4: The calculations are detailed in Appendix 3: Calculations Performed Upon a Calibration", p **101**

Warning:

Caution : For the DMC 2000 XB

Only the 2nd position is available for calibration with the primary source.

Calibration with the secondary source is not available (control without calibration only)

Warning:

Warning: It is imperative to use a carrier appropriate at the type of dosimeter used.

Otherwise, the dosimeters will be wrongly positioned in the IRD, which has the effect of producing measures, and therefore an improper calibration.

For dosimeters type:

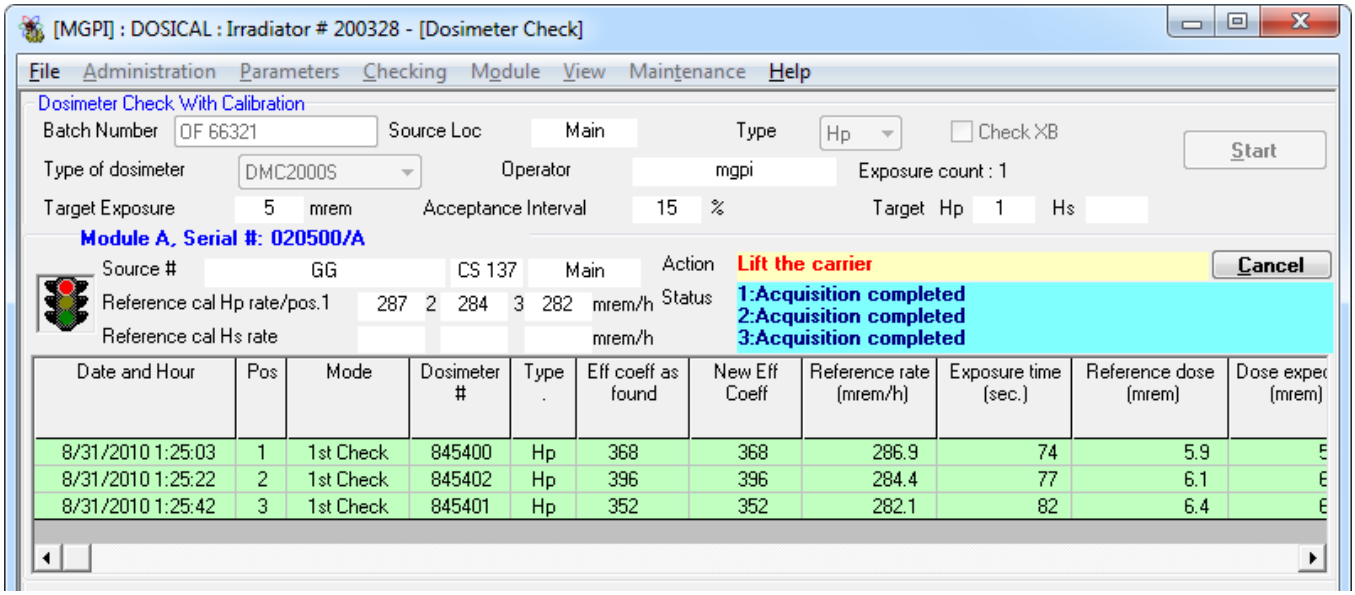
DMC 2000 S, X, XB: DMC 2000 carrier.

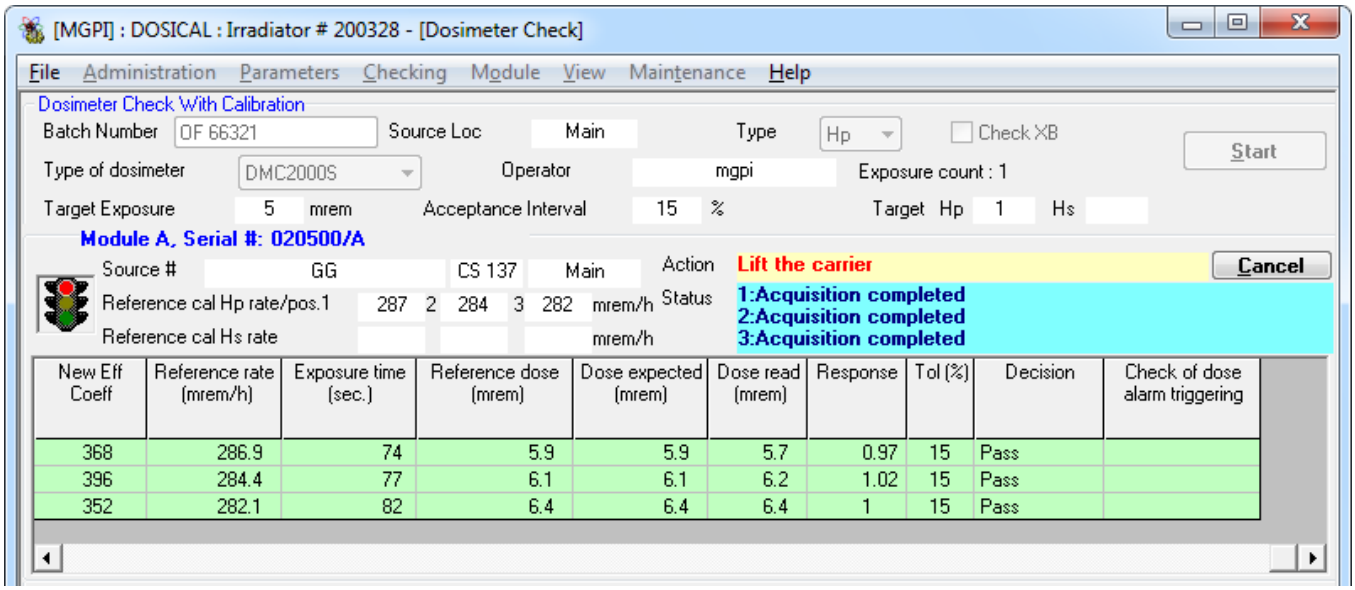
DMC 2000 GN: DMC 2000 GN carrier.

SOR/R, SOR/T: SOR carrier.

DMC 3000: DMC 3000 carrier.

4.2.2.5 Results Screen of a Check with Calibration





4.2.2.6 Using the command lines

This function allows to execute external software after each dosimeter check or at the end of the check session. For example, report edit.

In the case of the batch check with or without calibration, the name of the session is added as parameter to the command line.

4.2.2.7 Dosiparc link

This function allows to update the Dosiparc calibration data.

To use this function an ODBC link with the Dosiparc database is necessary (DSN: Dosiparc)

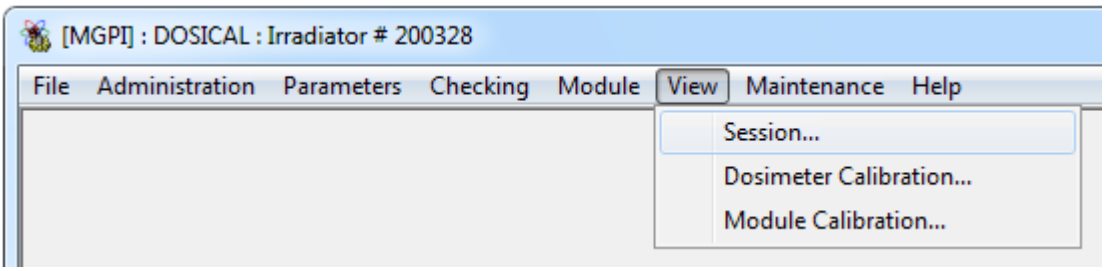
It is also necessary to change to 1, the label « Dosiparc » in the dosical.ini file. (Dosiparc=1)

4.2.3 Consulting Function

Access to this function is obtained from the "View" menu of DOSICAL.

This menu allows the access to the three following sub-menus:

- « Session... »,
- « Dosimeter Calibration...»,
- « Module Calibration...»,



4.2.3.1 Sessions

Access to this function is obtained from the "Session" sub-menu of the « View » menu of DOSICAL.

- Information zone "Session List": see screen next page
- For the selected session (click on the session table line), "Session Detail " zone:
  - Calibration information used in the selected session and by module
- Access to the list of dosimeter checks in the selected session by clicking on the "Check List" button, on the lower left corner of the screen.
- Available actions for the selected session:
  - At the "SUPERVISOR" level:
    - delete a session: click on the "Delete" button.
  - All levels:
    - print the session list: click on the "Print" button.
    - exit the session inquiry: click on the "Close" button

4.2.3.1.1 Selection and Sort-by

- The session list is sorted by date in decreasing order.

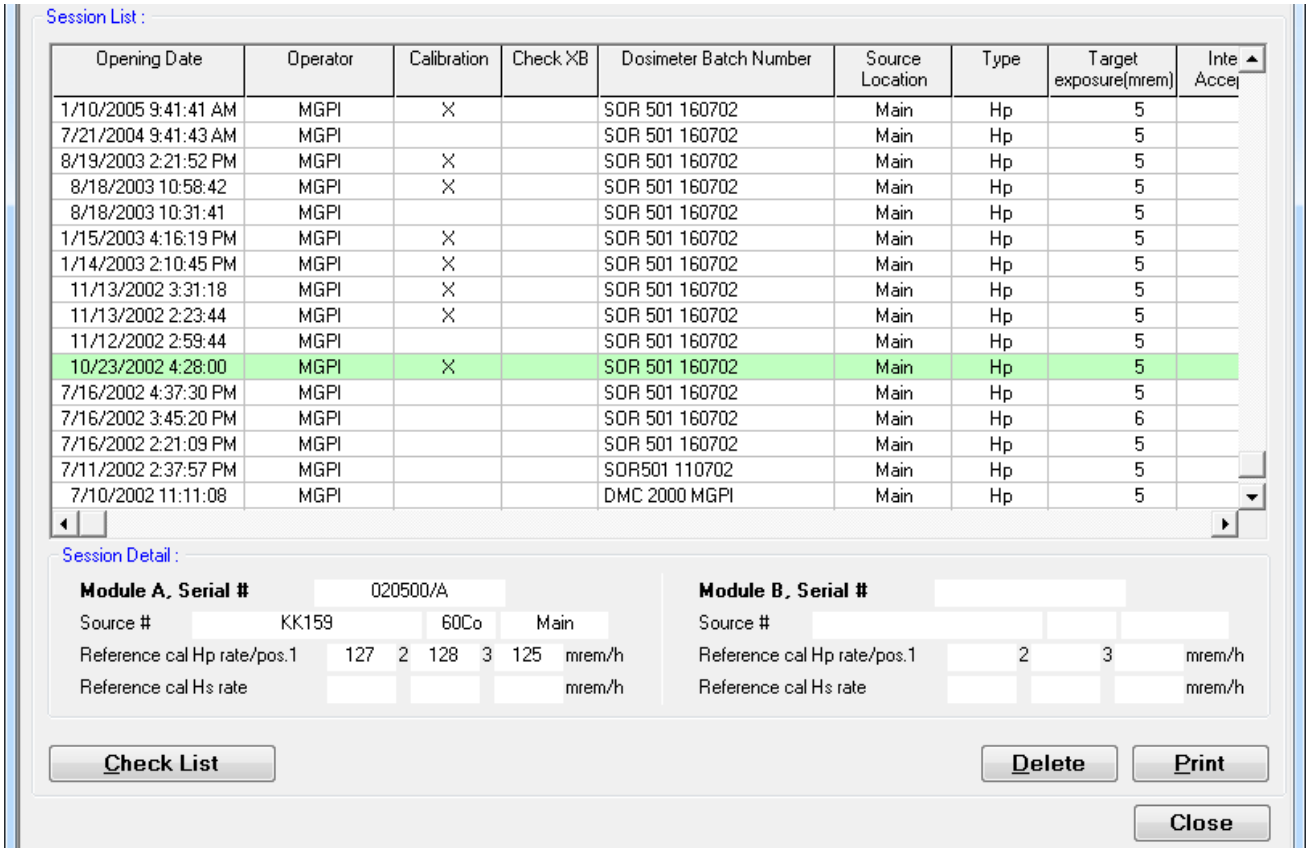


Figure 27 - Screen "Session list"

4.2.3.2 Dosimeter Checks

Access to this function is obtained from the "Dosimeter Calibration" sub-menu from the "View" menu of DOSICAL.

- This information is given in the "Check List" zone:
  see the screen next page for an exhaustive list of all the information.

4.2.3.2.1 Search criteria and Sort-by

- The search criteria are in order:
  - Selection interval of dosimeter number,
    if this interval is not provided, the checks performed on all the dosimeters are displayed.
  - Choice of the main or secondary source location,
  - Choice of all the checks or the last result per dosimeter by each session
- The default display of the checks is provided by decreasing dosimeter number and decreasing date; the table can be sorted by column in increasing or decreasing order by clicking the column titles.

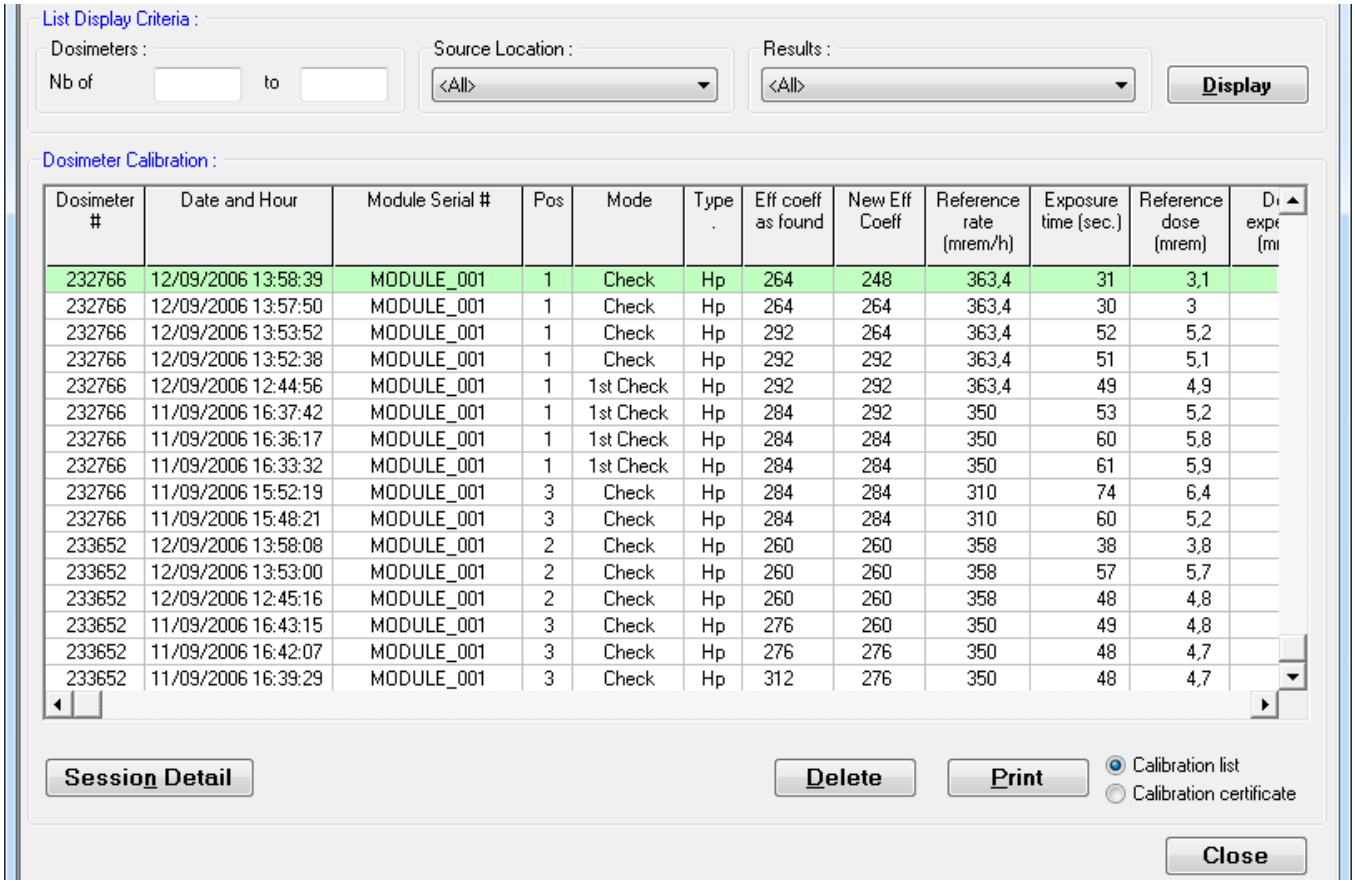


Figure 28 - "Check List" screen

- To see the checks according to the selected criteria in the "display criteria":
  click the "Display" button, on the top right hand corner of the screen.
- To delete the current selected check (line highlighted in green):
  click the "Delete" button, on the lower right corner of the screen.
- To print out the check results:
  click on the "Print" button , on the lower right corner of the screen.
- To exit the consultation:
  click on the "Close" button.

4.2.3.3 Module calibration

The sub-menu "Module Calibration" of the menu "View", allows to consult the calibration list of a given irradiator module, for a given source, either placed in the main source location or secondary source location, for a given dose equivalent measurement type.

For a selected calibration (see screen next page, line highlighted in green), you can consult by clicking

- the button "Check List" , the dosimeters checks , with or without calibration,

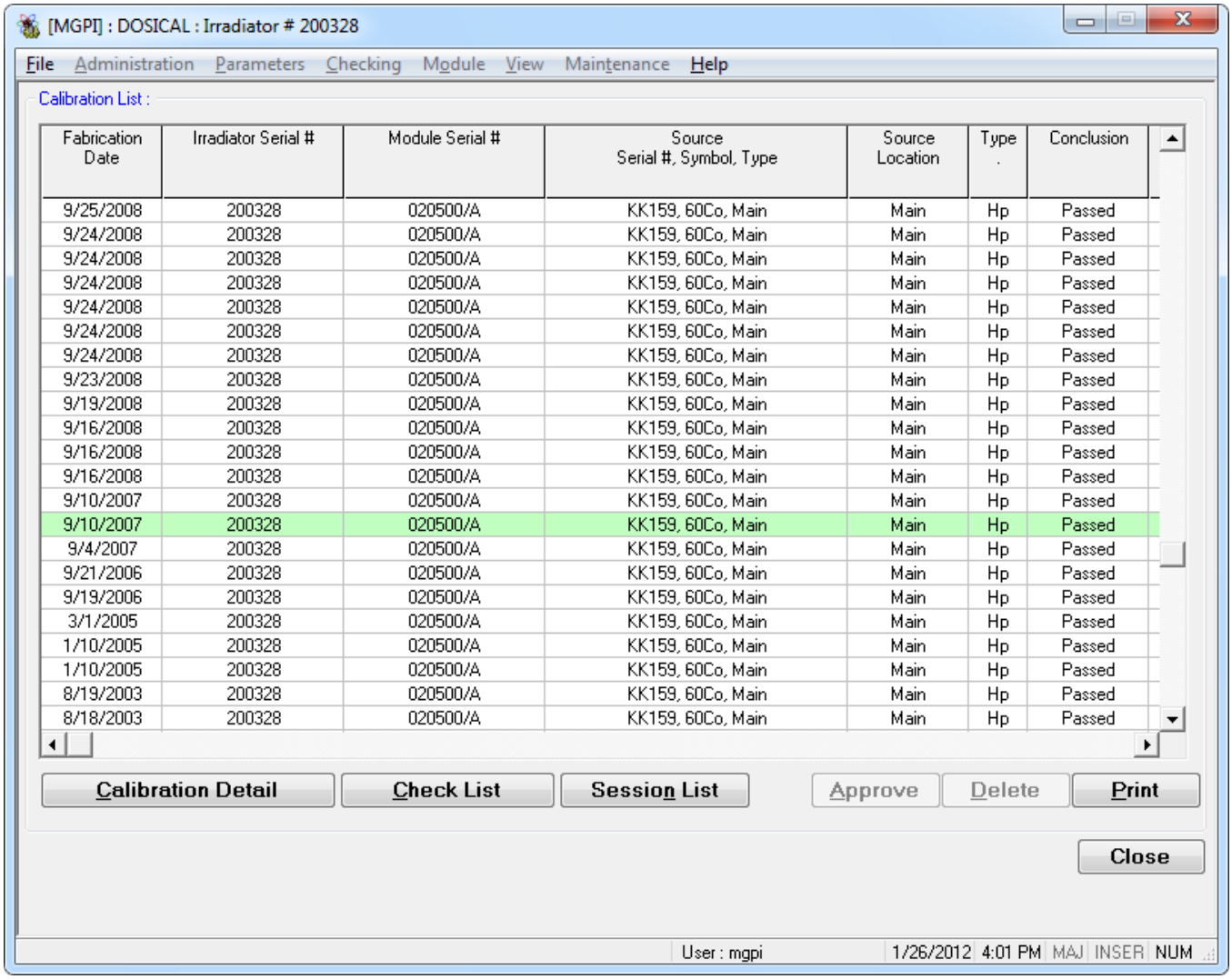
- the button « Calibration Detail » , the results of the tests related to a computerized calibration, if there is one, for the selected calibration.
- To print one or more calibration, you have to click on "Print" button. The software asks if you wish to print only the displayed list or the whole calibration.

At the « SUPERVISOR » or « MANUFACTURER »levels, you can:

- approve a selected calibration, (click on the "Approve" button)
- delete a selected calibration (click on the "Delete" button).

At all levels:

- print the calibration list: click on the "Print" button.
- Sort-by , the calibration display is sorted by decreasing date.



Fabrication Date	Irradiator Serial #	Module Serial #	Source Serial #, Symbol, Type	Source Location	Type .	Conclusion
9/25/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/24/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/24/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/24/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/24/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/24/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/24/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/23/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/19/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/16/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/16/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/16/2008	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/10/2007	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/10/2007	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/4/2007	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/21/2006	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
9/19/2006	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
3/1/2005	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
1/10/2005	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
1/10/2005	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
8/19/2003	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed
8/18/2003	200328	020500/A	KK159, 60Co, Main	Main	Hp	Passed

Figure 29 - « Calibration List » screen- Partial view of the fields of a table

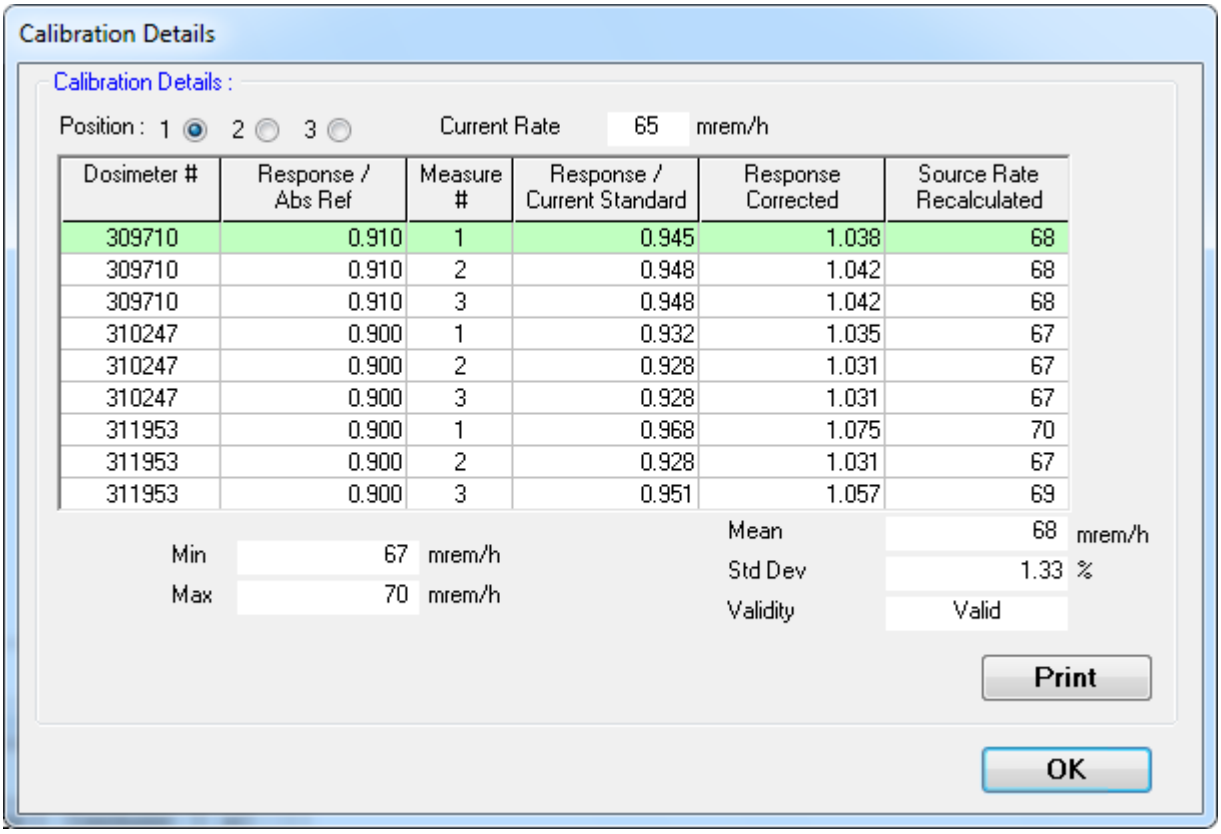


Figure 30 - « Calibration Details » Secondary screen,

-> accessible by clicking the button "Calibration Detail" of the screen related to the calibration list.

