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SAPHYMO GmbH

Manual

miniTRACE

Type CSDF

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1 Foreword

Thank you for purchasing the MiniTRACE CSDF contamination and survey meter. In order to gain a better understanding of its functions, please take a little time to read through this instruction manual.

MiniTRACE CSDF is a multifunctional contamination and survey meter that has been developed by Saphymo GmbH in Frankfurt/Main.

MiniTRACE CSDF is especially suited for use in nuclear plants, reprocessing sites, research centers, hospitals, and for occupational groups such as the armed forces, police or fire department.

MiniTRACE CSDF offers ease of use. It is the ideal instrument for identifying possible contamination simply and quickly (values are displayed in Bq, Bq/cm^2 or cps, depending on the mode). You can also use it as a multifunctional survey meter. With its energy compensated Geiger-Mueller pancake detector you can determine the ambient dose rate equivalent (H*(10)), displayed in µSv/h. The device is also suitable for food measurements and wipe tests.

The MiniTRACE CSDF enables the user to select different measurement cycles for the count up mode directly on the instrument or to choose between different radionuclides.

Additionally, the optional MiniTRACE software enables you to set the alarm thresholds or calibrate the instrument (see additional software manual).

2 Description

2.1 Display

The display is composed of a 6-digit 7-segment display for the measurement results as well as a 5-digit alphanumeric display. The MiniTRACE CSDF shows the unit in “cps”, “Bq”, “Bq/cm^2”, “µSv/h”, “counts” and Bq/l.

Note: The dose rate displayed is energy compensated to the ambient dose rate equivalent (H*(10)). To measure the dose rate correctly the lid must be closed.

The following status reports can be displayed on the MiniTRACE CSDF display:

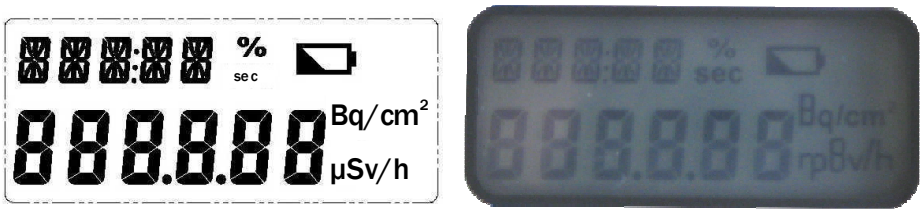

Figure 1: Information shown on the display

Display	Acoustic Alarm	Note
Unit: Bq, Bq/cm^2, cps, µSv/h or Bq/l	-	Available measurement units
CAPT	Yes	Detector error: If the detector is defective, the message “CAPT” will appear in the display. The warning is triggered when the detector fails to send an impulse for a period of 40 seconds.
SAT	Yes	Saturation: If the measurement range is saturated (value out of range), the message “SAT” will appear in the display. This message will remain until the measurement area is no longer saturated.
	No	Battery warning: If the battery symbol appears in the display, the battery should be changed. The instrument can still be operated for 10 hours after the battery symbol appears.
E < %	No	Statistical uncertainty in the mean value mode: The mean value is determined for a user-defined period. The default is set to 3 Sigma and adjustable by software.

Table 1: Status reports in the 5-digit alphanumeric portion of the LCD display

2.2 Alarm function

One alarm threshold for the MiniTRACE CSDF can be set via software for the following units:

- Alarm 1: Dose rate mode in µSv/h (default: 20 µSv/h)
- Alarm 2: Counts in cps (default: 0, meaning deactivated)
- Alarm 3: Activity in Bq (default: 60 Bq)
- Alarm 4: Surface contamination in Bq/cm^2 (default: 4 Bq/cm^2)

The alarm can be activated or deactivated using the mode button (See Figure 3). If you would like to activate the alarm, go to the "AL oN" menu and wait three seconds. If you would like to deactivate the alarm, go to the "AL oFF" menu and wait three seconds. The value of the alarm threshold is shown on the display.

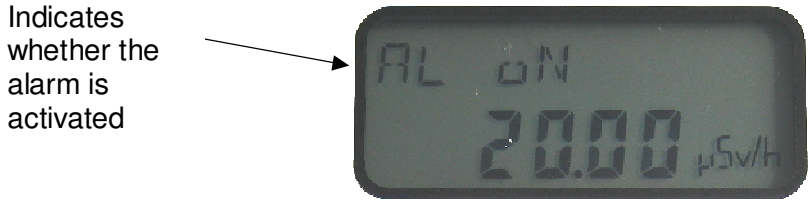

Figure 2: MiniTRACE CSDF display – alarm is activated

Note: After one of the operation modes has been selected, the status (here alarm activated) and the value (here 20.00 µSv/h) of the alarm setting are displayed.