9 exposure measurements (3 for each dosimeter) performed during the selected calibration are displayed (line overscored in green on screen).

5. Maintenance

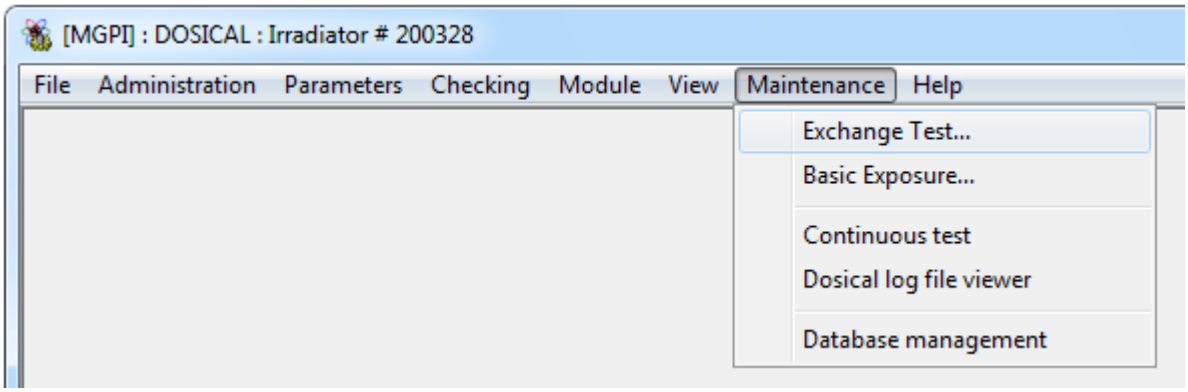
This section describes the preventive and corrective maintenance operations of the irradiator.

5.1 Maintenance Help Functions

5.2 "Maintenance" Menu

This menu allows the access to the 2 following sub-menus:

- « Exchange Test... »,
- « Basic Exposure...»,
- « Database management...»,



5.2.1 Exchange Test

This sub-menu of the menu "Maintenance" of DOSICAL allows to test an elementary data exchange between a dosimeter, a LDM2000 reader and a PC.

Each test is performed for a dosimeter position chosen within the 3 available positions. It is entirely controlled by DOSICAL.

The operator must insert the dosimeter before starting the test.

- to start the test: click on the 'Start" button
- to exit the test: click on the "Close" button.

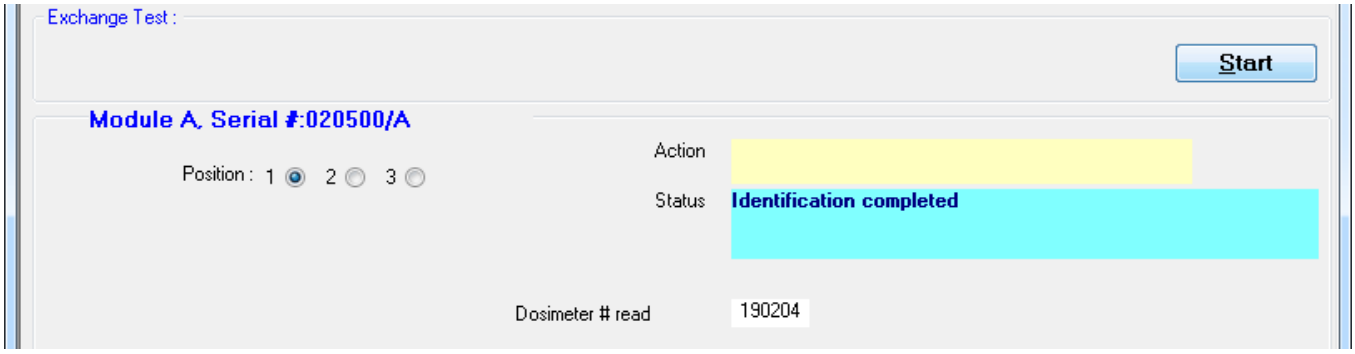


Figure 31 - "Exchange Test" screen - End of Test

5.2.2 Basic Exposure

This sub-menu of the "Maintenance" menu of DOSICAL allows to perform a basic exposure test of a dosimeter (identification, activation, exposure and measurement data acquisition).

Each test is performed for a dosimeter position chosen within the 3 available positions. It is entirely controlled by DOSICAL.

- to start the exposure test: click on the "Start" button.
- test abortion to the operator's initiative: click on the "Abort" button
- to exit the test: click on the "Close" button.

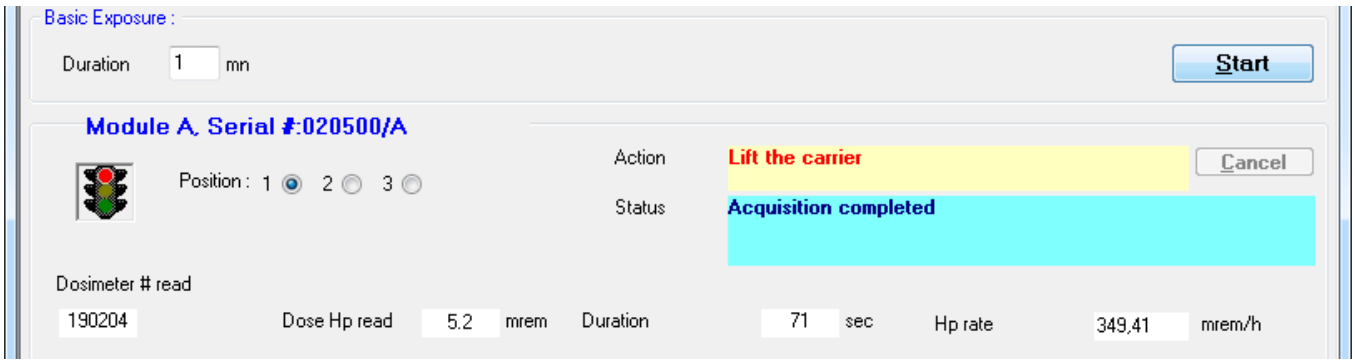


Figure 32 - « Basic Exposure » screen - End of Test

The displayed results are:

- Dosimeter Serial Number,
- Hp dose equivalent read,
- The measurement duration read from the dosimeter.
- Hp dose rate read.

Note:
In the case of an XB type dosimeter, the Hs dose read and Hs rate read fields are also present.

5.2.3 Continuous test

5.2.3.1 Introduction

This sub-menu of the "Maintenance" menu of DOSICAL allows to use the software in « continuous test mode ».

This mode allows you to check the proper communication between the irradiator and dosimeters, and return any communication errors in a trace file, through an fatigue tests when Check Function with or without calibration is used (*See 4.2.2.1 Dosimeter Check Function without Calibration & 4.2.2.4 Dosimeter Check Function with Calibration chapters*).

5.2.3.2 Enable/disable the "continuous test mode"

To enable/disable the "continuous test mode", simply select/deselect this mode in the Maintenance Menu, Continuous test. A checkbox indicate if this mode is in used or not.

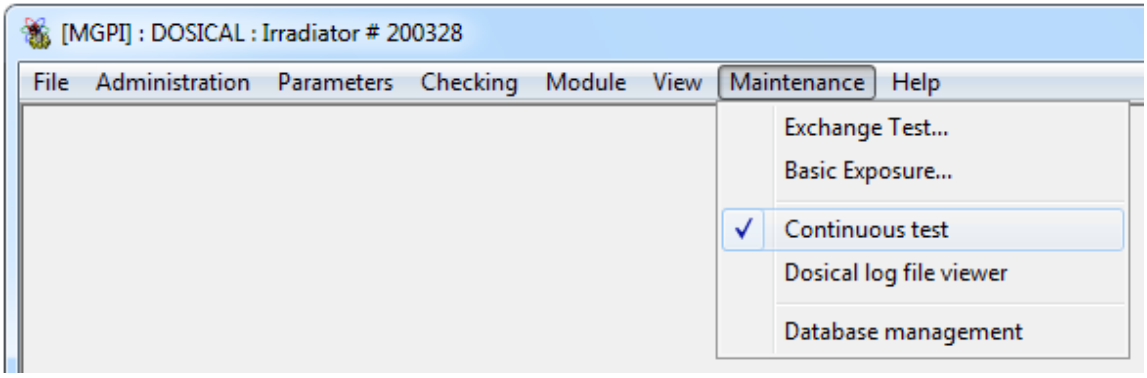


Figure 33 - The checkbox to indicate if the « continuous test mode » is in used or not.

5.2.3.3 Launch a dosimeter check function in "continuous test mode"

After activating the "continuous test mode", simply launch the dosimeter test check with or without calibration.

To do that, see 4.2.2.1 Dosimeter Check Function without Calibration & 4.2.2.4 Dosimeter Check Function with Calibration chapters.

5.2.3.4 Difference between the dosimeter check function in "continuous test mode" and "standard mode"

During the dosimeter check function with or without calibration in "continuous test mode", DosiCal performs all steps of the check function.

The only difference is in the step "End of Control": DosiCal relaunch automatically, another control, until the user decides to stop the fatigue tests.

A reminder text is displayed in the title bar of the Dosimeter Check Function without Calibration form.

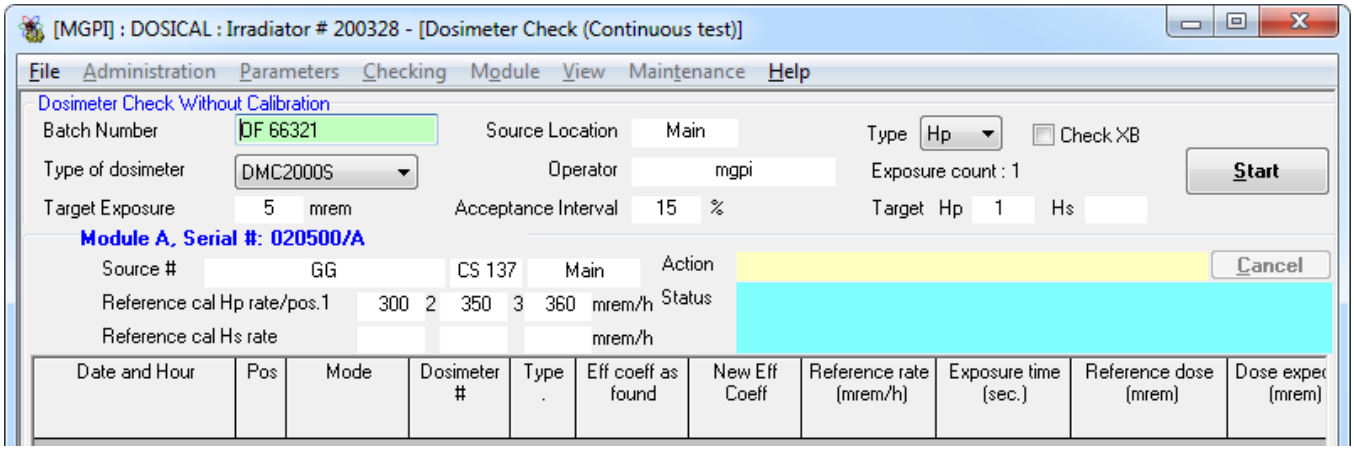


Figure 34 - The reminder text in the main Dosimeter Check Function without Calibration, to indicate if the « continuous test mode » is in used or not.

In addition, during the entire Dosimeter Check Function in “continuous test mode”, a real time monitoring window is displayed, to show and log the potential communication errors.

Those communications errors are saved in a log file, described in the in the following chapter.

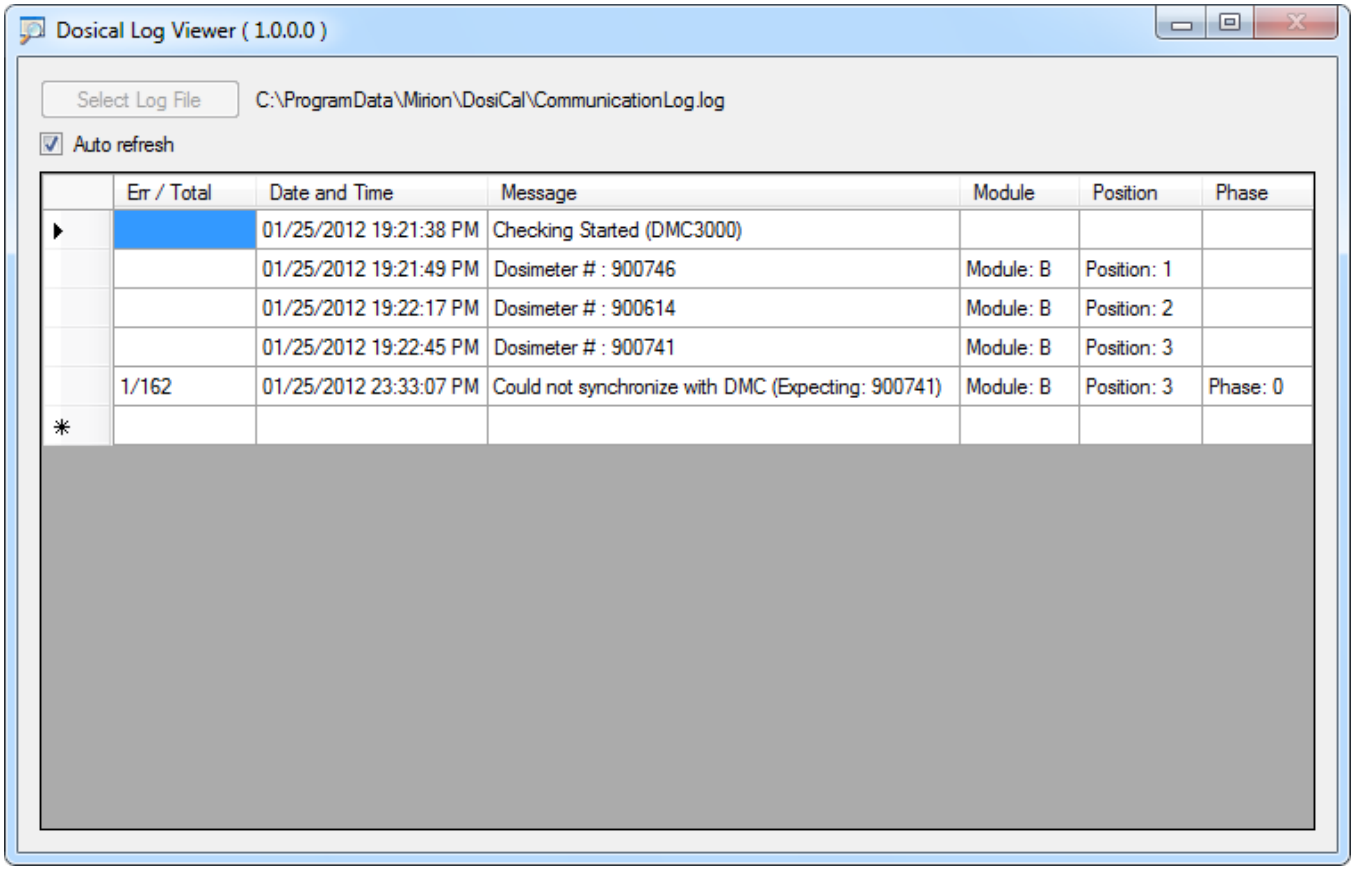


Figure 35 - The real time error monitoring window, during the Dosimeter Check Function in "continuous test mode"

5.2.3.5 *The log file generated during the Dosimeter Check Function in "continuous test mode"*

During the Dosimeter Check Function in "continuous test mode", a log file, that contains the different error event's information, that was intercepted, is automatically created.

It will contain in chronological order:

1. **At the beginning of the test**:
   - The date and time of test beginning.
   - The type of dosimeter used.
   - The message that indicates the beginning of the test.

2. **During the first check, up on the detection of each dosimeter:**:
    - The detection date and time.
    - The dosimeter serial number.
    - The module number that contain the dosimeter.
    - The position of this dosimeter in this module.

3. **At each communication error**:
    - The report "error number" on the checksum.
    - The date and time of this error.
    - The error message.
    - The dosimeter serial number expected.
    - The module number that contain the dosimeter.
    - The position of this dosimeter in this module.
    - The phase number.

4. **At the test completion**:
    - The date and time of test completion.
    - The checks total number.

The name of this log file is **CommunicationLog.log**.

It's located in the DosiCal data storage directory:

- **For Windows 9x :** The DosiCal installation directory.

- **For Windows 2000, Windows XP, Windows Server 2003 :**
  C:\Documents and Settings\All Users\Application Data\Mirion\DosiCal\

- **For Windows Vista, Windows Server 2008, Windows 7 and higher:**
  C:\ProgramData\Mirion\DosiCal\

5.2.3.6 The communication error list that are intercepted in "continuous test mode"

The Intercepted communication errors in this mode are:

- -30608 : Could not synchronize with DMC.
- -30204 : Multiple dosimeters.
- -30205 : No Dosimeter.

5.2.3.7 How to stop a Dosimeter Check Function in "continuous test mode"?

To stop a Dosimeter Check Function in "continuous test mode", the user have just to click on the "abort" button, at any check step. Then close the main Dosimeter Check Function form, by clicking on the close button.

5.2.4 The DosiCal Log Viewer

This sub-menu of the "Maintenance" menu of DOSICAL allows to load the DosiCal Log Viewer, to posteriorly show the content of the "continuous test mode" log file.

To load a log file, just load the "DosiCal Log Viewer", by the "Maintenance" Menu, "DosiCal Log File Viewer".

Then, in the "DosiCal Log Viewer" main form, just click on the "Select log file" button. The standard "Windows File Open/Save dialog box", is loaded.

In this dialog box, select a "continuous test mode" log file, and click on the "open" button.

The reader formats and displays the information contained in the log file.

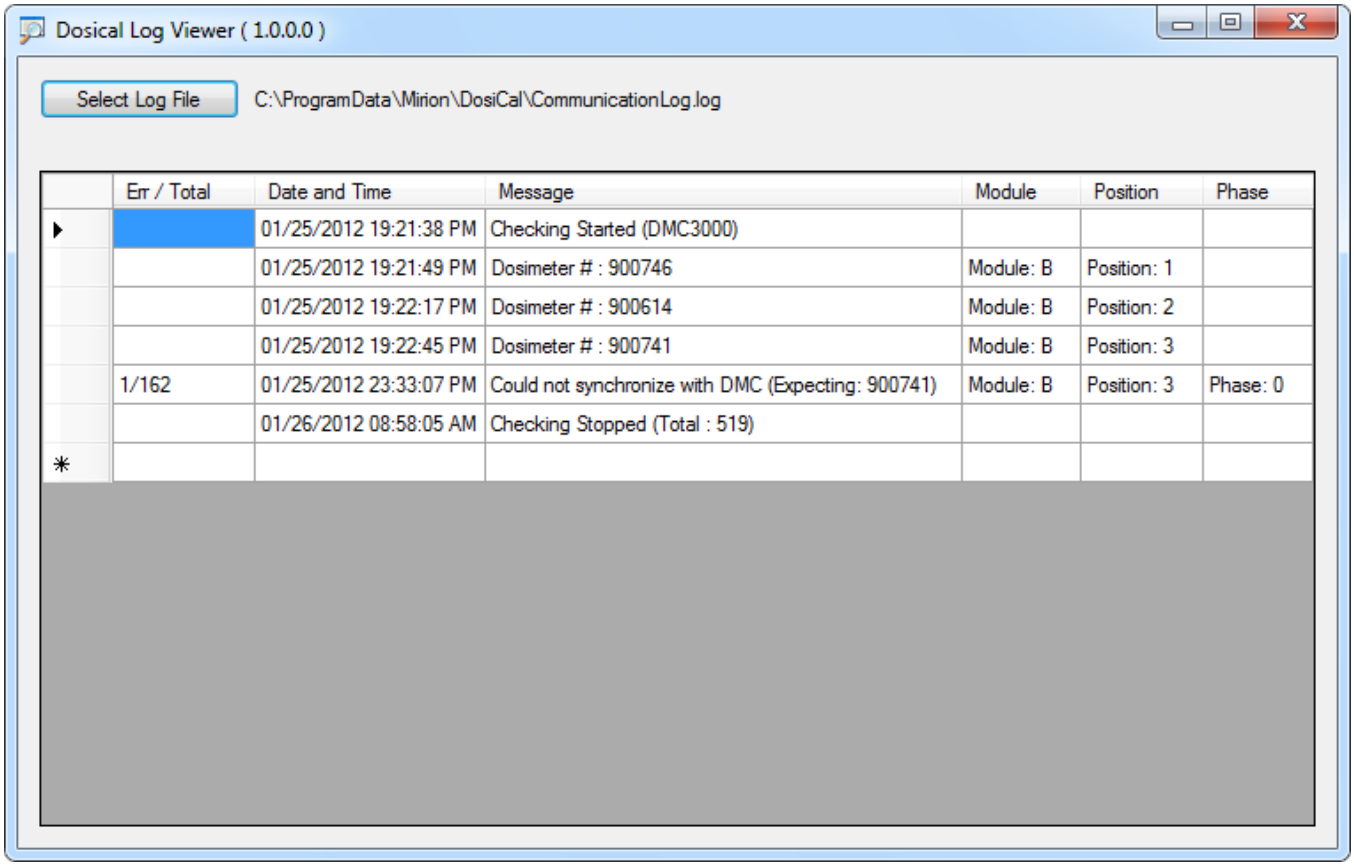


Figure 36 - The DosiCal Log File Viewer, with a "continuous test mode" log file loaded

5.2.5 Database management

The database purge function is intended to delete dosimeter check records in order to avoid saturation of the database used.

The "File" menu "Database management" sub-menu is only accessible at the "SUPERVISOR" and "MANUFACTURER" levels.

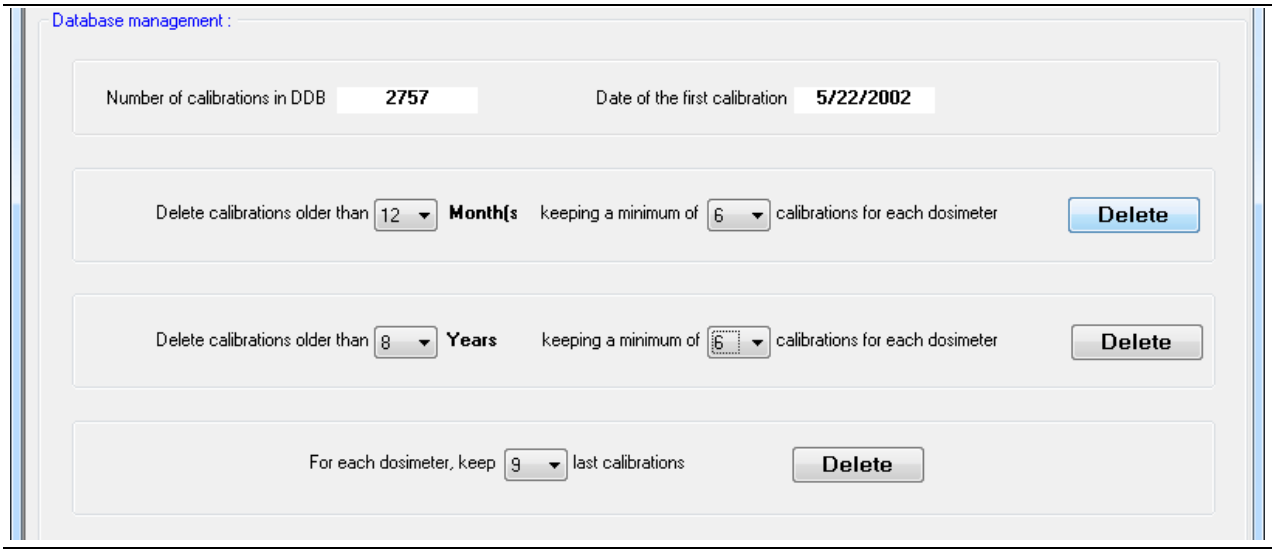


Figure 37 - DOSICAL "Database management" screen

- Database (DDB) information:
  - Number of calibrations in DDB,
  - Date of the first calibration.

- 3 possible types of purge:
  - Delete calibrations by selecting the age in months, as well as the minimum number of calibrations to be kept for each dosimeter.
  - Delete calibrations by selecting the age in years, as well as the minimum number of calibrations to be kept for each dosimeter.
  - Delete calibrations by only selecting the number of calibrations to be kept for each dosimeter.

5.3 Calibration

The calibration function allows the generation of reference dose rates used by dosimeter checks.

- A calibration is uniquely identified by:
  - One irradiation module,
  - One source location, main or secondary,
  - One source, identified by its serial number,
    - it allows the possibility to switch the source carriers.
    - if this number is not entered, a common number by default is taken
  - One measurement type: Hp or Hs
  - One type of dosimeter

Moreover, a calibration is characterized by its creation date.

A calibration then comprises:

- the set of the 3 available positions for a main source,
- a unique position for the secondary source.

Upon a session opening, the last created calibration is considered as the current calibration:

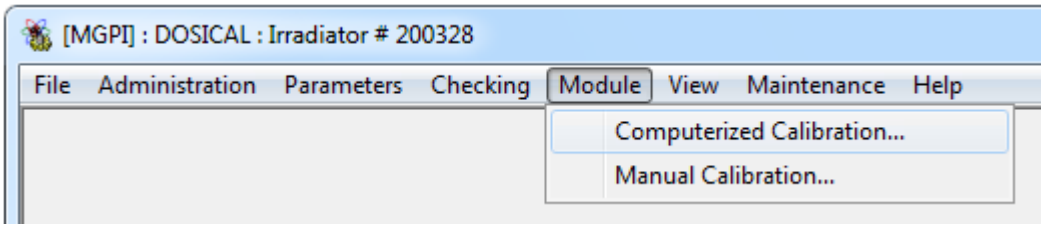
- for each serial number of the declared module,
- for the source selected (main/secondary),
- for the source serial number.

Access to the calibration functions is obtained from the "Module" menu of DOSICAL.

5.3.1 "Module" Menu

This menu allows the access to the 2 following sub-menus:

- « Computerized Calibration... »,
- « Manual Calibration...»,



5.3.2 Manual Calibration

This function enables the reference rate of each respective position to be forced to a given value.

This can follow a calibration process specific to the customer.

5.3.3 Access to the manual calibration function

It is obtained from the "Manual Calibration" sub-menu of the "Module" menu in DOSICAL. This access is only for users with the « MANUFACTURER » level and the « SUPERVISOR » level.

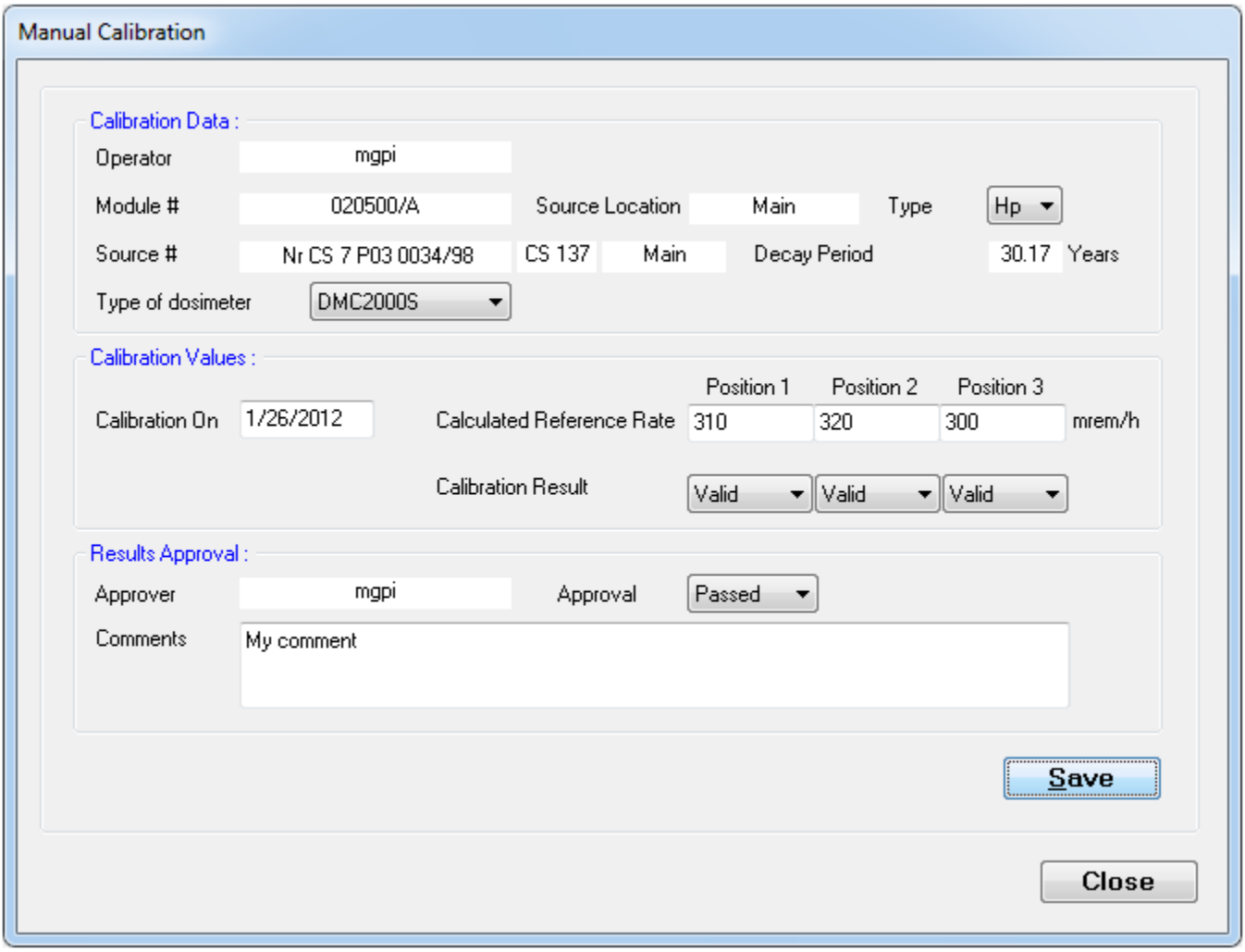


Figure 38 - « Manual Calibration » screen -

->The Reference Dose Rates calculated for each position of the dosimeters are forced

-> Module 1 - Source Nr CS 7 P03 0034/98 , Cs137 placed on the main source location - Hp-type measurement

The reference rates for the main source can be established by achieving basic exposure at each position.

For the secondary source, the Hs reference rate is established in position 2 only and according to this principle:

- Remove the plastic screen from the dosimeter irradiation field.
- Place the source shutter in intermediate position.
- Insert a dosimeter into the rack at location 2,
- Achieve basic exposure for a standard dosimeter.

The minimum exposure time is two minutes. Record the Hs rate only, given in mrem/h.

- Calculate the corrected Hp/Sr rate = read rate / Hp/Sr 90 standard dosimeter response (Sr 90 standard dosimeter response = read dose / expected dose).

The Hp rate is considered equal to the Hs rate.

- zone "**Calibration Data**":
  a selection by means of a scrolling list can be done for the following data:
  - the source location: main or secondary
  - The dose equivalent measurement: Hp or Hs
  - The source: serial number to select
  - Type of dosimeter
- zone "**Calibration Values**":
  for each calibration position:
  - Calculated Reference Rate,
  - Calibration Result:
    -scrolling list with two choices: valid or invalid
- zone "Results Approval"
  - Approval:
    - scrolling-list choices: passed or failed.
  - Comments: free text , complementary information on the performed manual calibration.
- Commands:
  - "Save": records the manual calibration into the Data Base.
  - "Close": exits the manual calibration function.

Note:
The dosimeter type is set by default to the last type used in manual or computerized calibration.

5.3.4 Computerized Calibration using Reference Dosimeters

CAUTION:
An existing calibration is required before using this function.
If it is not the case, enter an approximate manual calibration.
Blank the source prior to performing any operation

This function allows the creation of a calibration record, considering a lot of 3 Reference Dosimeters, previously characterized by means of an "absolute" reference (in general, using a secondary standard owned by an accredited laboratory).

The operation sequence consists in 9 exposures, identical to Dosimeter Checks (3 series of 3 successive exposures per dosimeter, each series corresponding to a permutation of the positions of the 3 dosimeters).

Access to this function is gained from the "Computerized Calibration" sub-menu of the "Module" menu of DOSICAL.

All the items of information related to the creation of calibration are stored in the data base.

The absence of information in the obligatory fields or the absence of validation cancels the creation of the calibration record.

The operating process is the following:

- Select the appropriate value for the « Source location », « Magnitude » and « Dosimeter type » fields.

Note:
If the secondary location has not been enabled in the « General parameters » menu, the « Source location » field cannot be modified and its value is « Main ».
The dosimeter type is set by default to the last type used in manual or computerized calibration.

- Select the 3 reference dosimeters,

Note
The reference dosimeter nomenclature must have been completed beforehand and comprise at least 3 valid reference dosimeters.

It is possible to use reference dosimeters DMC 2000 XB to establish the reference rate of DMC 2000 X.

In this case, after the computerized calibration , it will be necessary to perform a manual calibration to validate the calibration for the DMC 2000 X dosimeters

- Place the reference dosimeters in the 3 positions (in any order),
- Before any computerized calibration and for XB dosimeters, check that the response displayed for each reference dosimeter corresponds to the magnitude and isotope to be measured.
- Start the calibration (button "Start" of the "Calibration with Reference Dosimeters" screen) and follow the instructions ("Action" zone):

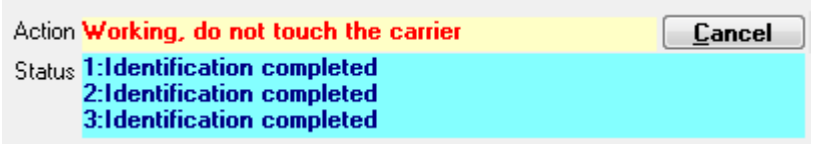


Figure 39 - "Computerized Calibration"

-> Screen Information Zone: End of Dosimeters Identification

DOSICAL then checks that the 3 present dosimeters correspond to those selected in the interface by comparing the serial numbers and also the dosimeter type. An error message appears if the dosimeters do not correspond.

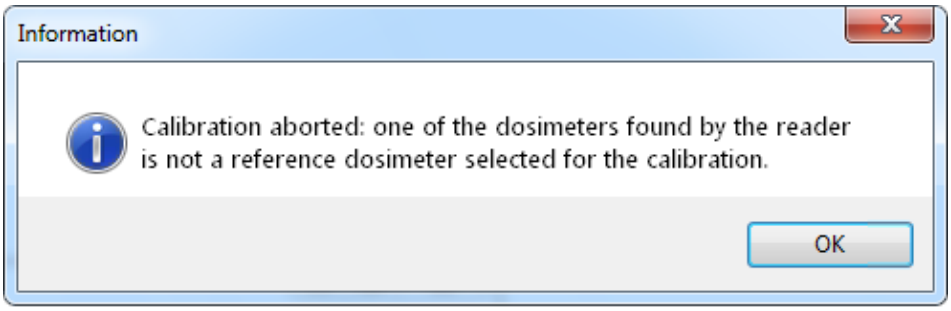


Figure 40 : Typical Error Message: The type of a dosimeter is incorrect.

The system performs 3 successive measurements and then waits for the carrier lift by the operator:

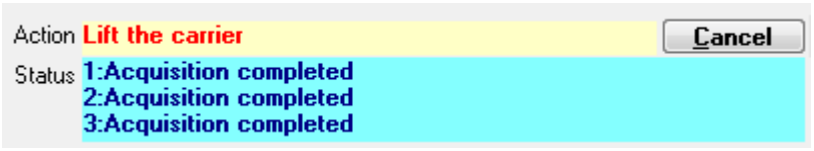


Figure 41 - "Computerized Calibration"

-> Screen Information Zone: End of Dosimeters Measurement Data Acquisition

- Lift the carrier, then execute a circular permutation of the positions of the dosimeters and move the carrier down:
  The system performs 3 successive measurements and then waits for the carrier lift
- Lift the carrier, then execute the last circular permutation and move the carrier down:
  The system performs 3 successive measurements and then displays the calculated results

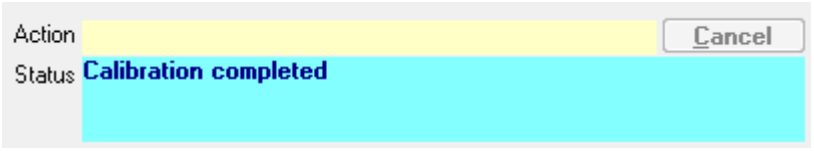


Figure 42 - "Computerized Calibration" Screen Information Zone: End of Calibration

Note:
To avoid a permutation error, consult the "Reference Dosimeters" table of the "Computerized Calibration" screen, columns "Position1", "Position2", Position3": each column lists, for each reference dosimeter, the number of performed measurements according to the occupied position (see picture next page).

Computerized calibration for the secondary source is only possible in Hs. If the secondary source is Sr 90, it is necessary to enter the response of each reference dosimeter for this radioelement. Refer to paragraph "4.1.5 Nomenclature of the

Reference Dosimeters" to enter this value.

For the XB dosimeters and for the secondary source only, the Sr 90 Hp rate is considered equal to the Sr 90 Hs rate. Therefore, after computerized calibration with Hs secondary source, manual calibration is necessary to set the Sr 90 secondary equal to source Hp rate value.

- The detail of elementary results can be consulted:
  Click on the "Detail" button, on the right corner of the "Reference Dosimeters" zone
- **To be valid**, **each calibration MUST BE APPROVED at the "SUPERVISOR" level**:
  Click on the "Approve" button, on the right corner of the "Reference Dosimeters" zone, if your access level is sufficient.

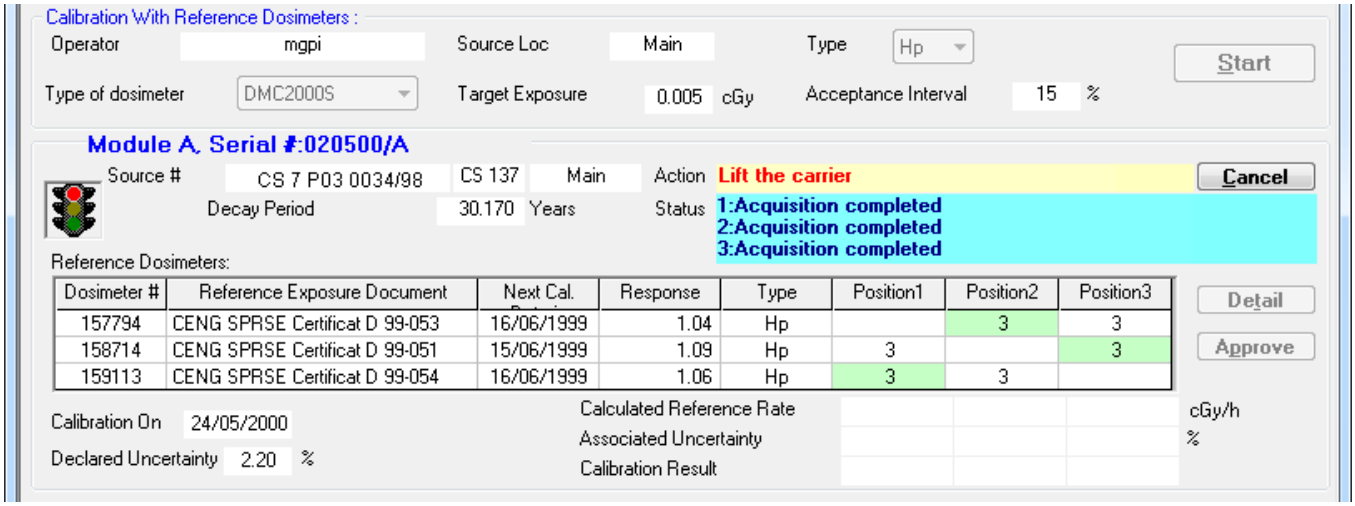


Figure 43 - "Computerized Calibration" screen:

-> End of the 3 Dosimeters exposures for the second permutation

The screen appears divided in the following fields:

- "Calibration with Reference Dosimeters" zone:
  - Remainder of the calibration characteristics:
    - not modifiable: Operator's Identification, Source Location Type, and Measurement Type.
    - modifiable: Target Exposure and Calibration Acceptance Interval.
- "Module x , Serial Number #:<Module Identification>" zone:
  - Remainder of the characteristics of the irradiation module source
  - System Dialog with the operator, on top right:
    - "Action" zone: instruction , in red color, for the operator's attention,
    - "Status" zone: report of the system actions in progress.
  - Results of the dosimeters previous calibration and display in real time of the number of exposures performed during the current permutation of the 3 dosimeters. Each cycle is

completed when 3 exposures for each dosimeter have been performed for the positions relative to the current permutation.

- Commands:
  - "Start": Starts the calibration process
  - "Abort": Aborts the calibration process,
  - "Detail": Gives access to the "Calibration Detail" screen, providing the results of the 9 measurements performed during the calibration process, which is 3 measurements for each dosimeter.
  - "Approve": Calibration Results.
  - "Close": Exits the computerized calibration function.

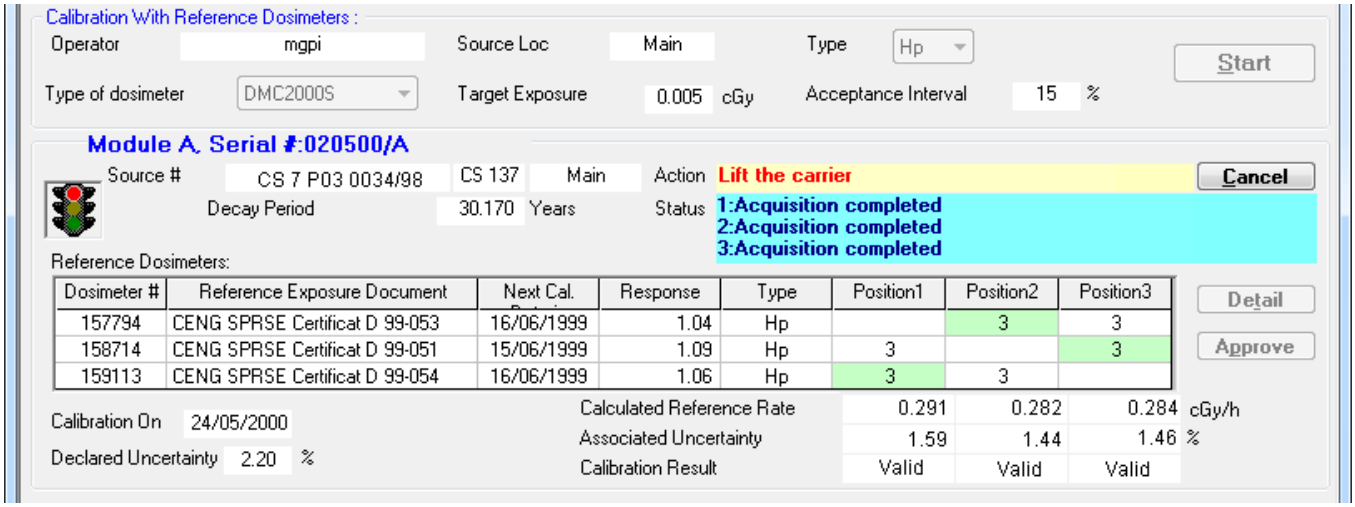


Figure 44 - End of a computerized calibration sequence:

-> End of a test series for each of the three dosimeter permutations.

"Detail" and "Approve" buttons are accessible. Exit the calibration sequence by clicking the "Close" button,
in the lower right corner of the screen

The validity criterion is achieved as follows:

If the equipment is equipped with a source, the relative standard deviation (or associated uncertainty) should be less than the declared calibration uncertainty of the reference dosimeters increased by 3% to allow for the minimum reproducibility error.

No basic measurement should be greater than more than 3 times the average standard deviation.
Otherwise, calibration is invalid.

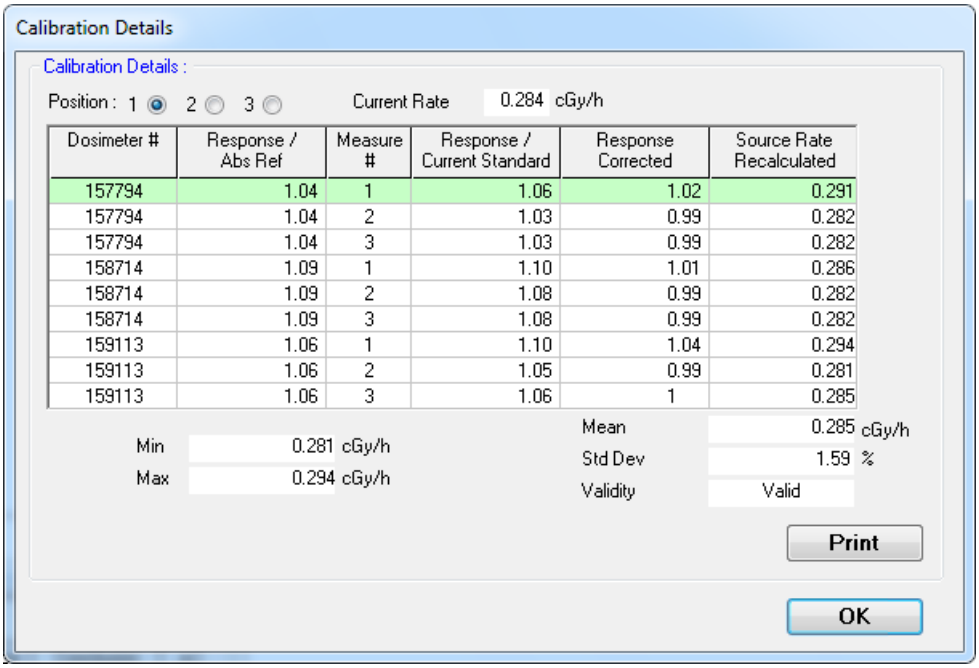


Figure 45 - Detail of a computerized calibration sequence of 3 dosimeters:

-> 3 measurements are displayed for each dosimeter for each position occupied during each permutation.

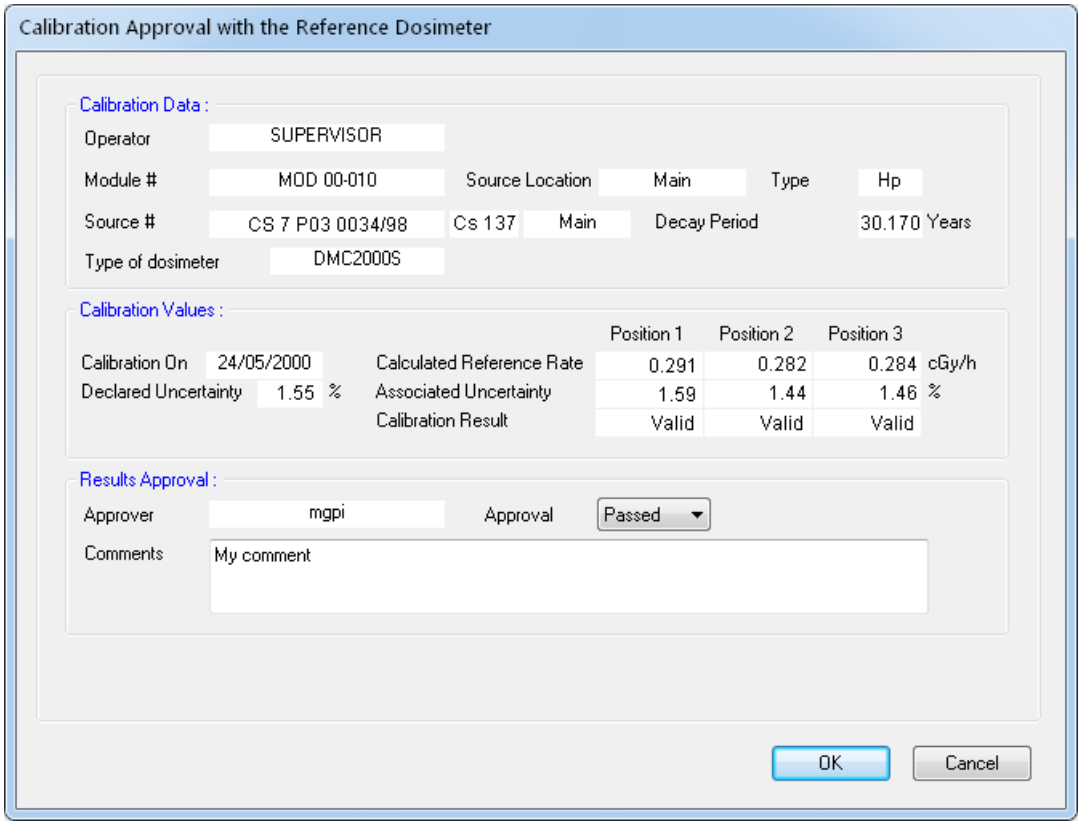


Figure 46 - Calibration Approval ("SUPERVISOR" level only)

5.4 Adjustment of Stops

A dosimeter must be always positioned in the carrier sleeve in the same way.