2.3 Operation Modes of the MiniTRACE CSDF

The following measurement modes can be set:

- **Rate mode (RATE)**: Dose rate in "µSv/h". To use this function properly the lid **must** be closed. The results will then be energy compensated to the ambient dose equivalent (H*(10)).
- **Rate mean mode (RMEAN)**: Dose rate mean value in "µSv/h". To use this function properly the lid **must** be closed. The results will then be energy compensated to the ambient dose equivalent (H*(10)). To reset the calculated mean value, press the mode button. This function is used to gain measurement results of a higher precision in a stable radiation environment. The longer the measurement, the higher the accuracy.
- **CPS mode (CPS)**: Count rate in "cps".
- **CPS mean mode (CMEAN)**: Count rate mean value, no unit is displayed. To reset the calculated mean value, press the mode button. This function is used to gain measurement results of a higher precision in a stable radiation environment. The longer the measurement, the higher the accuracy.
- **Bq mode (BQ)**: Activity in "Bq". You can use the mode button to choose between different radionuclides (along with their appropriate calibration factors; 4π-calibration). See Table 6.
- **Bq/cm^2 mode (BQCM2)**: Surface contamination in "Bq/cm^2". You can use the mode button to choose between different radionuclides (along with their appropriate calibration factors). See Table 7. Calibration based on ISO 7503-1.

- **Count up mode (CNTUP)**: Pulses are counted during the selected time interval. The interval can be set via the mode button. Possible intervals are: 60, 120, 300, 600, 1,800 and 3,600 seconds.
- **Food mode**: Contamination of food in “Bq/L”.

Note: If you turn on the instrument the last selected operation mode is still activated. The default calibration factors are set for a distance of 3 mm between grid and surface. For more details see Chapter 3.
The MiniTRACE CSDF is UNABLE to identify radionuclides!