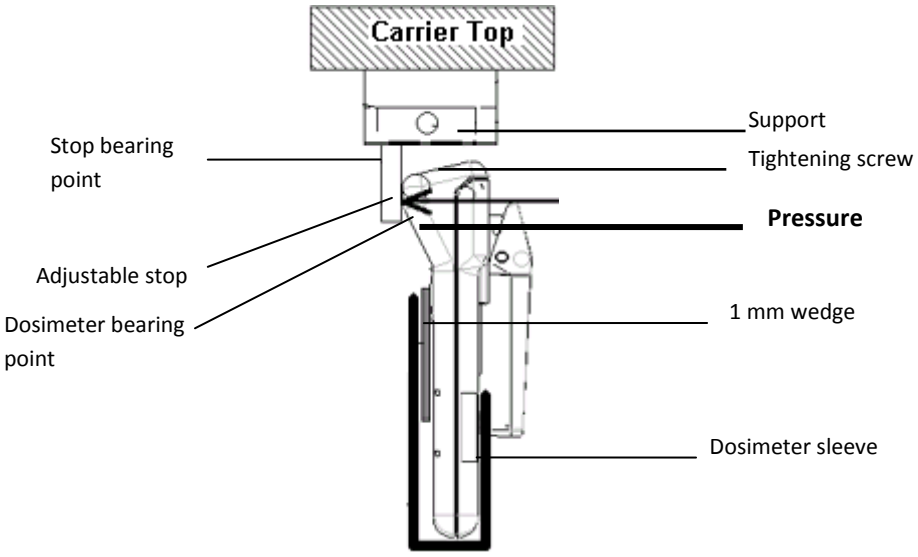
The positioning reference point is the bearing point of the dosimeter against the upper stop.

Proceed as follows to adjust:

CAUTION: Blank the source prior to performing any operation.

- Lift the carrier,
- Loosen the stop screws located above the sleeve at position 1,
- Insert a 1 mm thick shim in the sleeve between the dosimeter front panel (pushbutton side) and the sleeve wall,
- Position a dosimeter in the sleeve and position the adjustment stop against the dosimeter and bearing on its support (see illustration below),
- Secure the stop with its tightening screw and check that it does not pivot by pressing on the dosimeter bearing point,
- Readjust if required.

Perform this adjustment for positions 2 and 3.



5.5 Replacement of Air-Charged Springs

Note:
The spare springs shall previously be adjusted for a pressure of 55 N applied at mid-travel (if required, consult MGP Instruments for this adjustment).

The operation consists in replacing the air-charged springs one after each other.

Proceed as follows to adjust:

CAUTION:
Blank the source prior to performing any operation.

- Lift the carrier,
- Unscrew the upper and lower retaining screws of one of the springs,
- Position the attaching screws on the new spring,
- Apply a drop of low-strength thread locking compound to these screws to secure them after tightening,
- Reassemble the spring by proceeding in the reverse manner.
- Replace the other air-charged spring.

5.6 Spare parts and accessories

In order to communicate properly with the new generation of dosimeters DMC2000S, GN and SOR version V4 and the DMC3000, it is mandatory to update the communication antenna. (Communication kit 153773)

A modification instruction (bilingual) has been created to help the technician, reference 153491.

A kit, reference 154016, provides an update of the IRD2000 for the new dosimeter DMC3000. The bilingual installation instruction, reference 154983, helps the technician for this purpose. The antenna modification must be done too.

Description	MGP Instruments reference
IRD communication Kit (printed-circuit card, new antenna and mechanical support) for DMC 2000 et SOR V4, DMC3000	153773
Monitor without antenna and extension box	114024GJ001J
2 air-charged springs	129251
6-channel IRD extension box complete with associated multiplexing card	118819-SAV
3-channel IRD extension box complete with associated multiplexing card	118827-SAV
6-channel IRD multiplexing card	129226
3-channel IRD multiplexing card	129227
Source carrier without source	120015
Dosical software	129232
IRD cable between extension box and irradiation module	119223
PC cable for RS232 link	70032131BA
Power supply cable for Europe	71000310
Power supply cable for US	Not referenced
Power supply cable for UK	Not referenced
Portable sor assembly without actuator	129234
Portable dmc assembly without actuator	129235
3 Stops for SOR dosimeter	120093
3 Stops for DMC dosimeter	120094
Secondary source support with Sr/Y source	120117
Cs137 reference DMC 2000S dosimeters (x4)	127744
Cs137 reference SOR dosimeters (x4)	129224
Cs137 reference DMC 2000GN dosimeters (x4)	138486
Cs137 reference DMC 3000 (G2) dosimeters (x4)	154164
Cs137 reference DMC 3000 (G3) dosimeters (x4)	NOM000531

DMC 2000 S IRD rack (Mobile carrier)	129235
DMC 2000 GN IRD rack (Mobile carrier)	137911
SOR IRD rack (Mobile carrier)	129234
DMC 3000 IRD rack (Mobile carrier)	151023
Mobile carrier kit for IRD DMC 3000 (Extension box + mobile carrier + butterfly thumbscrews)	154016

Specific tools

Description	MGP Instruments reference
DMC2000S V4 reference HF communication range for communication Kit retrofit	154443
SOR V4 reference HF communication range for communication Kit retrofit	155658
DMC3000 reference HF communication range for communication Kit retrofit or adaptation for DMC3000	154444

5.7 Standard Product References

Description	MGPI Reference
IRD 3 DMC3000 Cs EN	NOM000312
IRD 3 DMC2000S Cs FR	129117
IRD 3 DMC2000S Cs EN	129118
IRD 3 SOR Cs FR	129119
IRD 3 SOR Cs EN	129120
IRD 6 DMC2000S Cs FR	129121
IRD 6 DMC2000S Cs EN	129122
IRD 3 DMC2000S EN without source	129123
IRD 6 DMC2000S EN without source	153405
IRD DMC 2000XB	Please consult us

Blank page

6. Technical characteristics

6.1 Physical Characteristics – standard version

Characteristics	Value or type
Radioactive source	Cs 137
Activity	≅ 370 MBq
Dose rate generated (at DMC 2000)	≅ 3 mSv.h-1
Dose per check	≅ 50 µSv
Uncertainty	≤ 5%
Duration of a check (for ≤ 3 dosimeters)	< 2 min
Checking rate without set alarm and test dose alarm	69 dosimeters/h for 1 module greater than 115 dosimeters/h for 2 modules
Dose rate generated	< 2.5 µSv/h at 1m < 7.5 µSv/h at 30 cm

6.2 Mechanical Characteristics

- dimensions:
  - width: 350 mm
  - height: 443 mm
  - depth: 529 mm
- weight: <= 80 kg

6.3 Electrical Characteristics

- power supply: 230 V - 50 Hz
- consumption: < 2 A
- complies with the European standards related to the radio interference limitations (directives 89/336 and 92/31)

6.4 Environmental Conditions

- temperature
  - operating: 10°C to 45°C
- ambient humidity (without condensation)
  - operating: ≤ 80%
- absolute ambient pressure
  - operating: 860 to 1060 hPa
- The external dose rate has to be lower than 10µSv/h to not influence measurements.

6.5 Special Characteristics

- Cs137 sealed source:
  - complying with ISO 2919
  - ISO classification: C 65445
- Property transfer covered by EURATOM regulation No. 1493/93 which induces the obligation of a prior transfer declaration to the appropriate authorities of the recipient country.
- Compatibility with the arrangements stipulated by decree 86-1103 and 75-087, changed 88-662 of the French regulation, which induce the obligation of installing the IRD in radiologically "monitored" area:
  ambient dose equivalent rate: 2.5 µSv/h ≤ Hp(10) ≤ 7.5 µSv/h.

6.6 Processing Unit: basic configuration

- Processor: 32 bits (x86) or 64 bits (x64) ≥ 1 GHz
- Minimum disk space: ≥ 1Go
- RAM : ≥ 1Go
- Graphics device: Minimum resolution of 1024x768
- Operating Systems: ≥ Windows 98
- MGPI software package: DOSICAL license

7. Appendix 1: Installation of the Software Package

This chapter describes the installation and configuration procedures for the software package required to use the IRD according to the type of environment of your PC:

- Windows 98™
- Windows 2000™ or XP™
- Windows Vista™
- Windows Seven™ or higher

The operating systems (listed above) are assumed to be already installed in the IRD operating PC.

The installation is made from a CD-ROM

The following tables list the installation and set-up procedures of the software modules, with a reference to the page describing the procedure in this appendix according to the operating system of the PC involved.

7.1 List of Installation and Set-up Procedures

	Procedures	**Page**
	Installation of DOSICAL	75
	Selection of the ODBC data source and designation of the user data base	84
OPTIONAL	Customization of « DOSICAL » also see typical "DOSICAL" main configuration file "main.ini"	91 91

Hereafter in this appendix, the CD-ROM drive of your personal computer is identified by character string « <D>:\ ».

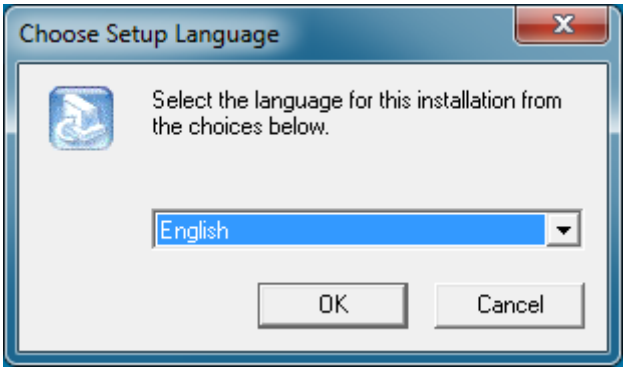
7.2 Installation of ” DOSICAL “ (#784)

Insert the DosiCal CD ROM in the drive. If the CD ROM autoplay function was enabled, the DosiCal installation program is automatically launched

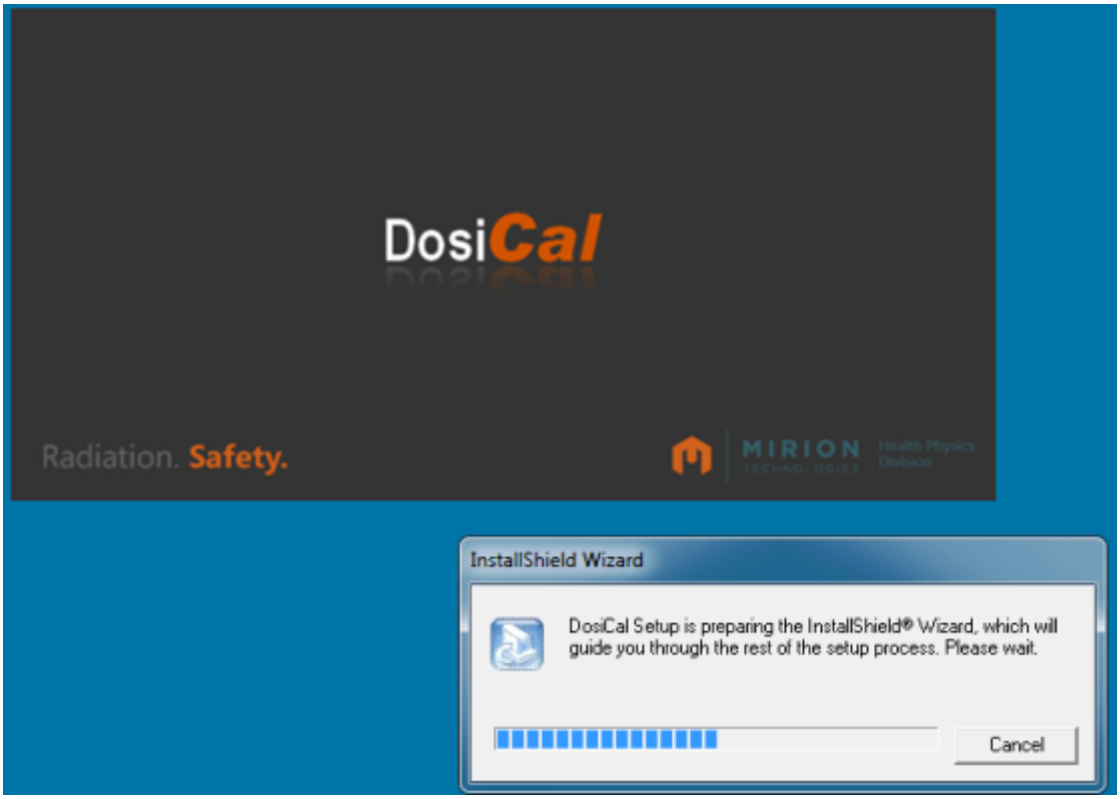
In the otherwise case, launch directly the installation program by executing the « Setup.exe » file, that is in the CD ROM root.

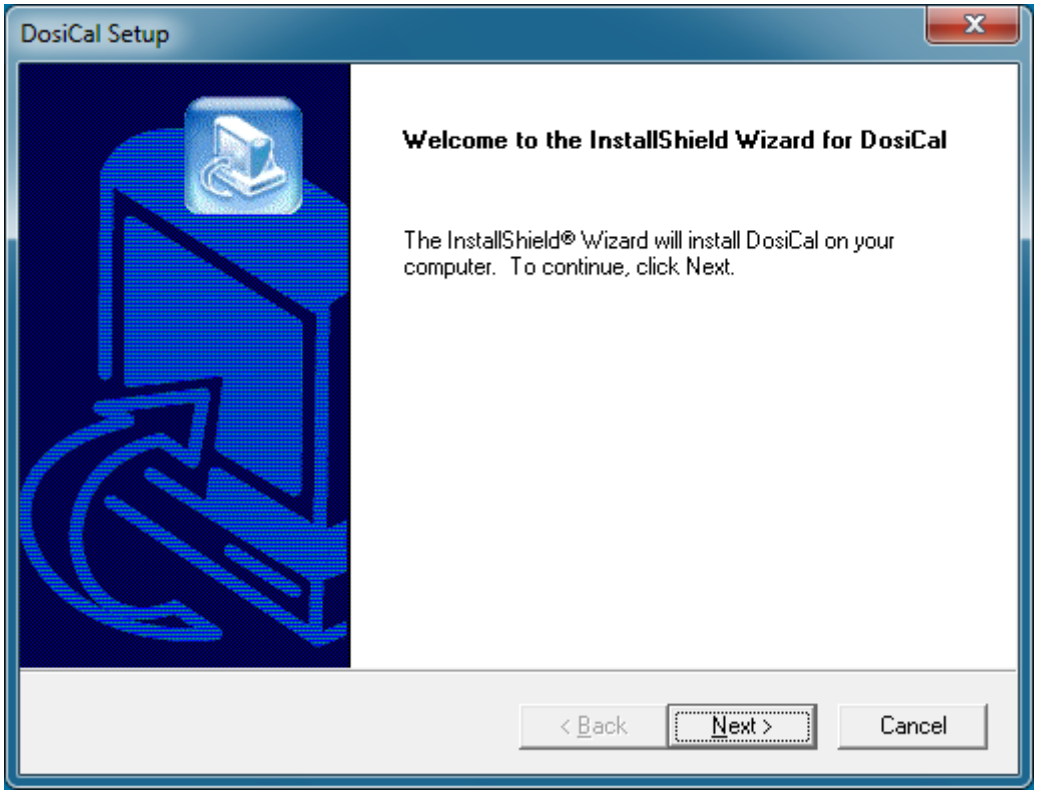
The installation of the « **DosiCal** » software (#784) starts.

The following dialog box is displayed



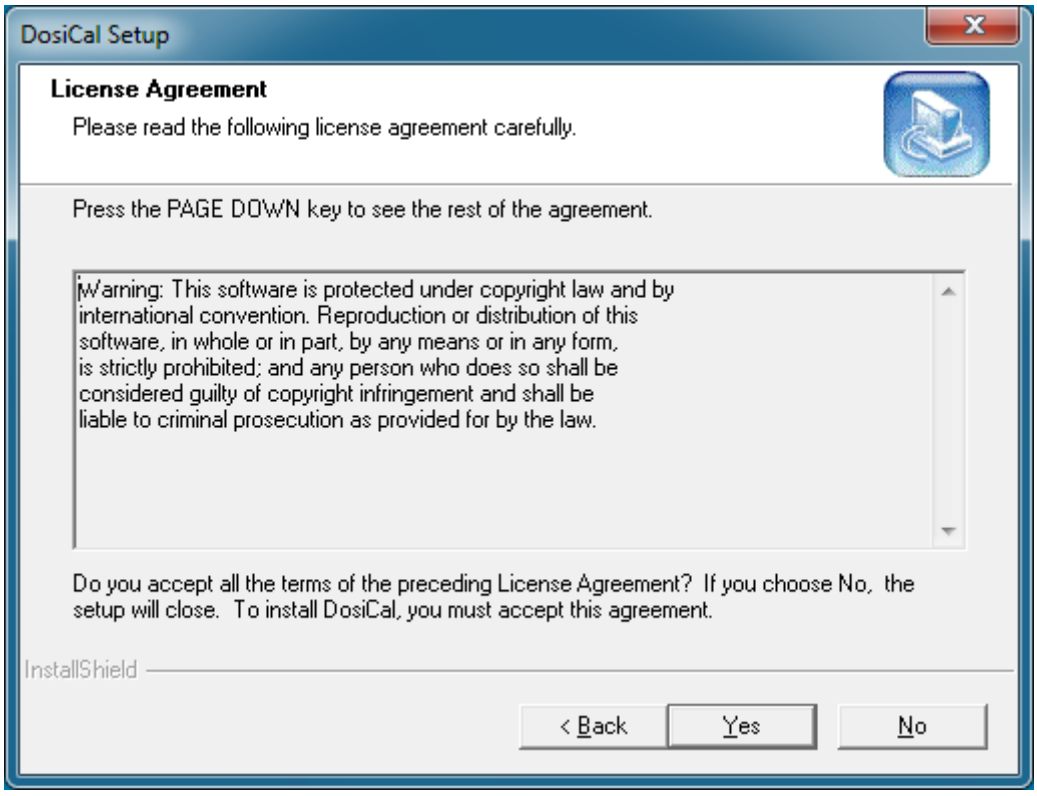
Once the installation procedure language is selected, click on the « OK » button to start installing. The following screens are displayed.



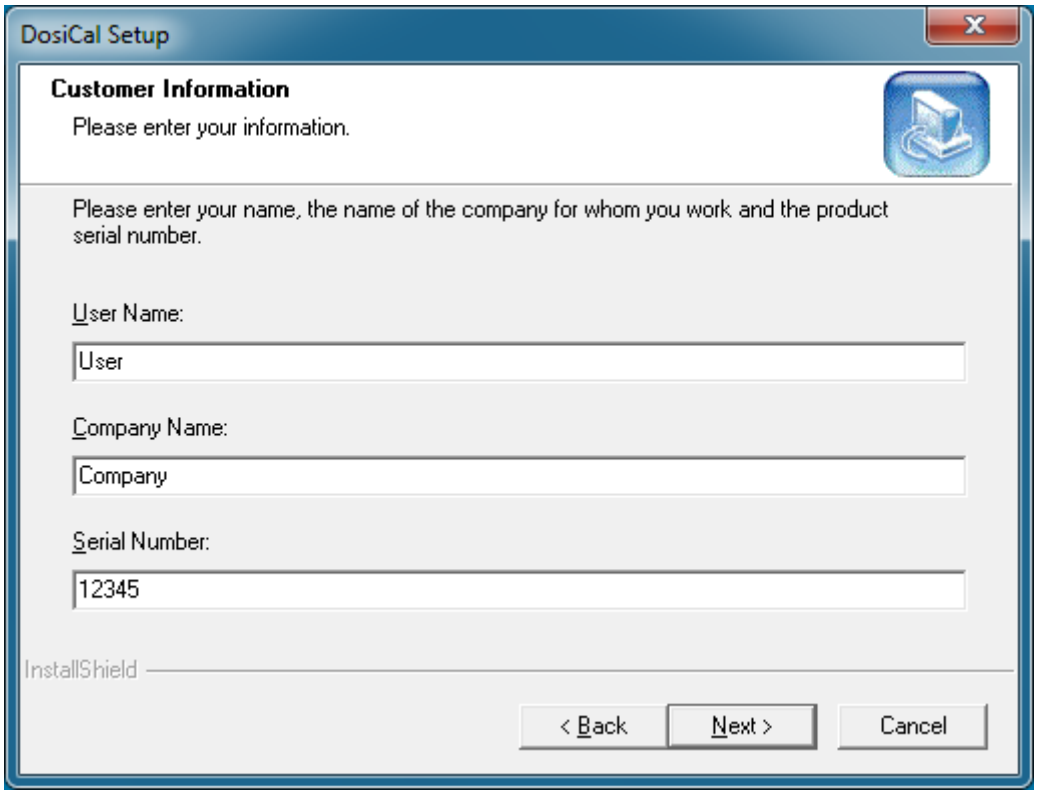


Click on « Next » to continue.

Accept the following license agreement or abort installation if you do not agree the agreement terms.

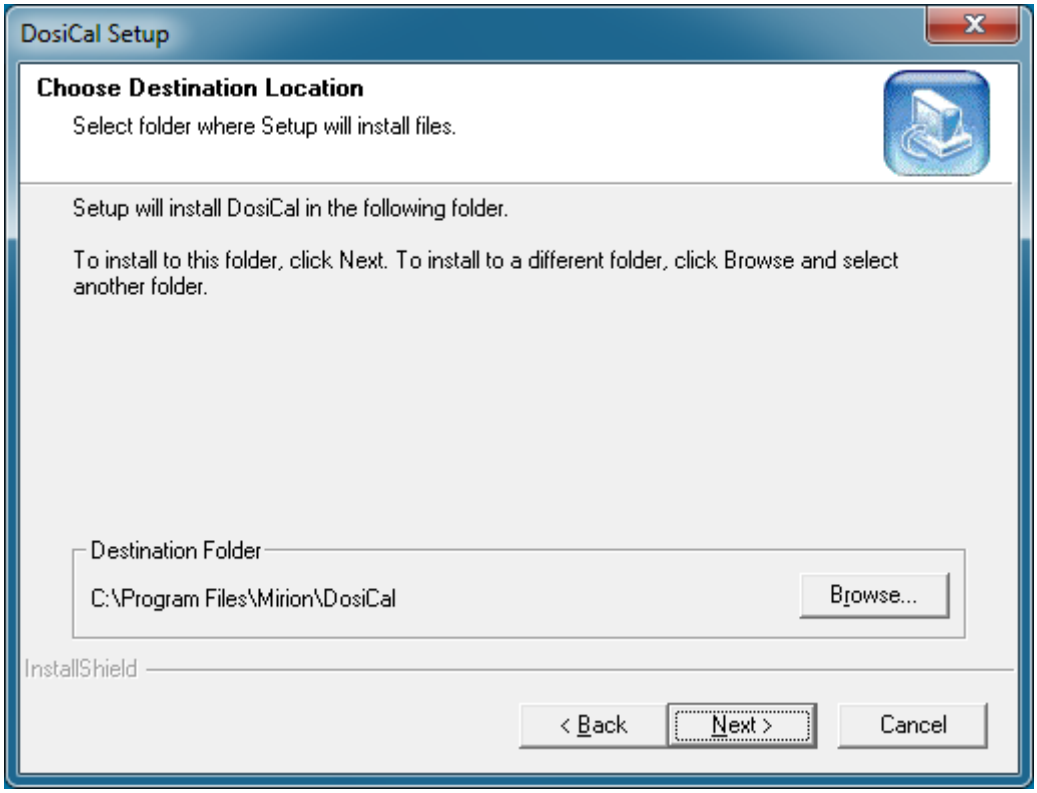


The customer information screen is then proposed:



Once the “User name” and the “Company name” are entered, click on the « Next » button

The following dialog box above appears

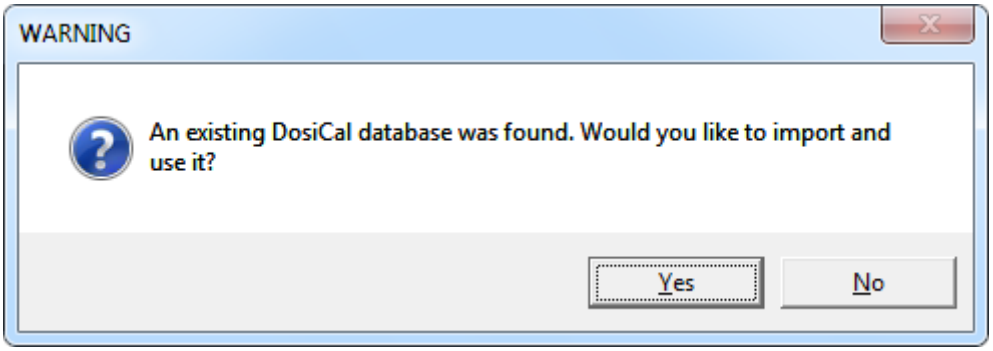


It is then possible to change the « Dosical (# 784) » installation directory by selecting the desired directory by means of the « Browse » button.