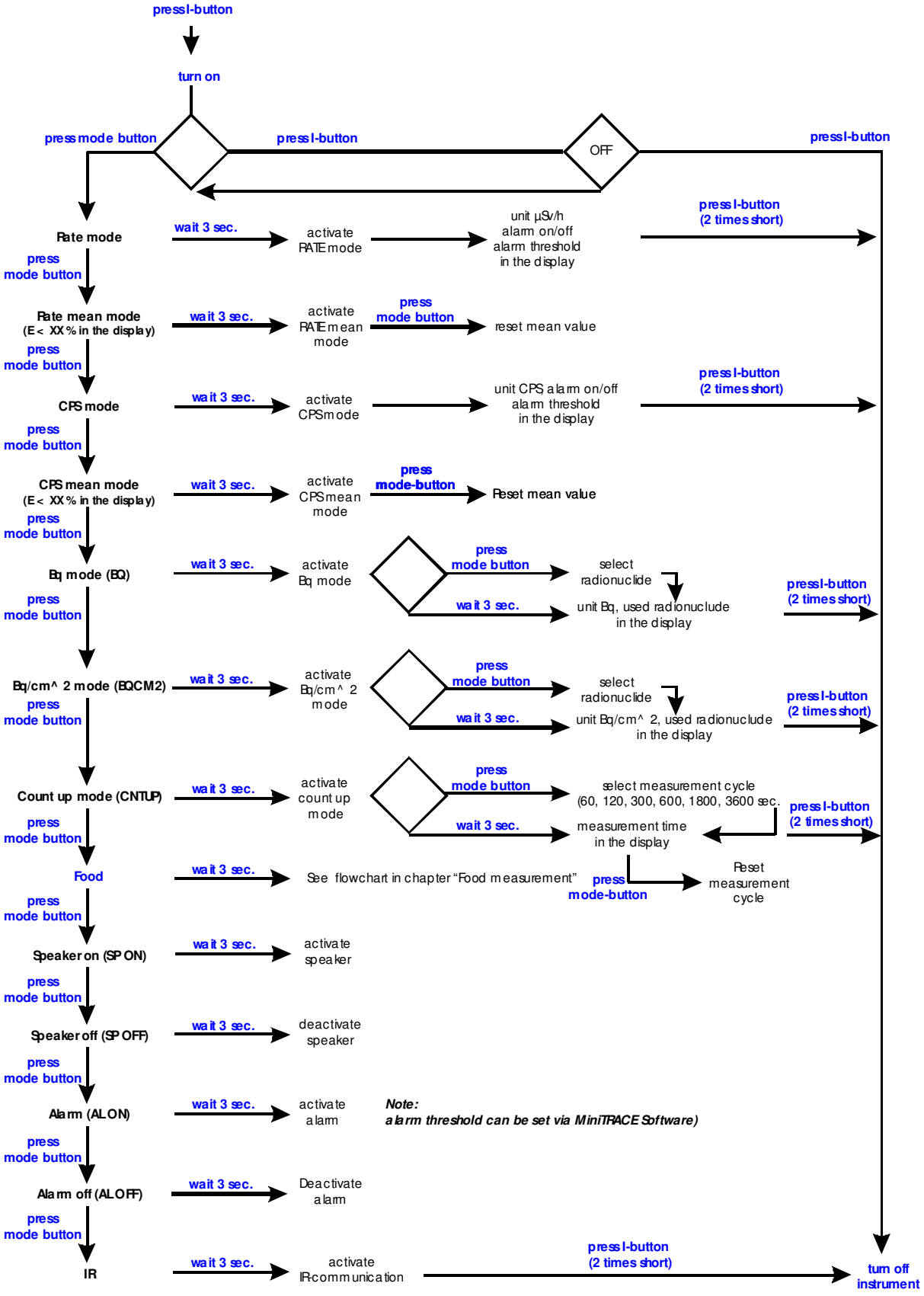

Figure 3: Using the mode button to select an operation mode

2.4 Measurements

2.4.1 Information for your own radiation protection

- Protect yourself from an unnecessary dose. The easiest way is to reduce the length of exposure.
- Increasing the distance reduces the dose due to the inverse square law.
- Radiation doses should all be kept as low as reasonably achievable.
- Protect yourself against contamination by using the rubber gloves and the tweezers.
- Do not touch the surface with your hand or the MiniTRACE to prevent the spread of contamination.
- Avoid incorporation and inhalation. Incorporation or inhalation of radioactivity is much more dangerous than contamination of the skin.

For more information see:

Euratom: http://www.euratom.org

IAEA: http://www.IAEA.org

WHO: http://www.who.int

2.4.2 Examples of natural radionuclides in food and limits for artificial radionuclides in food

In all foods you will find some **natural** radionuclides, mainly the long-lived K-40 and the long-lived radionuclides of the uranium-radium and thorium decay series. Alongside the nutrients necessary for growth, plants and animals also absorb radionuclides, due to their similar chemical properties. The level of radionuclide concentration in food is determined by the radioactivity of the source media used (soil, water), the availability of nutrients and other substances from soil and water and other conditions at the location of the plant or animal production.

Higher radionuclide concentrations are found in the livers and kidneys of animals (in comparison to the meat) due to their function as "pollution filters" as part of the metabolism of various elements, above all radionuclides.

Some interesting numbers (literature source BfS/Germany):

- Natural K-40 in:
  - fruits: approx. 50 Bq/kg
  - milk: approx. 50 Bq/l
  - meat: approx. 100 Bq/kg
  - peas/beans: approx. 380 Bq/kg
  - man: approx. 40-60 Bq/kg

The national threshold for food differs from country to country.

In Germany the following thresholds apply: Regulation 1707/86 dated 30.5.86 (2) for:

- Total Cesium 370 Bq/kg for milk and baby food
- 600 Bq/kg for other food.

More information can be found at:
Japan:
http://www.mhlw.go.jp/english/topics/foodsafety/index.html
http://www.mhlw.go.jp/english/topics/foodsafety/dl/110318-1.pdf

Germany:
http://www.bmu.de/atomenergie_sicherheit/doc/47216.php

2.4.3 Measurement tasks for the MiniTRACE CSDF

With the MiniTRACE CSDF you choose between the following operation modes:

Mode	Unit	Lid open	Lid closed
Dose rate H*(10) (Menu RATE) Preferred direction observed, see Figure 27	µSv/h	-	X
Dose rate mean value H*(10) (Menu RMEAN) Preferred direction observed, see Figure 27	µSv/h	-	X
Count rate (Menu CPS)	cps	X (α, β, γ)	X (γ)
Count rate mean value (Menu CMEAN)	cps	X (α, β, γ)	X (γ)
Activity (Menu BQ)	Bq	X (α, β, γ)	Not recommended
Surface contamination (Menu BQCM2)	Bq/cm^2	X (α, β, γ)	Not recommended
Count up (Menu COUNTUP)	cps	X (α, β, γ)	X (γ)
Food (Menu FOOD)	Bq/l	-	X (γ)

Table 2: Overview of measurements

Note: Measurement results in the “Surface contamination” (Bq/cm^2) mode are based on ISO 7503-1. For the activity mode (Bq) we have calibrated the instrument in a 4 π geometry.
The internal calibration factors are default values and not individually calibrated.