To proceed with the installation, after possibly changing the « Dosical (# 784) » installation directory, just click on the « Next » button.

In case of an upgrade or a reinstallation of DosiCal :

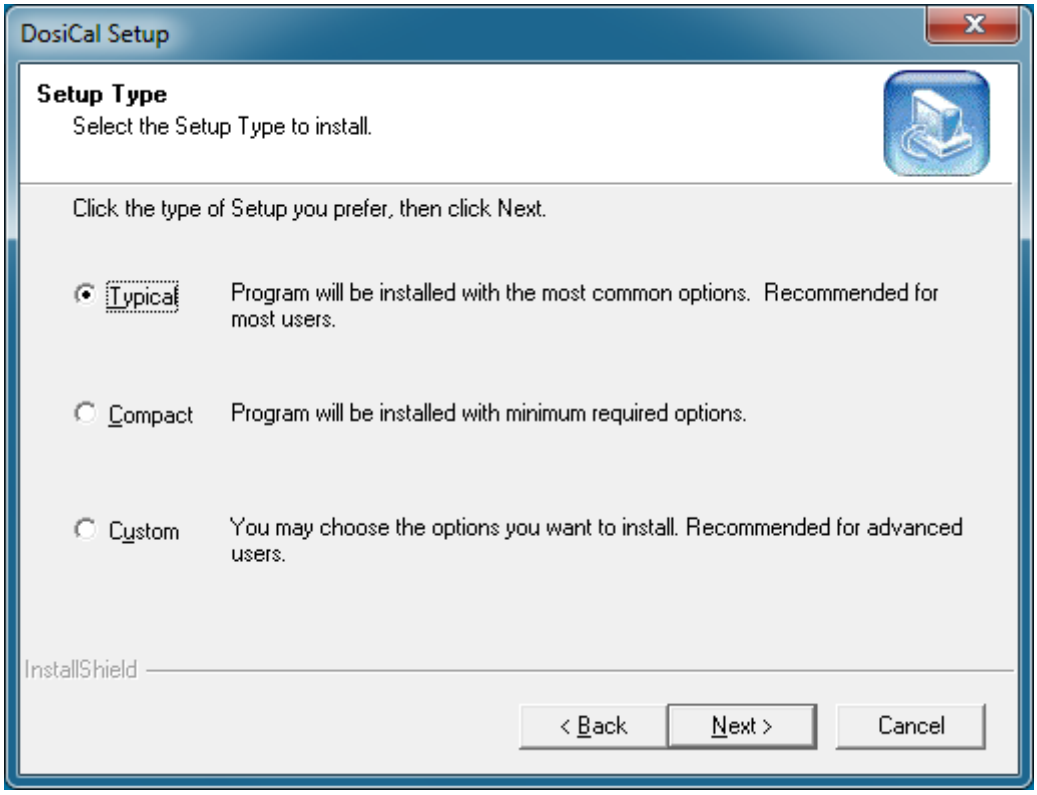
If a DosiCal database is already present on the computer, the program offers its importation and use.



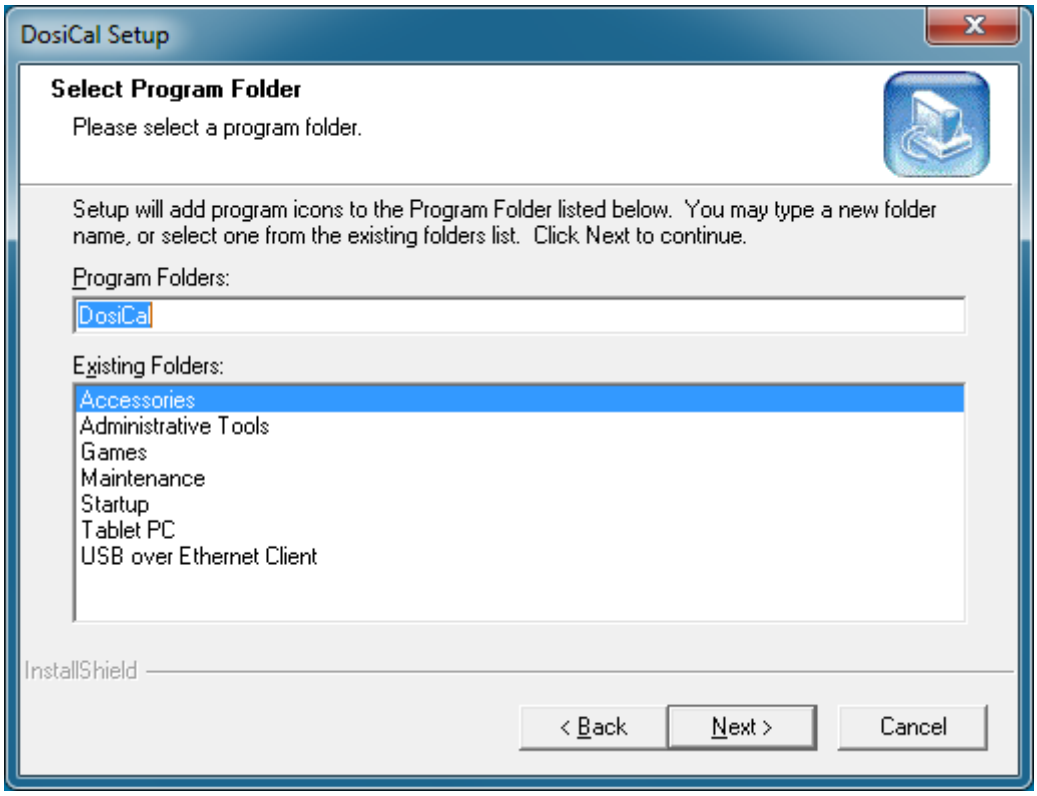
Click “Yes” to import and use the existing DosiCal database.

Click “No” to replace the existing DosiCal database, by an empty database.

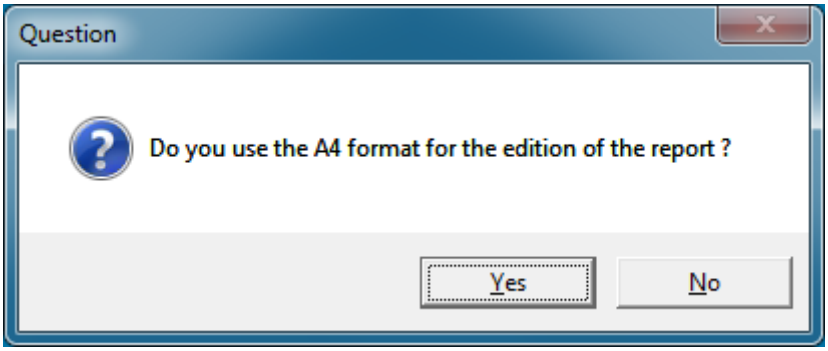
The type of desired installation is then requested; it should however be noted that, regardless of the mode selected, the result is the same since there are no optional components in this setup.



The program folder, which must contain the Dosical application shortcuts, is then requested, as shown by the following screen:



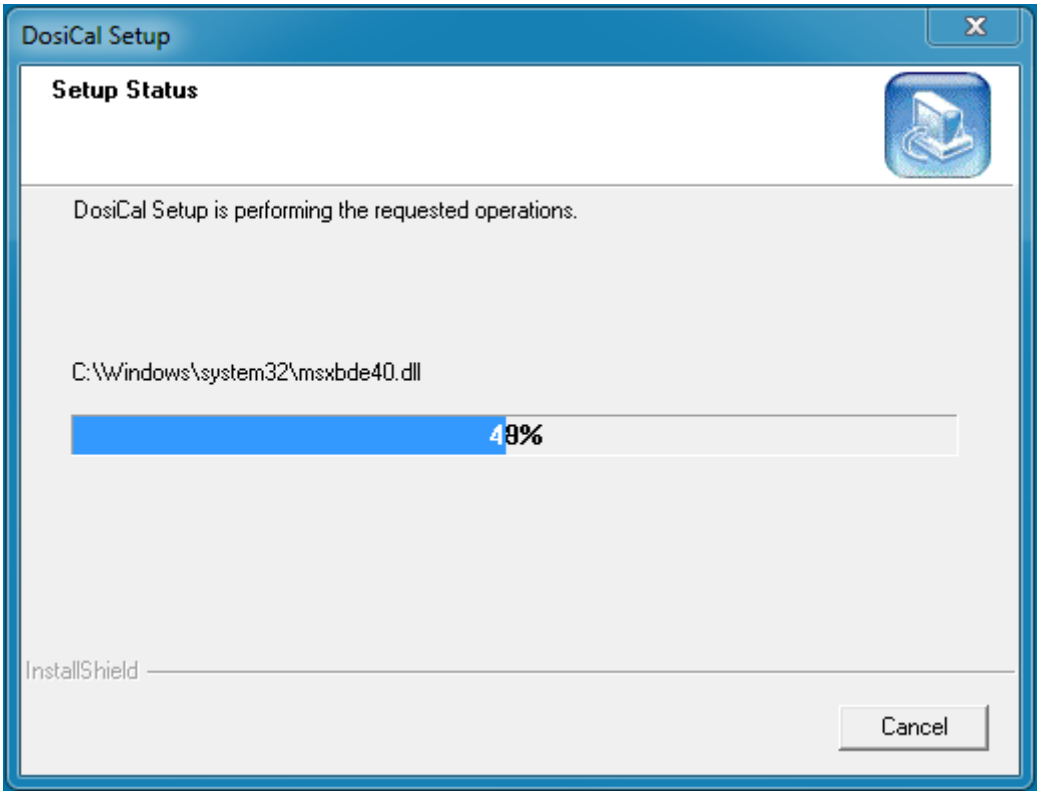
Then, the program asks what format will be used by DosiCal when he generates a report: A4 or North America (US Letter).



Click “Yes” to use the A4 paper size.

Click “No” to use the North America paper size (US Letter).

The installation subsequently takes place:

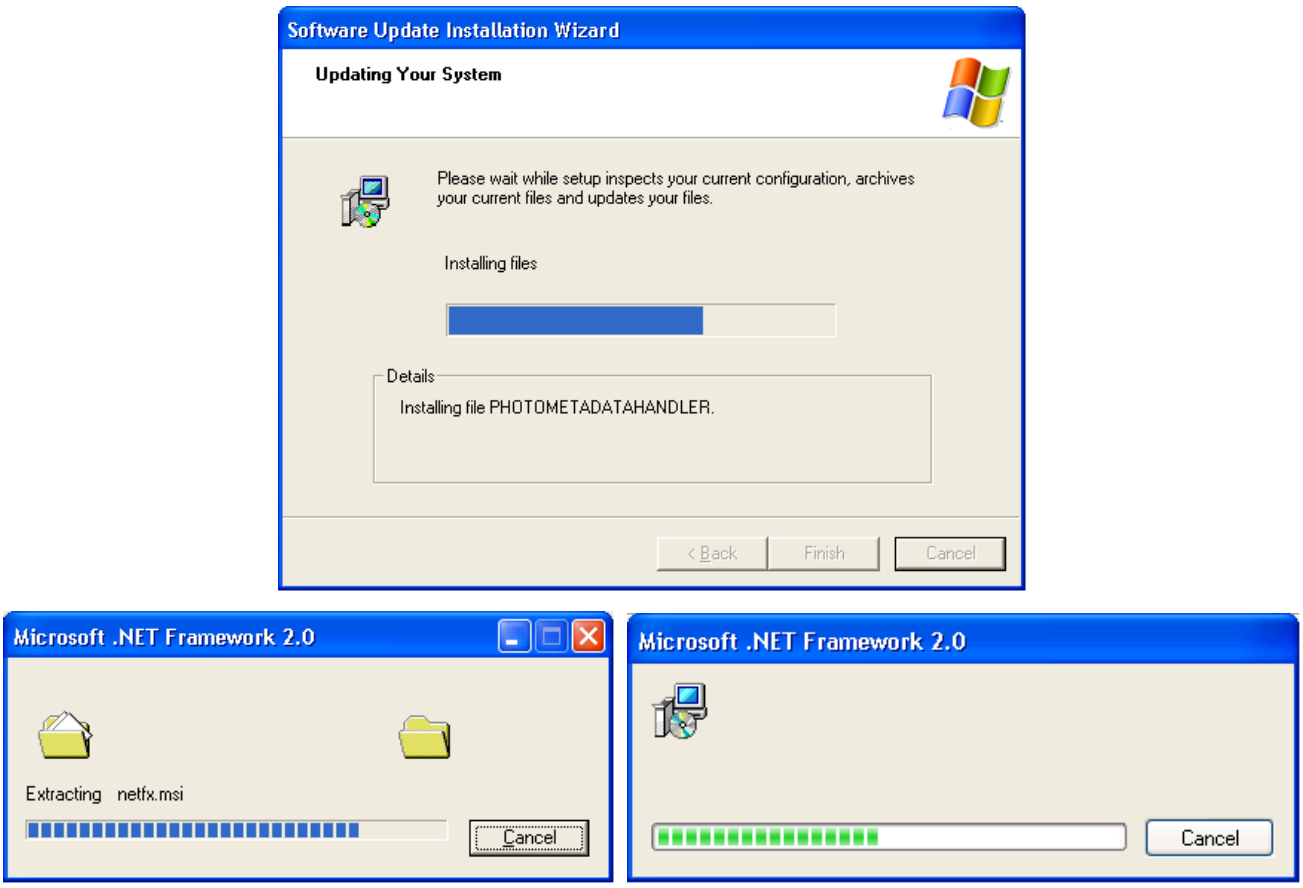


In case of Windows 98, Windows 2000, Windows XP, Windows Server 2003:

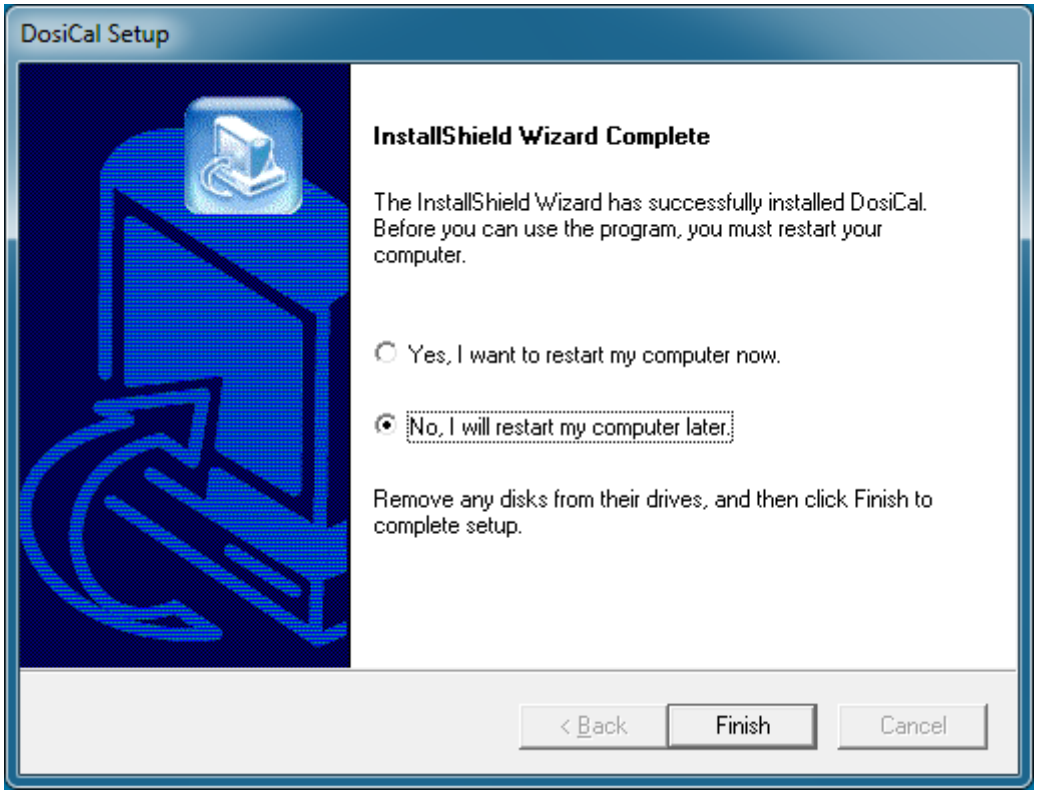
The installation program install or update some required components (depending the computer configuration) :

- Windows Installer v3.1 redistributable package (v2)
- Windows Imaging Component
- Microsoft .NET Framework v2.0 (x86) redistributable package

Therefore, one or more dialog boxes may be displayed as the following:



When the installation is successful the following window appears



Before you can begin to use DosiCal it is strongly recommended to restart your computer to finish the installation of any shared components that could not be recorded / updated during that Windows® session.

Select « Yes, I want to restart my computer now» if you saved all your data, and closed all your applications.

Otherwise select « No, I will restart my computer later».

In the event of installation fault, a message detailing the failure cause is displayed. In such a case, please send us this message to help us in diagnosing the failure of your installation.

Note:
when the DOSICAL software is run for the first time, if an earlier version of the database "dosical.mdb" is available, it will be updated with the new parameters to the default values.

7.2.1 Manual Selection of ODBC Data Source and Designation of User Data Base (advanced user)

During the DosiCal installation, the data source is automatically created.

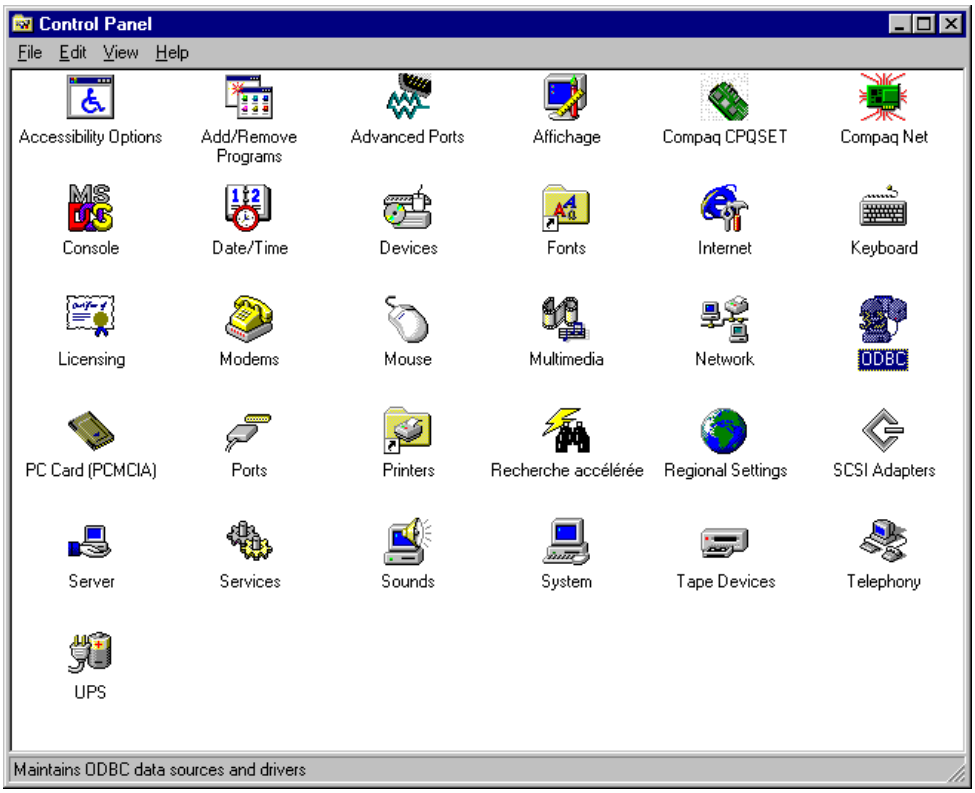
However in advanced use of DosiCal, it can be necessary to create or modify the data source manually.

Warning:
This manipulation is reserved to advanced user.

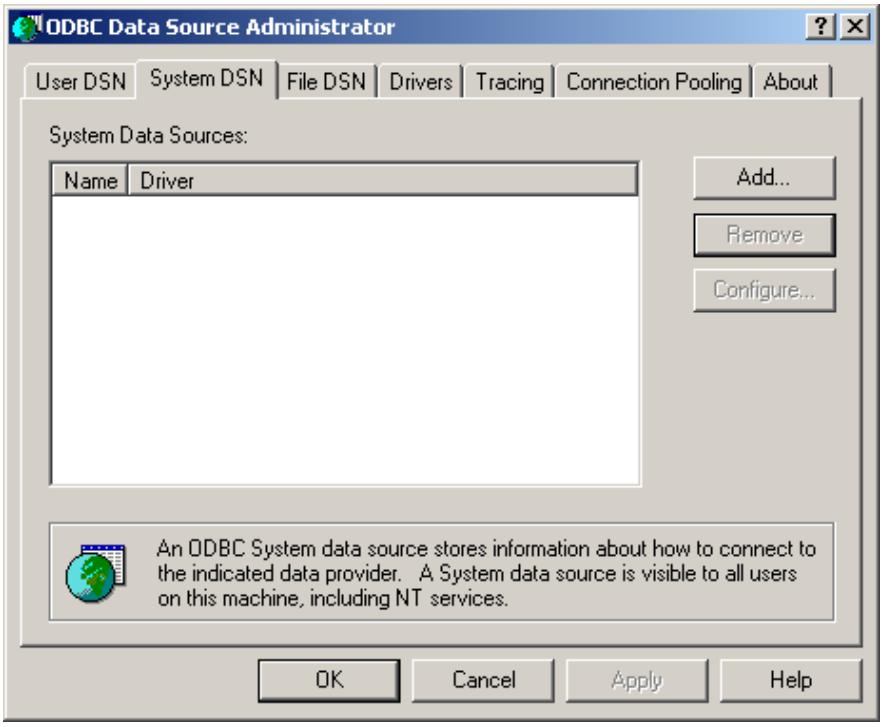
It is required to configure the **DOSICAL** ODBC source through the designation of the ODBC driver to be implemented (MS Access in this case) and the indication of the data base location:
« **dosical.mdb** » file, installed by default in the DosiCal data storage directory (See. 7.5.3 DosiCal M specific upgrade).

7.2.1.1 Under Windows 98 / 98SE

In the « Control Panel » on your « Workstation », double-click on the « 32bit ODBC » or « ODBC » icon.

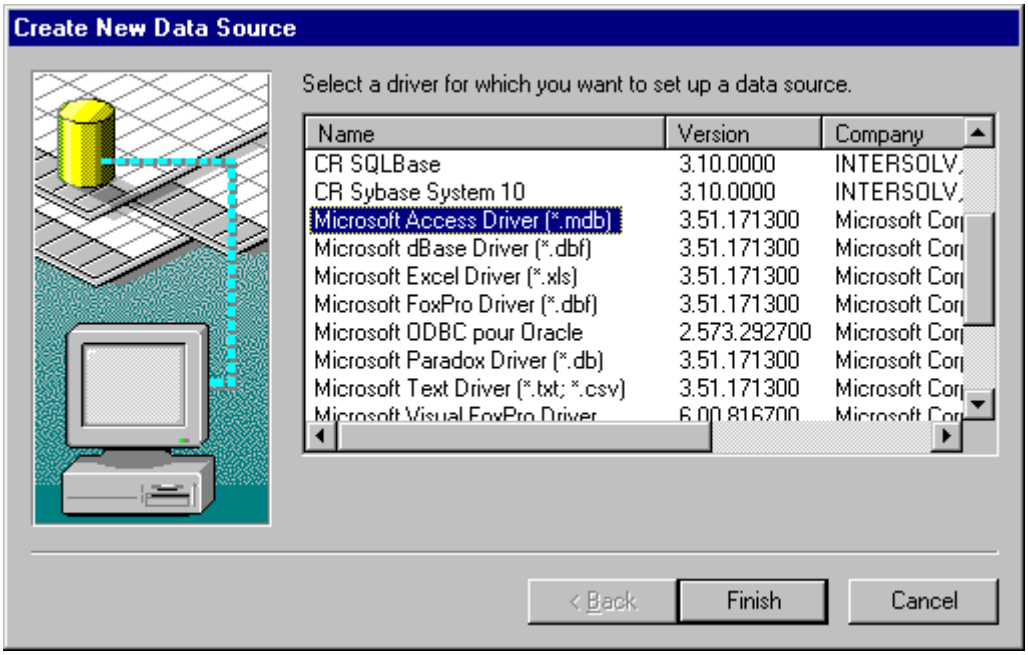


The following dialog box appears:



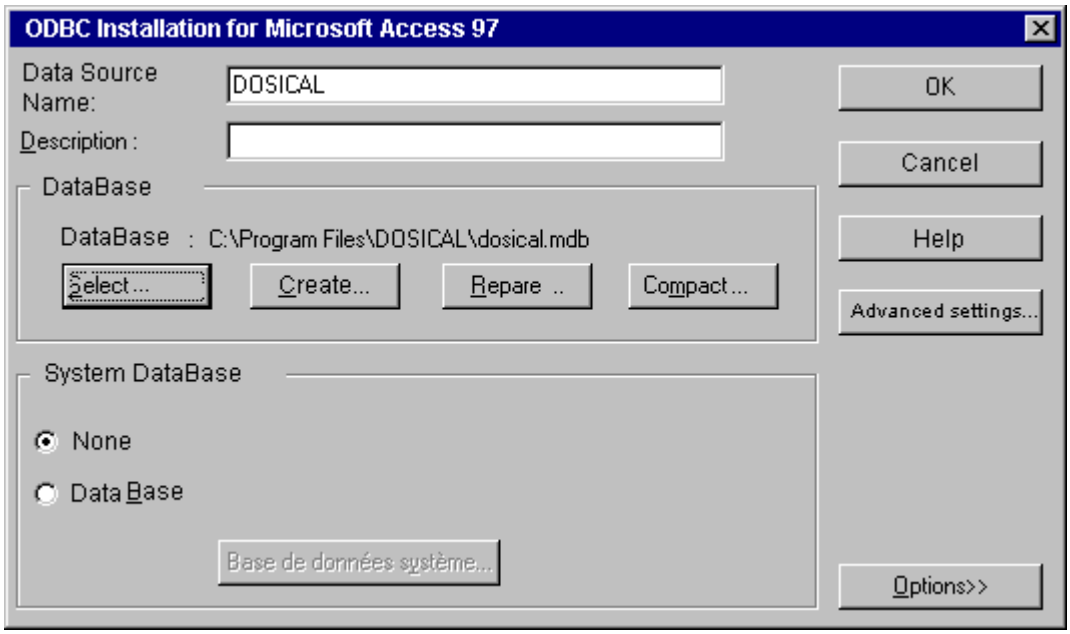
- Then click on the « System DSN » tab and the « Add... » button to create the ODBC source.

Then, the following dialog box appears:



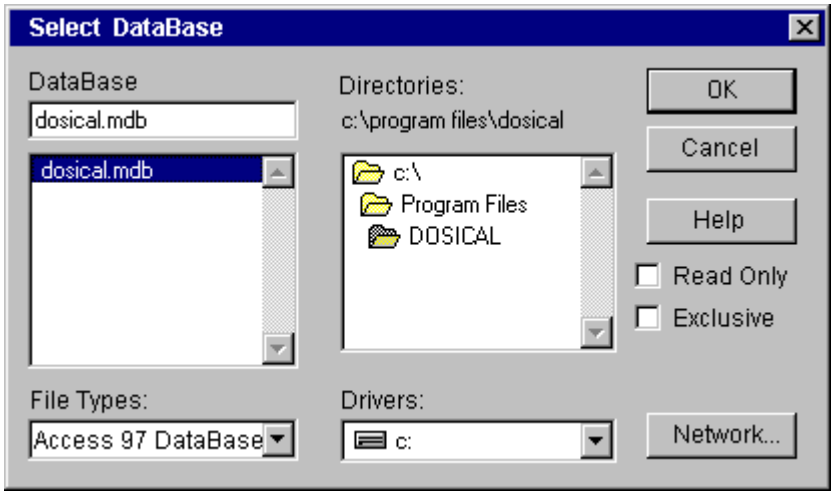
Select « Microsoft Access Driver (*.mdb) » in the above data field and click on the « Finish » button.

The following dialog box appears:



- In the « Data Source Name: » data field, enter « DOSICAL » as data source name and then click on the « Select... » button.

The following dialog box appears:

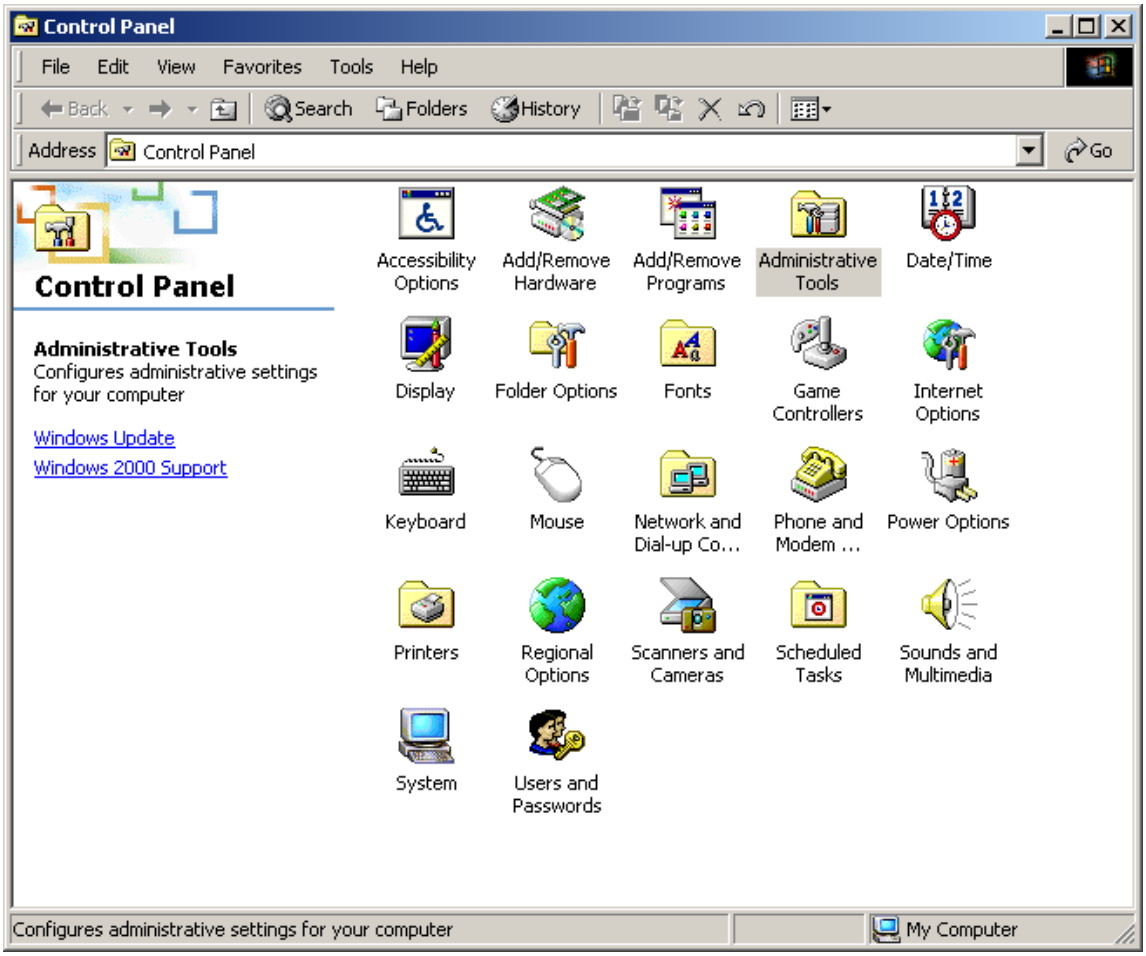


- Then select the « dosical.mdb » file
- Then click on the « OK » button.
- Click « OK » for each of the dialog boxes which are displayed in turn and until the return to the « Control Panel ».

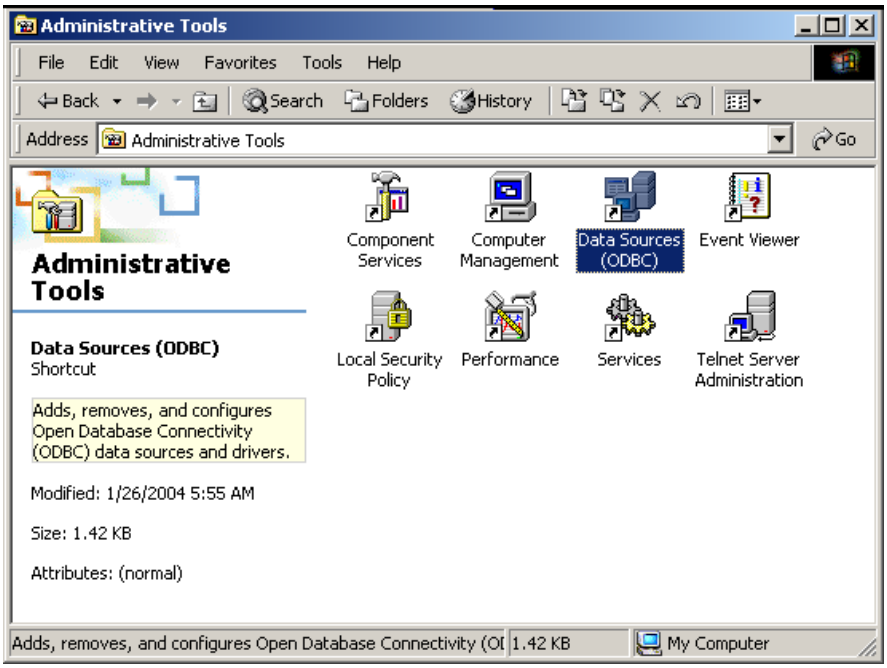
The ODBC source intended to access the data base used by « **Dosical**» is now created.

7.2.1.2 Under Windows 2000 / XP / Vista / Seven

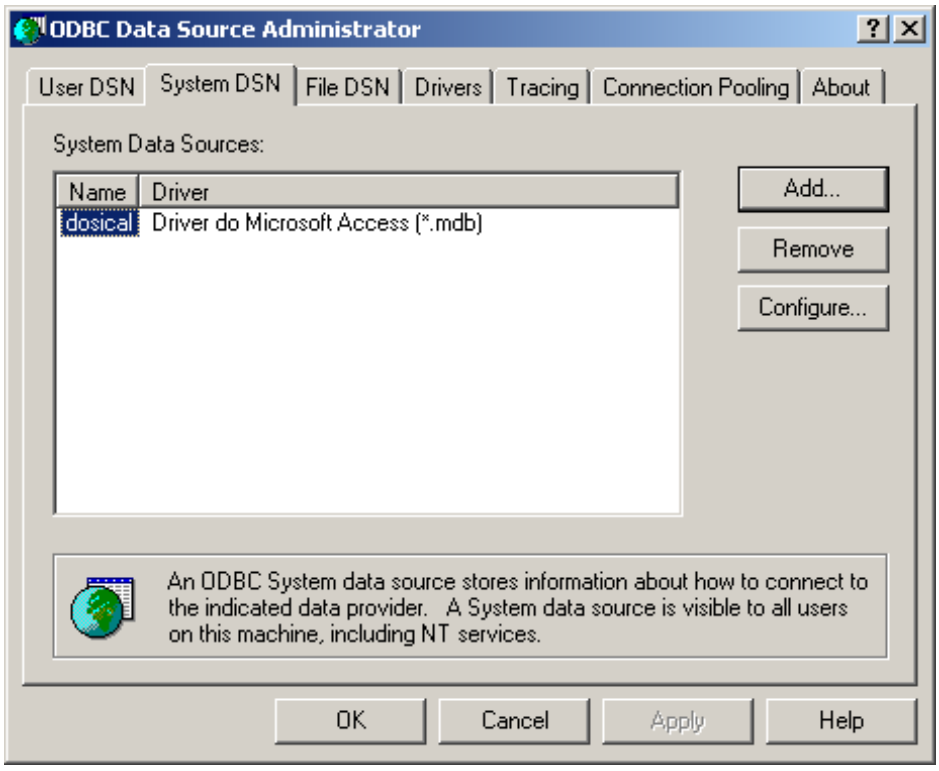
In the “Control panel”, double-click on the on the “Administrative Tools” icon.



Then open the Data source file (OBDC).

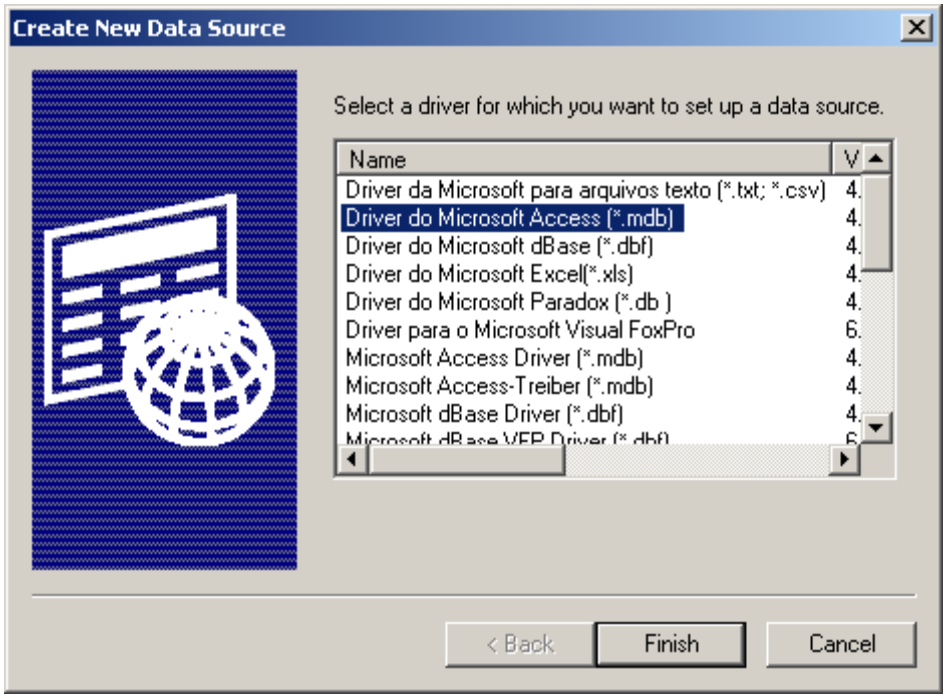


The following dialog box appears:

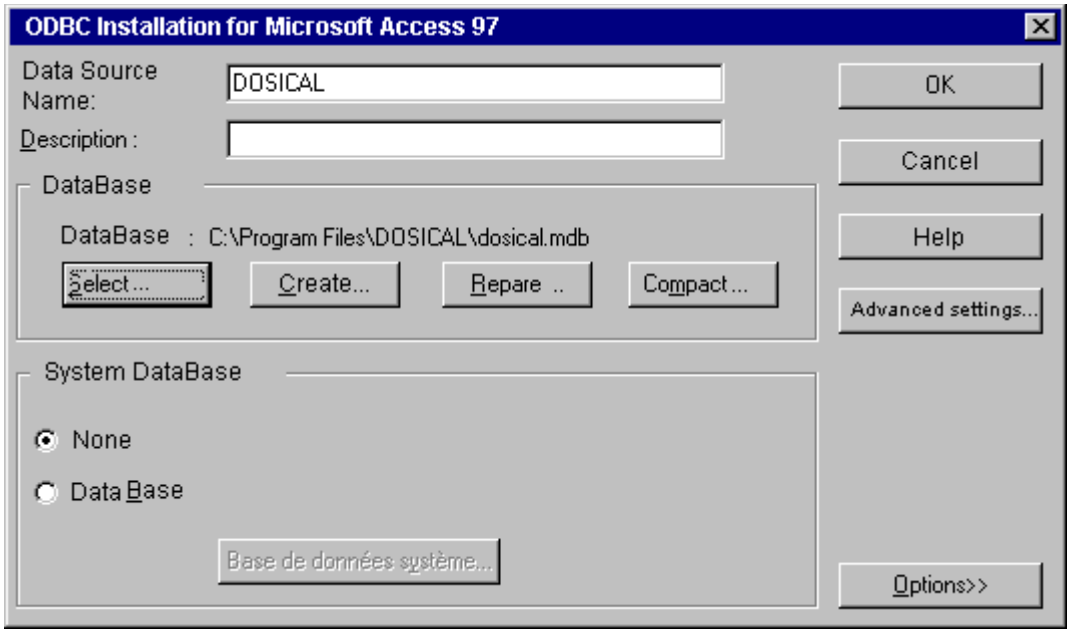


- Then click on the « System DSN » tab and the « Add... » button to create the ODBC source.

Select « Microsoft Access Driver (*.mdb) » in the above data field and click on the « Finish » button.

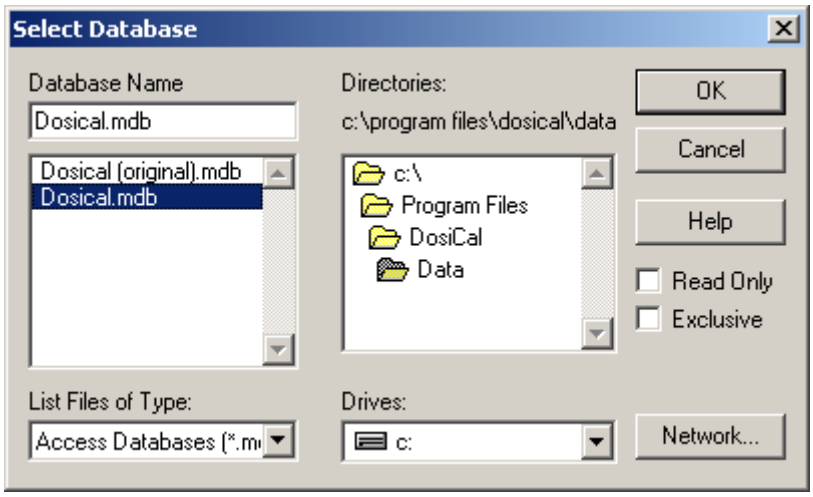


Then, the following dialog box appears:

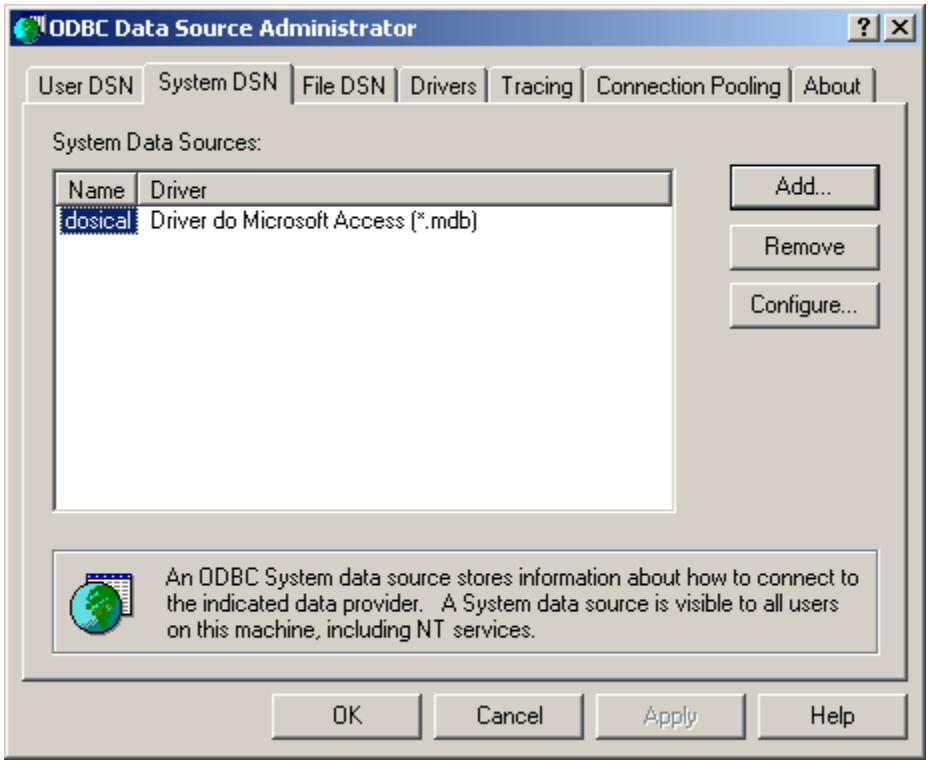


- In the « Data Source Name: » data field, enter « DOSICAL » as data source name and then click on the « OK » button.

The following dialog box appears:



- Then select the « dosical.mdb »
- Then click on the « OK » button.
- Click « OK » for each of the dialog boxes which are displayed in turn and until the return to the « Control Panel ».



The ODBC source intended to access the data base used by « **Dosical**» is now created.

7.3 Customization of « DOSICAL »

« **Dosical** » is customized by editing the « main.ini » file (*see paragraph* Typical « Dosical » Software « main.ini » Main Configuration File*, page 91*), resident in the « Dosical » installation directory, with a Windows standard text editor, and by replacing:

- the value associated with the « Name » (=« nom/name ») entry of the [User] section with a specific name limited to 19 characters,
- the value associated with the « Company » (=« entreprise/company ») entry of the [User] section with a specific name limited to 30 characters.

DO NOT MODIFY the value associated with the « NumeroSerie » (=« 0123456789 ») entry of the [User] section ..

7.4 Configuration Files

7.4.1 Typical « Dosical » Software « main.ini » Main Configuration File

; Host software package main section

[Principale]

NomHote=""

NomServeur=""

SeparateurExcel="\t"

Sizeable=1

Moveable=1

Maximize=1

Minimize=1

Visibilite=1

Reduction=0

GestionWelcome=1

GestionJournal=1

GestionHorloge=1

GestionAdministration=1

GestionOutils=0

GestionAudio=1

GestionToolbar=0

NiveauDebog=0

MultiInstances=0

ControleSortie=0

; Software package version definition section (medium No. 614)

[Progiciel]

Mnemonique=DOSICAL

Icone=dosical.ico

Version=784x

DateVersion=jj mmm aaaa

; Definition section of different software package access levels

[Niveaux]

NiveauInitialisation=0

NiveauSortie=0

; Extension definition section

[Outils]

Argument=" /f%s"

; Language file definition section

[Langues]

fra=fra.ini

eng=enx.ini

enu=enx.ini

; User definition section

[Utilisateur]

Nom=nom/name

Entreprise=entreprise/company

NumeroSerie=0123456789

7.4.2 Update DosiCal to an higher version

Before you can update DosiCal to an higher version, it is imperative to uninstall the old version.

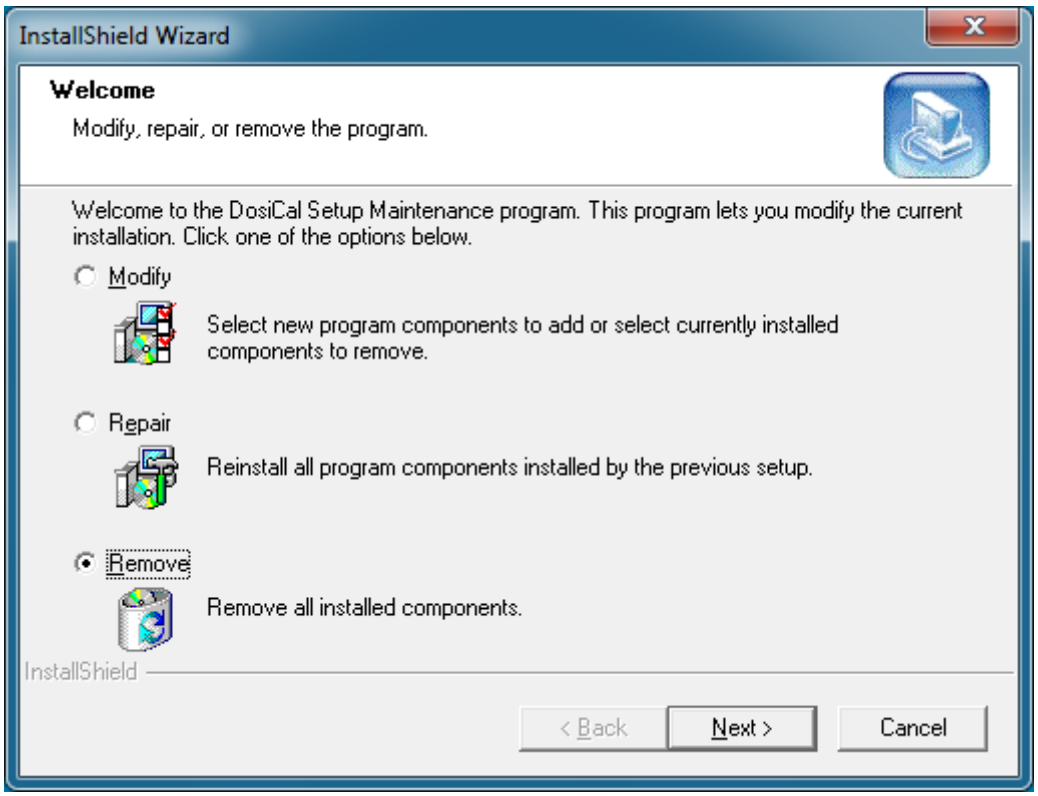
DosiCal uninstalling, doesn't delete any configuration files modified or created when using the software, for example, the database.

To start the DosiCal uninstallation, launch the "Add / Remove Programs" utility:

- **For Windows 9x, Windows 2000, Windows XP, Windows Server 2003 :**
  a. Start Menu, Control panel, Add/Remove Programs.
  b. Select DosiCal in the list, and then click on the "Delete" from the list.