Figure 4: Opened protective lid

2.4.3.1 Ambient dose rate equivalent measurement – H*(10) in µSv/h

Select the “RATE” menu by using the mode button. Once “RATE” is displayed, wait 3 seconds; the menu will start automatically. For further details see Figure 3.
This mode reacts very quickly to changes in the radiation level.
To determine the ambient dose rate equivalent (H*(10)) correctly, the lid must be closed! When the lid is open, the ambient dose rate equivalent is NOT calculated correctly.
The value is given in µSv/h.

Note: The ambient dose rate equivalent gives you important information for radiation protection.

Dose limits for radiation protection in Germany are (in 2011):

- Population 1 mSv/a
- Professionally exposed persons: 20 mSv/a

2.4.3.2 Mean value of the ambient dose rate equivalent – H*(10) in µSv/h

Select the “RMEAN” menu by using the mode button. Once RMEAN is displayed, wait 3 seconds; the menu will start automatically. For further details see Figure 3.

We recommend this menu if the ambient dose rate equivalent is “stable” in your environment and you would like to determine the dose rate more precisely. The longer the measurement, the higher the accuracy. This mode does NOT react to rapid changes in the radiation level.
To determine the mean value of the ambient dose rate equivalent (H*(10)) correctly, the lid must be closed! When the lid is open, the mean value of the ambient dose rate equivalent is not calculated correctly. The value is given in “µSv/h”. In the top left corner of the display, statistical uncertainty is given. By default a statistical uncertainty of 3 sigma is calculated. You can change the sigma value using the MiniTRACE software. For more details see the software manual.

Note: The ambient dose rate equivalent gives you important information for radiation protection.

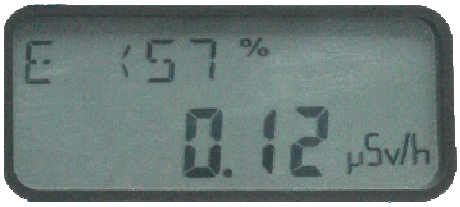

Figure 5: Display in dose rate mean mode

2.4.3.3 Count rate measurement in cps

Select the “CPS” menu by using the mode button. Once “CPS” is displayed, wait 3 seconds; the menu will start automatically. For further details see Figure 3.
This mode reacts very quickly to changes in the radiation level.
With this menu you can check the contamination of a surface, for example. The value is given in **c**ounts **p**er **s**econd (cps). With the lid closed only γ-radiation is measured. If you open the protective lid (material: aluminum, thickness: 1 mm) you will see the Geiger-Mueller

pancake detector. With the lid open you can measure α-, β- and γ-radiation. This detector is very sensitive and protected by a grid.

Note: All given measurement values are gross values. This means that background values are NOT subtracted.

Basically you should do contamination measurements (i.e. on surfaces) in 2 steps:

1. Measurement with lid closed to determine the γ-contamination
2. Measurement with lid open to determine the α-, β- and γ-contamination

To determine the β-component another step is necessary:

3. Measurement with lid open and a sheet of paper on the detector. Subtract the value from measurement 3 from measurement 1; the result contains the β-contamination.

To determine the α-component another step is necessary:

Measurement with lid open and a sheet of paper on the detector. Subtract the value from the result without and with paper and you will get the α-contamination.

To determine the α- and β-components another step is necessary:

Subtract the value from measurement 2 from measurement 1; result contains the α- and β–contamination.

Note: For a higher precision of the measurement result the radiation background has to be measured first and then subtracted from the final result.
α–radiation can be shielded with a piece of paper.
β-radiation is almost completely shielded by closing the lid.