- **For Windows Vista, Windows Server 2008, Windows 7 et supérieur :**
  a. Start Menu, Control panel, Programs and Feathures
  b. Select DosiCal in the list, and then click on the « Uninstall/change» button from the “Menu bar”.

- **Whatever the operating system :**
  c. The maintenance program starts

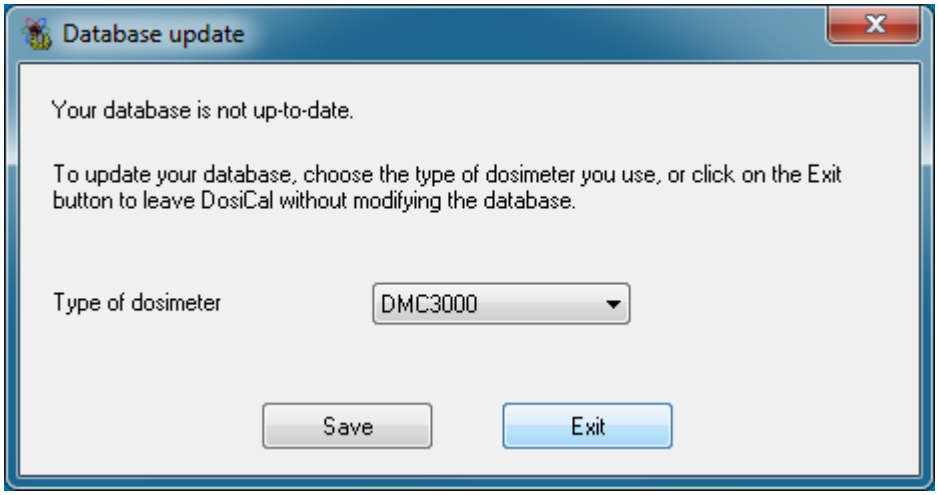


d. Select « Remove », and click on the « Next » button.

e. Validate the uninstallation confirmation message.

7.4.3 DosiCal H specific upgrade

After updating of the DOSICAL software to version H, the following window appears upon the next running:



You must enter the type of dosimeter you use. This operation allows for assignment of this dosimeter type to all the records present in the database. It also allows for assignment of the previously used target value to the target corresponding to this dosimeter type (in the case of an XB dosimeter, the target retained will be XB Hp Main).

In order to save your selection and access the DOSICAL software, click the « Save » button.

In order to cancel DOSICAL running, without saving your selection, click the « Exit » button.

7.4.4 DosiCal M specific upgrade

Since the M version, DosiCal are Windows 7 ready.

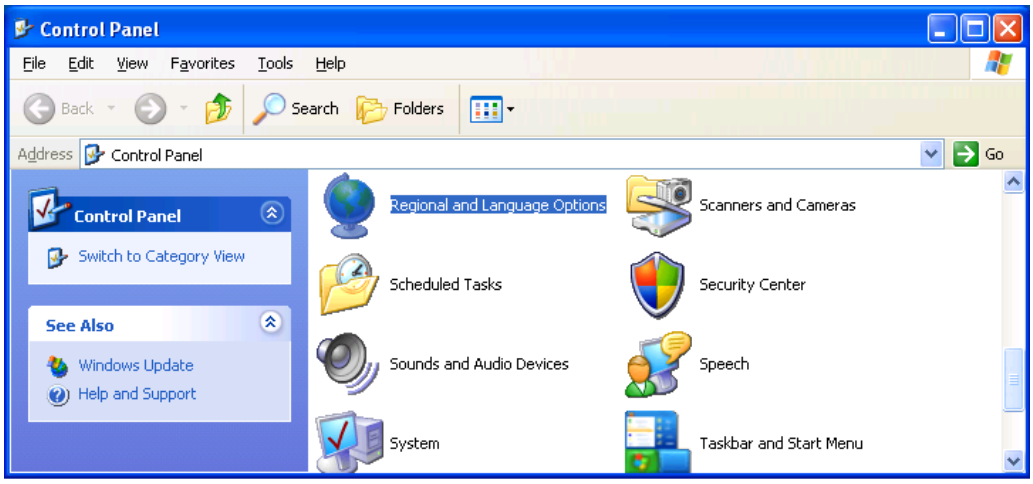
This compatibility leads to move the DosiCal data directories (database and configuration files DosiCal, dosimeters configuration files ...), which were in the DosiCal installation directory.

Depending the operating system, the New DosiCal data storage directory becomes:

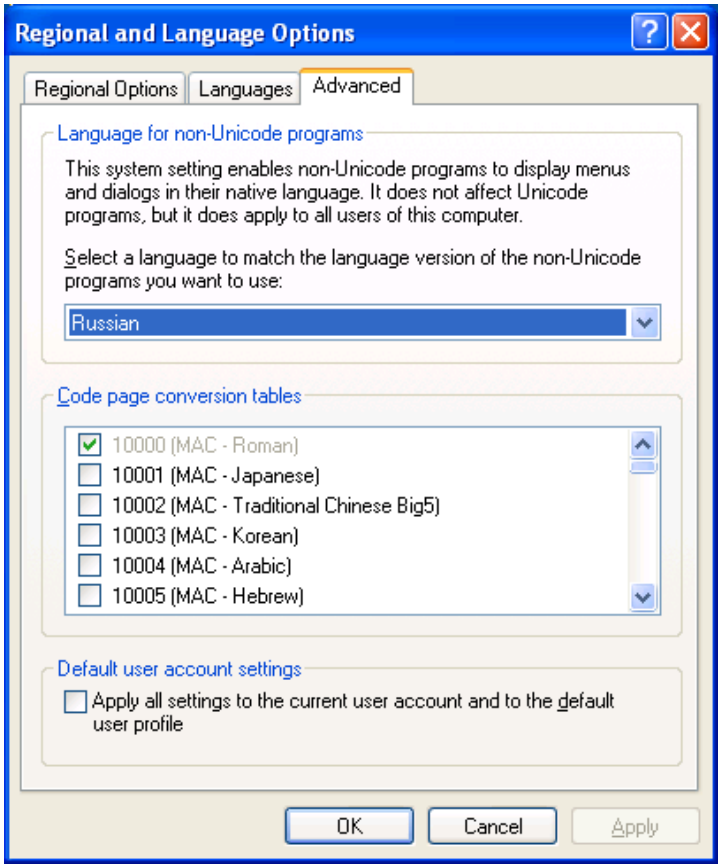
- **For Windows 9x :** The DosiCal installation directory.
- **For Windows 2000, Windows XP, Windows Server 2003 :**
  C:\Documents and Settings\All Users\Application Data\Mirion\DosiCal\
- **For Windows Vista, Windows Server 2008, Windows 7 and higher:**
  C:\ProgramData\Mirion\DosiCal\

7.5 Use of DosiCal with the Russian language on an English Windows XP system

In order to use correctly DosiCal software with the Russian language you have to configure the regional settings of Windows XP as follows:
From the Control Panel, select and open the " regional and language options" .



Select the "Advanced" tab and in the drop-down list corresponding to the language used for non-Unicode applications, select Russian.



The system may ask the cdrom to install Windows XP if it detects the absence of certain files. In this case insert the cdrom and validate the option to copy files from the cdrom.

The system may also ask if you want to replace some files needed to use the Russian language already on the computer by those present on the installation CD of Windows XP. It is not necessary.

8. Appendix 2: User Profiles

When the user runs the DOSICAL software, only the following functions are available to him:

- consultation,
- identification, enabling him, after authentication with a password, to access the software reserved functions (according to the profile assigned by the administrator).

Four user profiles are provided with, for each one, the following accesses to the reserved functions of the DOSICAL software:

- « Administrator »:
  - access to the account management only, to declare the DOSICAL users and assign them with a profile.
  - User/password by default: mgpa/mgpa
- « Operator »:
  - dosimeter check: with or without calibration,
  - creation of module calibration with reference dosimeters: the calibration is not valid as long as it is not approved by a supervisor-type user,
  - maintenance functions: exchange test, basic exposure.
  - consultation and editing of the results.
  - User/password by fault: mgpo/mgpo
- « Supervisor »:
  - functions accessible to the operator profile,
  - management of some software general parameters,
  - management of nomenclatures: irradiator, module, reference dosimeters,
  - approval of module calibration with reference dosimeters,
  - creation of manual calibration,
  - deletion of session, dosimeter check and module calibration.
  - User/password by fault: mgps/mgps
- « Manufacturer »:
  - access to all the software functions, except for the account management.

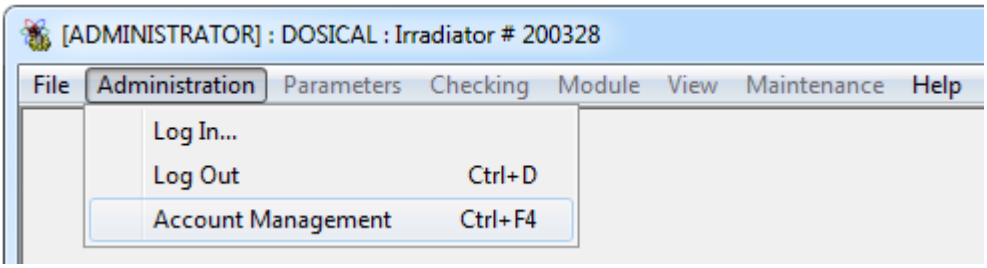
Note :
A user can only have one profile assigned by the administrator (no cumulated profiles).

The DOSICAL access level management, which is to be performed by the "administrator" user, is performed through the DOSICAL "Administration" menu, as described below.

8.1 "Administration" Menu

This menu allows access to the following three sub-menus:

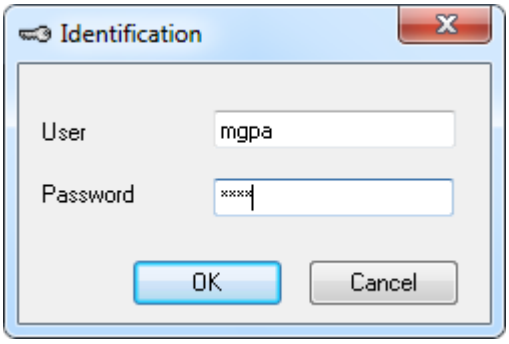
- "Log in",
- "Log out",
- "Account Management".



8.1.1 Identification

This function enables the user to identify himself with his password in order to continue the session with another user profile.

- Administration / Identification:



After validation, the user can continue the session with his user profile.

Advice:
Reminder: the user name and profile appear in the status bar of the DosiXom main screen.

8.1.2 End of Session

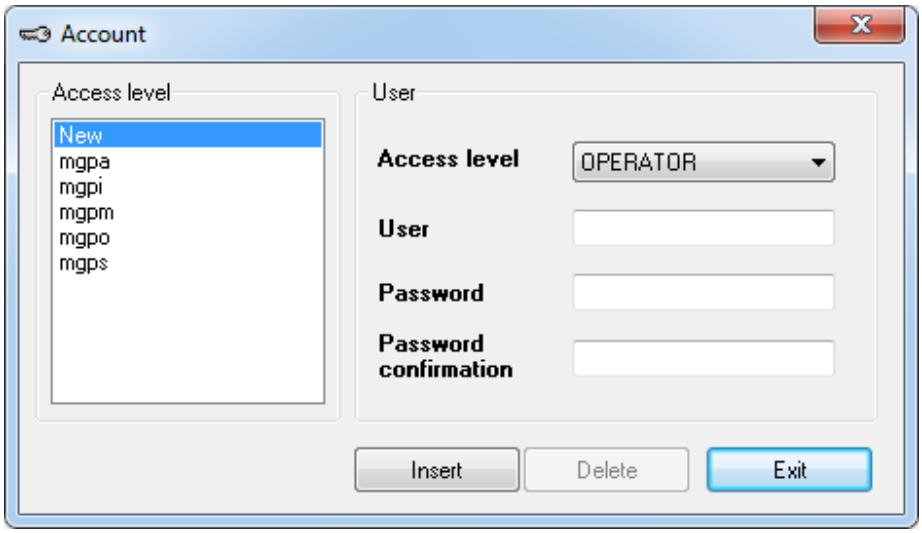
This function is used to continue the session with an Operator account.

- Administration / Log Out

8.1.3 Account Management

This function is used to manage the user accounts (addition, deletion, modification of the password). It is accessible only for a user having the Administrator profile.

- Administration / Account management:



- **List of users** area: this area comprises the list of users recorded in the system.
- User's data area:
  - **Access level**: this field is used to define the user profile concerned among the Administrator, Supervisor and Operator profiles
  - **User**: this field is used to enter the user name
  - **Password**: this field is used to define the password allocated to the user. When typing, the characters are replaced with a series of **x**.
  - **Password confirmation**: this check field is used to enter the password again to make sure that it corresponds to that entered in the Password field. In case of error, the password must be entered again.

8.1.3.1 Addition of a New User

From the Users management box:

- In the **List of users** area, select the **Add New User** label and fill in the different fields of the **User's data** area (Access level, User, Password, Confirm).
- Validate this new user by clicking **Add**.

8.1.3.2 Modification of a User

From the Users management box:

- Select the user involved in the List of users area and modify the fields of the User's data area.
- Validate the modifications applied by clicking **Modify**.

8.1.3.3 Deletion of a New User

From the Users management box:

- Select the user involved in the List of users area.
- Delete this user by clicking **Delete**.

9. Appendix 3: Calculations Performed Upon a Calibration

9.1 Current Reference Dose Rate Calculation:

The dose rate of the reference sources must be corrected for the radioactive decrease between the date of calibration and the current date:

For the selected module, the selected source, for the current position (1, 2,3), for the quantity concerned (Hp/Hs),

Current_Ref_Rate = Calibration_Ref_Rate * exp (- 0.693 * duration / decay) * BackScattering_Coef

where:

- duration : Current_date - Calibration_date in the same unit as the period
- decay: activity decay period defined upon source calibration
- BackScattering_Coef: Is the coefficient entered in the “Targets” screen. It is applied on V4 dosimeters following their type, on a Hp measure. In every other case, the value is 1.

9.2 Exposure Duration Calculation

Obtained by the division of the dose target by the current reference rate:

Theoretical_Exposure_duration = Target_Exposure_Dose * 3600 / Current_Ref_Rate

where:

- Target_Exposure_Dose is defined among the general parameters (only depends on the main or secondary source selection).
- duration in seconds: rounded off to the next higher value.

9.3 Reference dose calculation and expected dose calculation

Obtained by multiplying the actual exposure duration (read in the dosimeter) by the current reference rate:

reference_dose = actual_exposure_duration * current_ref_rate / 3600

expected_dose = actual_exposure_duration * (current_ref_rate * target) / 3600

where:

- Duration in seconds

- dose and rate in homogeneous unit
- target

9.4 Response Calculation and Decision

The response is the quotient of the read rate over the expected dose.

Response = Read_Dose / Expected_Dose (displayed value)

- complying if target - tolerance/100 =< response_reference =< target + tolerance/100
  - tolerance expressed in %

Note:
The tolerance is termed "acceptance interval".

9.5 New Efficiency Coefficient Calculation

The calibration is achieved only if the response remains within an acceptance interval fixed upon the definition of the control characteristics; otherwise, an error is indicated (case of a dosimeter fault or false handling).

Expected_response = read_dose / expected_dose

theoretical_modified_efficiency = current_efficiency * Expected_response

The displayed efficiency is the actual value read in the dosimeter. It may be slightly different of the theoretical_modified_efficiency.

9.6 Backscattering coefficient

This coefficient compensates the difference on the contribution of scattered field effect on V4 dmc compare to previous version (V1, V2 and V3) when irradiated on a small irradiation chamber with shielding as IRD2000. It is set by default at 1.07 and can be adjustable on the screen “targets and coefficients”.

This coefficient is mandatory when mixed populations V3 (V1, V2 or V3) and V4 are calibrated. If only V3 (V1, V2 or V3) or only V4 dosimeters are calibrated on the IRD2000 (no mixed populations), the reference dosimeters used to calibrate the IRD2000 must be on the same version as the dosimeters to be calibrated.

The reference rate is the rate seen by a V3 (V1, V2 or V3) reference dosimeter. A V4 dosimeter receives more dose as previous versions of dosimeters due to scattered field emitted by the lead shieldings of the IRD and a better angular response of V4 dosimeters.

During the IRD calibration, the calculated rate of a V4 reference dosimeter is reduced:

Calibration_ref_rate of V4 Reference dmc = (read dose / exposure time) / **backscattering Coefficient**

And no correction is applied if a V3 (V1, V2 or V3) is used as reference dosimeter.

Note:
It is possible but not recommended to mix V3 and V4 reference dosimeters.

When a calibration of a V4 dosimeter is performed, the expected dose is corrected using the coefficient

Expected_Dose of a V4 = exposure time x current_ref_rate x target x **backscattering coefficient**

During a calibration of a V3 dosimeter, no correction is done.

9.7 DMC2000 XB Case

The type of dosimeter is determined by its serial number. A section is reserved to this model.

The DMC2000XB provides 2 Hp and Hs doses.

The result of a check is expressed in two result lines, each analyzing the reference dose rate and the read dose specific to Hp or Hs (the duration read is common).

The calibration of a source according to one of the quantities may be non-existent. In such a case, any corresponding processing can be ignored and only the other quantity considered.

If the operator selected the main source, a check with calibration can be performed, provided that the calibration according to the two quantities exists, and a new efficiency coefficient for each Hp and Hs quantity can be calculated.

10. Appendix 4: Calculations Made Upon Calibration

Relative standard deviation or associated uncertainty

= 1/ average (x) * $\sqrt{[(n*\Sigma(x)^2 - (\Sigma x)^2) / (n*(n-1))]}$

with

- x = recorded measurements,
- n number of measurements.

The backscattering coefficient, set on the screen “targets and coefficients” is applied on read dose of V4 dosimeters (for GN dosimeters, firmware > 4.3) in the case of Hp measures.

During the IRD calibration, the calculated rate of a V4 reference dosimeter is reduced:

Calibration_ref_rate of V4 Reference dmc = (read dose / exposure time) / **backscattering Coefficient**

And no correction if a V3 is used as reference dosimeter.

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11. Appendix 5: Basic principles for response adjustment of dosimeter

11.1 Introduction: Characteristics of an electronic dosimeter

An electronic dosimeter is a personal dose equivalent measurement device; dose equivalent value is defined by dose rate, exposure time and energy of incident radiation.

The dose rate measurement of an electronic dosimeter is usually linear although the energy response curve is rarely flat on all the energy range. Energy response is conditioned by the physical characteristics of the detector and by the mechanical assembly of the device itself.

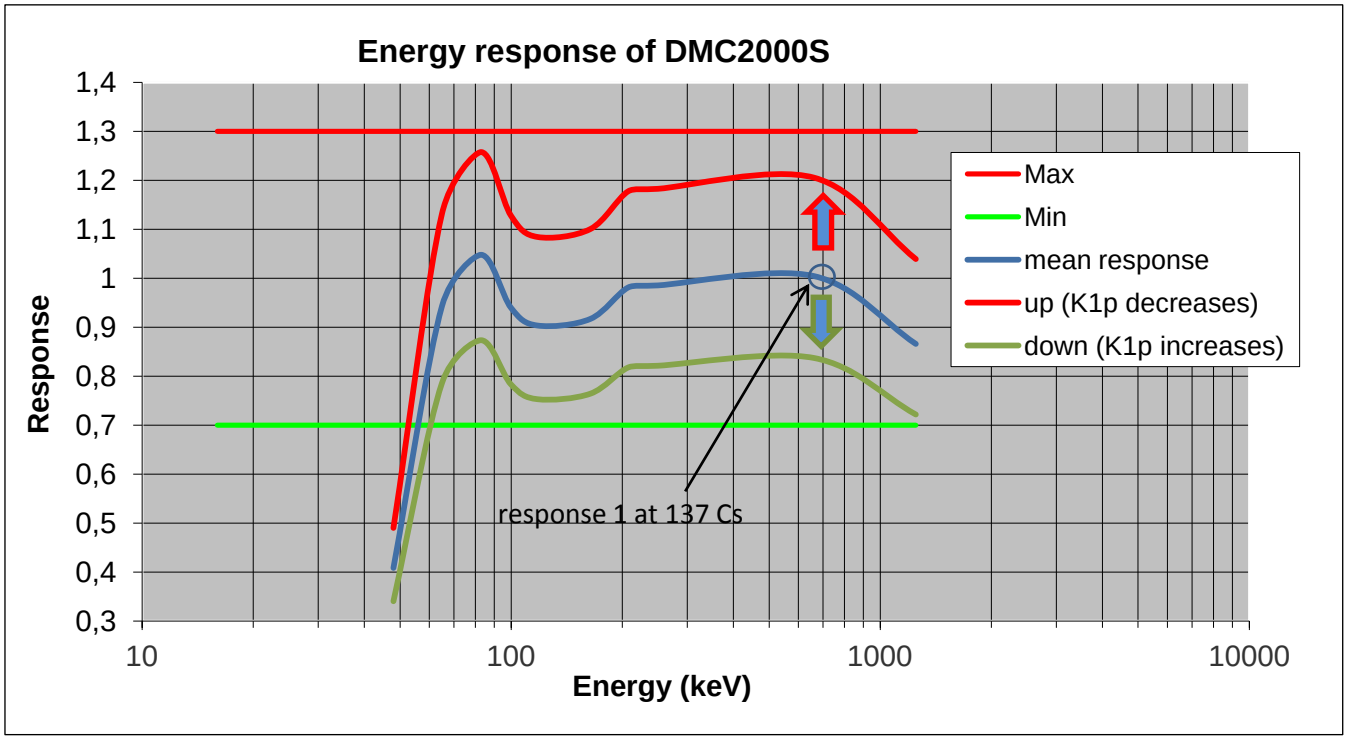
Mirion Technologies constantly improves its electronic dosimeters performances in order to reach the optimal energy response curve.

Our electronic dosimeters provide an energy response variation over performing the regulation recommended range stated in "CEI 61526 Ed 3 Radiation protection instrumentation – Measurement of personal dose equivalents Hp(10) and Hp(0.07) for X, gamma, neutron and beta radiations – Direct reading personal dose equivalent meters"

This standard allows a response between 0.71 and 1.67 over the whole energy range. They are represented by the red and green lines in the graphic below.

The dose response is the ratio between measured dose by the dosimeter and expected dose. This response can be adjusted by changing the efficiency coefficient on our electronic dosimeter. The efficiency coefficient represents the number of pulse per seconds detected when exposed to a 10 mSv/h radiation rate.
When the efficiency coefficient increases, the dosimeter response decreases.

The following graphic shows the energy response curve of our electronic dosimeter after factory calibration process where a response at ^{137}Cs is targeted to 1.



K1p ➔ Efficiency coefficient of the dosimeter.

11.2 IRD's function

The IRD (literally **D**osimeter **IR**adiator) is designed to verify and adjust if necessary the dose response of the electronic dosimeters of the following families: DMC 2000, DMC 3000, SOR/R and SOR/T.

It offers 2 control functions:

- **Verification without calibration**: the dosimeter response to a targeted value will be verified but dosimeter will not be adjusted (i.e. : K1p efficiency coefficient will not be changed)
- **Verification with calibration**: Dosimeter response to a targeted value will be verified and response will be adjusted if not in the acceptance interval. Acceptance interval is defined as percentage in the software general parameters section.
  - Adjustment is made by changing the K1p efficiency coefficient.
  - Response will be verified after adjustment.

11.2.1 Definitions

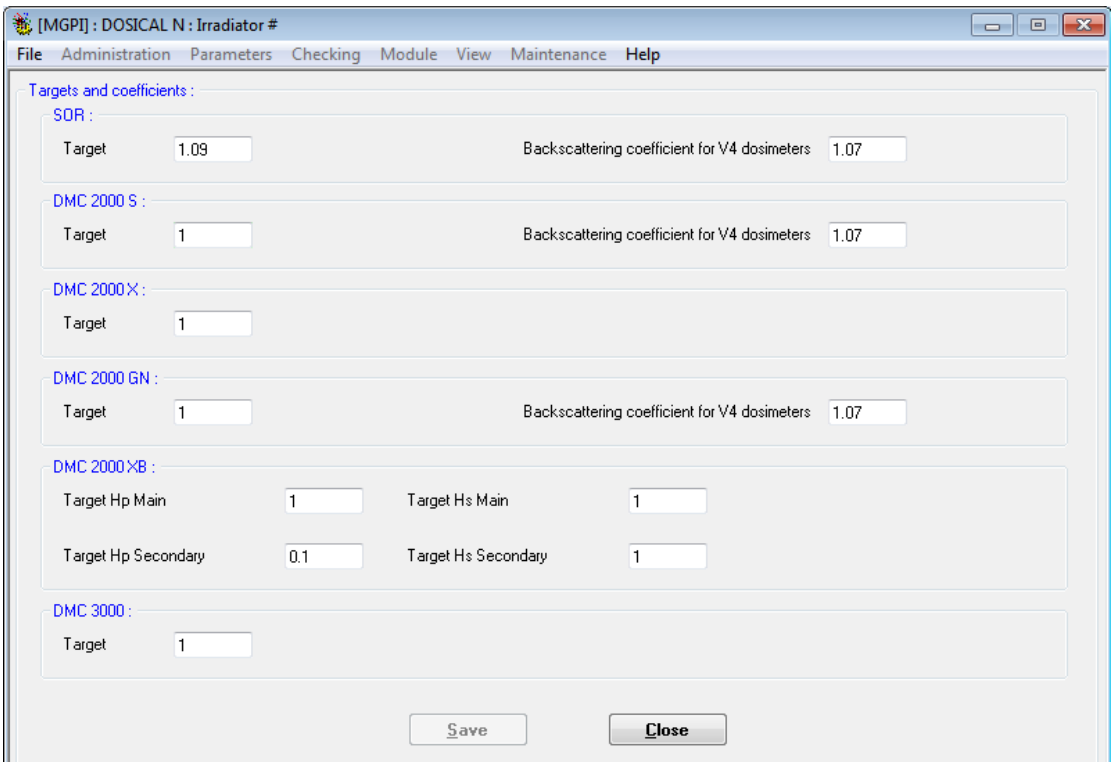
11.2.1.1 Target

In the DOSICAL Software, the term "target" is used to designate the value of the response targeted when shooting dosimeter with a reference isotope. The reference isotope of the IRD 2000 is ^{137}Cs. If we want to target a true response (1 to 1) to this radio-isotope the target shall be set to 1.

The users may want to change this value in order to adapt the response of the dosimeter to the spectrum encountered in the plant or the facility where the dosimeter is used.

In the example above we can see that the dosimeter response to ^{60}Co is 0.83 (energies at 1173 KeV and 1332 Kev). If dosimeter is to be used in an environment where ^{60}Co is pre dominant the target to ^{137}Cs should be placed to 1.20 that is 1/0.83. The efficiency coefficient of the dosimeter will be calculated by DOSICAL in order to have a response at ^{137}Cs to 1.20. The consequence is that when exposed to pure ^{60}Co the dosimeter will measure 1 to 1 (0.83*1.20).

For more information about target, see §4.1.3.4 *Target Information*.



11.2.1.2 Reference rates

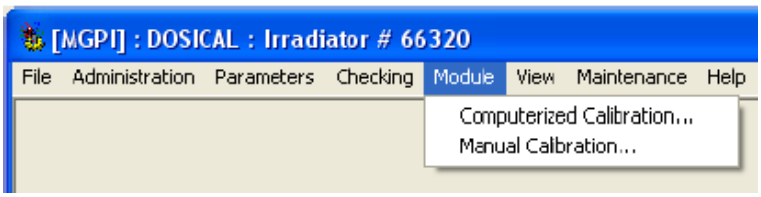
To operate and do its calculations, DOSICAL software needs to know for each of the positions (3 or 6) the reference rate. To measure this reference rate, some very well known dosimeters are used; they are called the reference dosimeters. 3 reference dosimeters per dosimeter type are needed.

11.2.1.3 Reference dosimeters

These reference dosimeters have been calibrated with national reference source. MIRION Technologies can provide sets of reference dosimeters for each type of dosimeter (see §5.6 *Spare parts and accessories*).

11.2.2 IRD calibration

The DOSICAL SW offers a function that will allow, using reference dosimeters and a specific procedure, to define the reference rate of each of the position where the dosimeters are going to be exposed afterwards. This function is called assisted calibration.



11.2.2.1 Manual calibration

This function, detailed in §5.3.2 *Manual Calibration*, sets reference to each dose rate of each position to a starting point. This has to be done for each dosimeter type. The values are not controlled by the software. If the user does not perform the assisted calibration afterwards, these manual values will be used for calibration of the dosimeters.

Manual calibration sample:

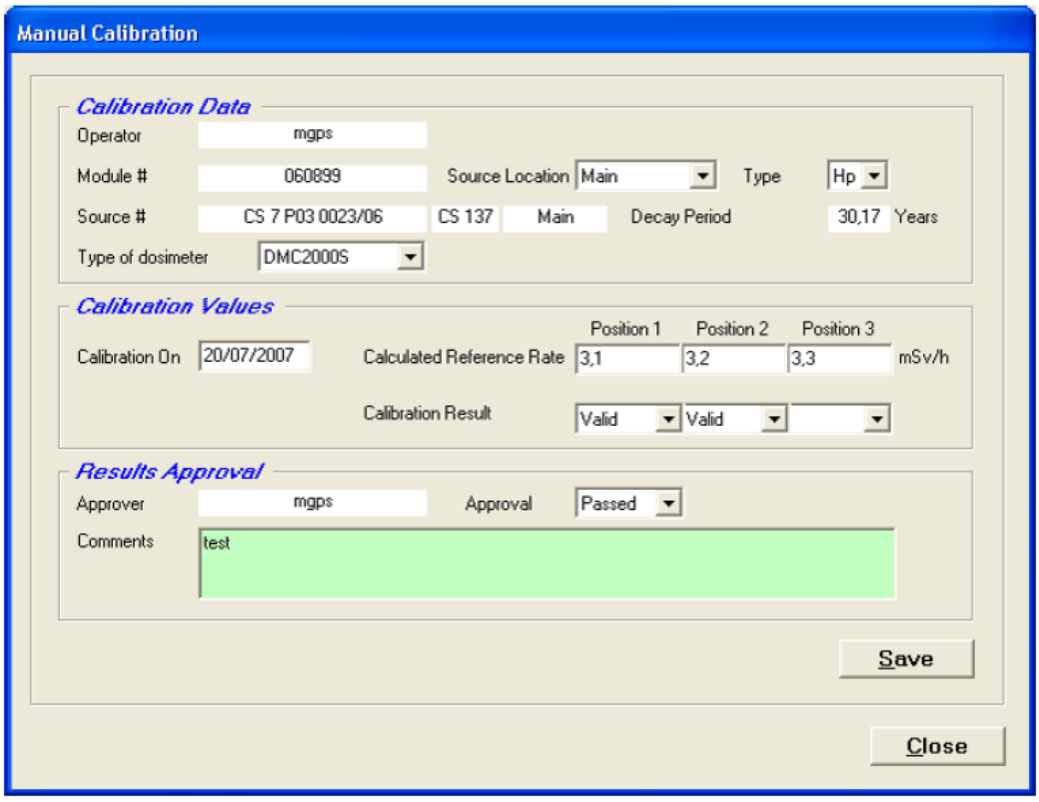


Figure 47 - Manual calibration screen

Declaration of the reference dosimeters

Prior to perform assisted calibration, each reference dosimeter shall be declared into the system (§4.1.5 *Nomenclature of the Reference Dosimeters*).

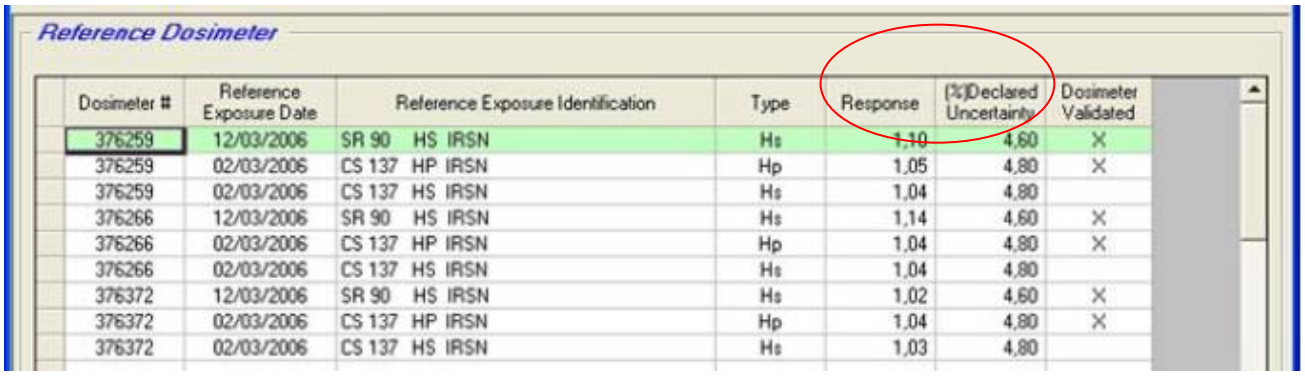
Main parameters to mention are:

- Serial number
- Response
- Uncertainty

The procedure is to be renewed each year when reference dosimeters are recalibrated themselves.

Some laboratories provides the calibration coefficient, the ratio between expected dose and dose read on the dosimeter.
Response is equal to the reciprocal of the calibration coefficient.

Caution: Response = $\frac{1}{calibration\ coefficient\ (\overline{N})}$



Dosimeter #	Reference Exposure Date	Reference Exposure Identification	Type	Response	(%)Declared Uncertainty	Dosimeter Validated
376259	12/03/2006	SR 90 HS IRSN	Hs	1,10	4,60	X
376259	02/03/2006	CS 137 HP IRSN	Hp	1,05	4,80	X
376259	02/03/2006	CS 137 HS IRSN	Hs	1,04	4,80	
376266	12/03/2006	SR 90 HS IRSN	Hs	1,14	4,60	X
376266	02/03/2006	CS 137 HP IRSN	Hp	1,04	4,80	X
376266	02/03/2006	CS 137 HS IRSN	Hs	1,04	4,80	
376372	12/03/2006	SR 90 HS IRSN	Hs	1,02	4,60	X
376372	02/03/2006	CS 137 HP IRSN	Hp	1,04	4,80	X
376372	02/03/2006	CS 137 HS IRSN	Hs	1,03	4,80	

If the dosimeter already exists in the reference dosimeters list, in order to change the values, a new one must be created with the same serial number and the previous one must be disabled.
A reference dosimeter cannot be deleted because some previous results may refer to it.

11.2.2.2 Computerized calibration

"**Computerized calibration**": allows defining a reference dose rate for each position of the IRD basket by the use of 3 reference certified dosimeters.

The sequence consists in 27 exposures that look like normal controls. Each reference dosimeter will be exposed 3 times in each of the 3 positions, then dosimeters will rotate position.
At the end of the sequence the 3 dosimeters will have been exposed in each of the 3 positions.

This automatic calibration can be done if a manual calibration has been done at least once. The manual calibration allows defining a dose rate to start with for each position.

During calibration each dosimeter is exposed during an amount of time in order to integrate the dose defined in the general parameters of the system.

Example:

Targeted dose is 0.05 mSv

- Dose rate mentioned for position 1 is 2.70 mSv/h
- Dose rate mentioned for position 2 is 2.90 mSv/h
- Dose rate mentioned for position 3 is 3.00 mSv/h
- In position 1 the dosimeter will be exposed 67 seconds that is 0.05/2.7 * 3600
- In position 2 the dosimeter will be exposed 62 seconds that is 0.05/2.9 * 3600
- In position 3 the dosimeter will be exposed 60 seconds that is 0.05/3.0 * 3600

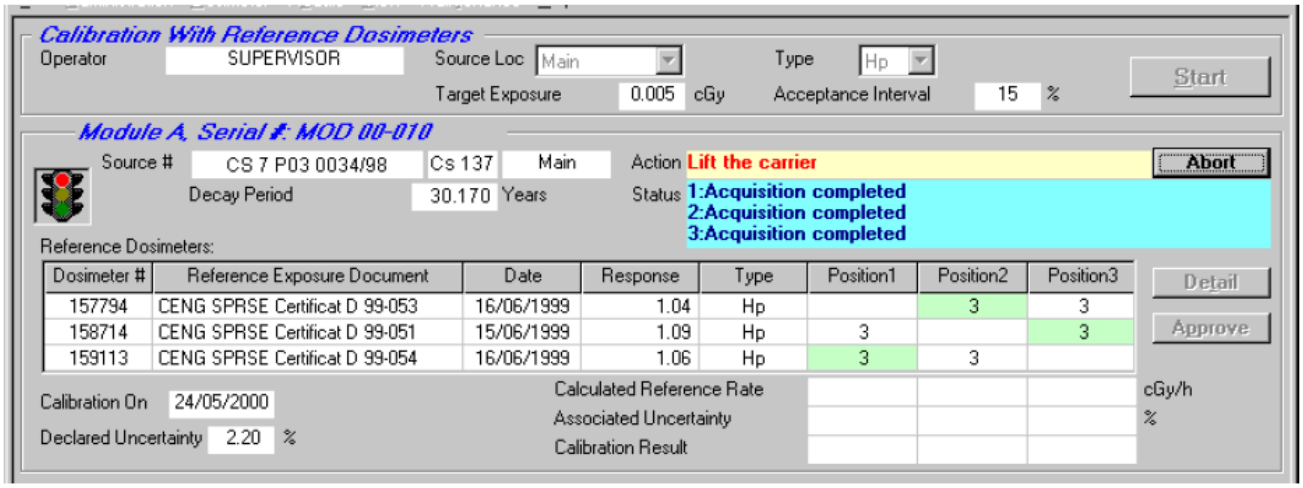
These times are minimum guaranteed exposure times per position. They may slightly vary. At the end of the assisted calibration the final rate for each position is defined by using the values (duration/dose) measured by each reference dosimeter not by the exposure time of the software itself.

If the user does not mention manually the very first rate for each position the automated calibration cannot take place.

If the manually set rate is within + or – 15% there will be no influence on the automated procedure calculation. If the rate is over estimated the final calculated rate will be calculated with some uncertainty that is not acceptable.

At the end of the automated calibration, the exposure time for the next calibration will be estimated knowing the calculated dose rate and the targeted dose for each exposure.

Assisted calibration window sample:

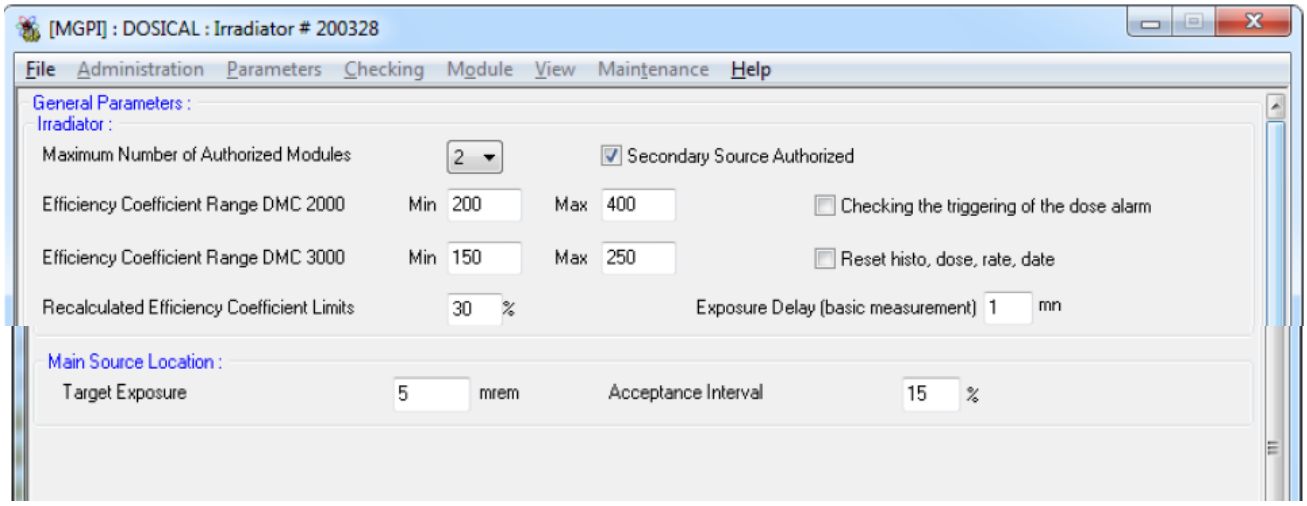


11.3 Calibration and acceptation parameters

Parameters that will define if a dosimeter is conform, out of range or invalid are defined in the general parameters windows (see §4.1.3.1 *General Parameters*).

11.3.1 General parameters

Hereafter are described the main parameters involved in the calibration process.



Efficiency coefficient range for both DMC2000 and DMC3000: defines the minimum and maximum acceptable values that the software allows itself to calculate. Should the new efficiency coefficient be out of this range, the dosimeter would be considered as defective.

Recalculated efficiency coefficient limits: defines the maximum acceptable variation for the new calculated efficiency coefficient. Should the new efficiency coefficient be more than + or – this percentage from the "as found" one, the dosimeter would be considered as defective.

Targeted exposure dose: set by default to 0.05mSv, this dose corresponds to the minimum dose the dosimeter shall be exposed to in order to have a reliable result from the whole measurement chain. Reliable means with an uncertainty lower than 5%.

Decreasing this parameter would increase calibration uncertainty, increasing would increase the exposure time and decrease calibration process efficiency.

Acceptance Interval: the window around the target where the dosimeter efficiency coefficient will not be changed.

11.4 DosiCal acceptation criteria

When performing verification, DosiCal determines the response of the dosimeter.

The dosimeter can be declared:

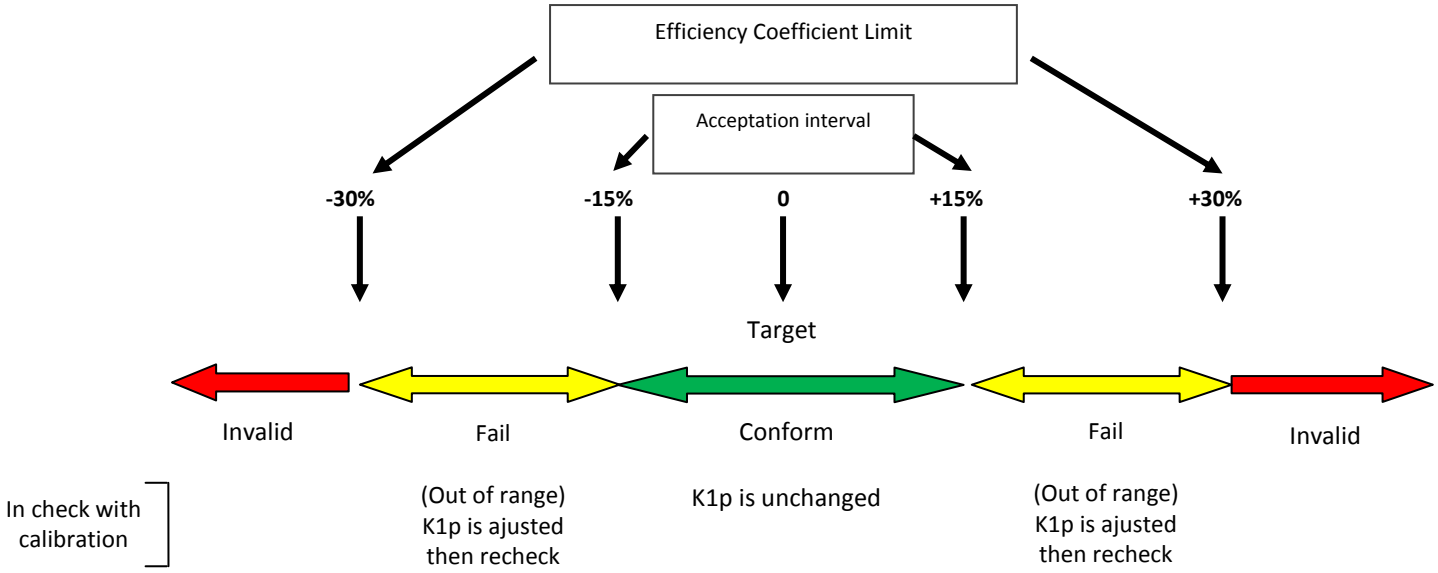
- **Conform** (good to go): the measured response is within + or - the acceptation interval defined in the general parameters.
- **Fail** (out of range): the measured response is out of the acceptation interval and the recalculated efficiency coefficient (if check with calibration):
  - Is within + or – the Efficiency coefficient limit (+/-30%)
  - remains in the Efficiency coefficient range ([200 - 400])

  Dosimeter will be adjusted

  Said differently: the new efficiency coefficient did not change a lot (< +/-30%) and the new value is within interval ([200 - 400])
- **Invalid**: the measured response is out of the Efficiency coefficient limit. The dosimeter is defective.

11.4.1 Represented areas

On the figure hereafter the acceptation interval has been set to 15% and the Efficiency coefficient limit has been set to 30%.



Other parameters

- **Exposure Delay (basic measurement)**: minimum exposure time when performing a basic exposure test. (Maintenance menu)
- **Dose for the triggering**: Dose alarm value to set in the dosimeter in order to allow the verification of the dose alarm triggering. Recommended value is targeted dose -30%.
- **Restored Dose**: Dose alarm value to restore after dose alarm test.

If the dose alarm test is chosen (general parameters) DosiCal will set a dose alarm to 50 mrem in our example.
At the end of the verification (with or without calibration), the software will check that the alarm was triggered on the dosimeter and will declare the dosimeter good or failed. In any case a new dose alarm value will be programmed into the dosimeter, 500 mrem in our example.

WARNING: this test does not perform a verification of the dosimeter buzzer itself.

12. Glossary

12.1 Actions and Sequences of Actions

Calibration [of Irradiator]: operation consisting in establishing the irradiator reference response. Can be performed with reference dosimeters or other measurement means.

Check, or Physical Check, or Source Test [of Dosimeter]: operation consisting in evaluating the response of a dosimeter exposed to a source under reproducible conditions. Check that the dosimeter response is within a given interval around the expected reference response.

Calibration [of Dosimeter]: sequence including a check possibly followed by a calibration with final check.

Calibration [of Dosimeter]: operation consisting in modifying the efficiency coefficient of a dosimeter so that its response is within a given acceptance interval.

Calibration Session: series of calibrations performed under similar conditions.

12.2 Dose Equivalent Definition

- **Hp**: deep dose equivalent Hp(10)
- **Hs**: superficial dose equivalent Hp(0.07)

12.3 Units

Unit	Measurement Type	Qualification	Conversion
rem	dose equivalent	**former unit** 'rad equivalent man'	1 rem = 10 mSv
mrem	dose equivalent	**former unit**	1 mrem = 10^{-2} mSv
rem/h	dose equivalent rate	**former unit**	1 rem/h = 10 mSv/h
mrem/h	dose equivalent rate	**former unit** millirem per hour	1 mrem/h = 10^{-2} mSv/h
mSv	dose equivalent	**international unit** 'milliSievert'	1 mSv = 10^{-1} rem 1 mSv = 10^{+2} mrem
mSv/h	dose equivalent rate	**international unit**	1 mSv/h = 10^{-1} rem/h 1 mSv/h = 10^{+2} mrem/h

Unit	Measurement Type	Qualification	Conversion
cGy	absorbed dose	absorbed dose unit 'centiGray'	1 rem or 10 mSv
cGy/h	absorbed dose equivalent rate		

12.4 Equipment Items

- Definition of reference dosimeters:
  Dosimeters whose response is evaluated with respect to a reference traceable with the national or customer's standards.

Type of Equipment	Name	Version	Quantity (ies) Evaluated
Irradiator	**IRD 2000**	**Standard**	
	IRD 2000 + DMC 3000 Kit	**Standard**	
Dosimeters	**DMC 2000 S** New-generation	Standard	Hp(10)
	SOR	DMC2000S military version	
	DMC 2000 X	DMC2000, version X	12.4.1.1.1.1.1.1 p(10) by including X-rays
	DMC 2000 XB	DMC2000, version XB	Hp(10) Hp(0.07)
	DMC 3000	Standard	Hp(10)

- Table of equipment items likely to be used according to the operating context

12.5 Software

- **DOSICAL** IRD control unit software

12.6 Calculated Parameters

Efficiency coefficient or efficiency
parameter establishing a proportionality relation between the dosimeter counting and the response displayed: by convention, expressed in counts per second for 10 mSv/h. This parameter is modified by the calibration.

12.6.1 Target

Value of the expected response, during calibration of the dosimeter to the reference body. It must be determined by the radiation monitoring skilled person. It depends on the source mounted in the IRD. This parameter is set to 1 by default.

MGPI supplies dosimeters with different targets.
*In the case of calibration with an irradiator fitted with a Cs 137 source, for standardization to:**

- *Co 60 and for a DMC2000S, the target will be equal to 1.17.*
- *centered between the Cs 137 and the Co 60, and for a SOR, the target will be equal to 1.09.*
- *For a DMC2000XB, in HP and Hs measurement, with Cs 137, and in HS measurement with SR 90 the target will be equal to 1*
- *For a DMC2000XB, in HP measurement, with Sr 90, the target will be equal to 0.1*

Usually, the main source corresponds to Cs137 and the secondary source to SR 90.
The target value is prone to modification according to the evolution of the dosimeters

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