2.4.3.4 Mean value of the count rate in cps

Select the “CMEAN menu” by using the mode button. Once “CMEAN” is displayed, wait 3 seconds; the menu will start automatically. For further details see Figure 3.
With this menu you can check the contamination of a surface, for example. If the count rate is “stable” in your environment and you would like to determine the count rate more precisely you can use this menu. The longer the measurement, the higher the accuracy. This mode does NOT react to rapid changes in the radiation level.
The value is given in **c**ounts **p**er **s**econd (cps). In the top left corner of the display, the statistical uncertainty is given. By default a statistical uncertainty of 3 sigma is calculated. You can change the sigma value using the MiniTRACE software. For more details see the additional software manual.

With the lid closed only γ-radiation is measured. If you open the protective lid (material: aluminum, thickness: 1 mm) you will see the Geiger-Mueller pancake detector. With the lid open, you can measure α-, β-, and γ-radiation. This detector is very sensitive and protected by a grid. See also 2.4.3.3.

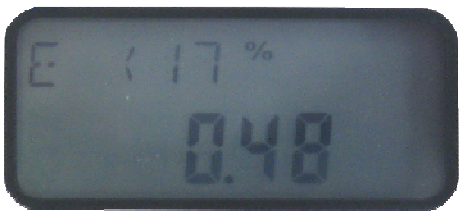

Figure 6: Display in cps mean mode

2.4.3.5 Measurement of surface contamination

2.4.3.5.1 Measurement of the activity in Bq

With this menu you can check the contamination of a surface, for example, based on a 4 π-calibration.

Select the “BQ” menu by using the mode button. Once “BQ” is displayed, wait three seconds. You can select the radionuclide you would like to measure by pressing the mode button. After additional three seconds, the display will indicate whether an alarm threshold has been activated for the activity measurement. Then the measurement starts automatically. For further details see Figure 3. The activity is given in “Bq”. See also 2.4.3.3, 2.4.3.5.32.4.3.5.4.

You can select the following radionuclides with the built-in calibration factors (4 π-calibration):

- Am-241
- C-14
- Cl-36
- Co-60
- Cs-137
- Sr-90
- U-238
- User (see below)

If you would like to select another radionuclide, press the mode button once, wait three seconds, and then select the radionuclide. The display will indicate whether an alarm threshold has been activated for the activity measurement. The measurement will then start automatically.

You can assign your own calibration factor for the radionuclide “User” using the software. For further information see the software manual.

Note: MiniTRACE CSDF can not determine the radionuclide. Selection of the radionuclide has to be done by the user.

2.4.3.5.2 Measurement of surface contamination in Bq/cm^2

With this menu you can check the contamination of a surface, based on ISO 7503-1 calibration. The measurement of the surface contamination can be done in two different ways. For more information see Chapters 2.4.3.5.3 and 2.4.3.5.4.

Select the “BQCM2” menu using the mode button. Once “BQCM2” is displayed, wait three seconds. You can then select the radionuclide you would like to measure by pressing the mode button. After an additional three seconds, the display will indicate whether an alarm threshold has been activated for the activity measurement. The measurement will then start automatically. For further details see Figure 3. Activity is given in Bq/cm^2.

You can select the following radionuclides. Associated built-in calibration factors are based on ISO 7503-1:

- Am-241
- C-14
- Cl-36
- Co-60
- Cs-137
- I131
- Sr-90
- U-238
- User (see below)

If you would like to select another radionuclide, press the mode button once, wait three seconds, and then select the radionuclide. The display will indicate whether an alarm threshold has been activated for the activity measurement. The measurement will then start automatically.

You can assign your own calibration factor for the radionuclide “User” using the software. For further information see the software manual.

Note: MiniTRACE CSDF cannot determine the radionuclide. Selection of the radionuclide must be carried out by the user.

2.4.3.5.3 Surface contamination with a direct measurement

Select the “BQCM2” menu or “Bq” mode. For further details see Figure 3. To measure the surface contamination with a direct measurement you will need to open the lid. With this method you measure the nonadherent and adherent surface contamination.

With the lid open, move the detector slowly over the surface, without allowing the MiniTRACE to touch the surface. We recommend activating the acoustic registration of impulses (“SP oN” menu). If you find a contaminated area, position the MiniTRACE at this point. The distance between the surface and the MiniTRACE grid should be as little as possible; we recommend approx. 3 mm.

Before you start with this measurement you need to determine the background radiation and subtract it from the later result. For further information see ISO 7503-1 or your national guidelines.

Note: The closer you are to the surface, the better the results will be. Be sure not to touch the surface with the MiniTRACE CSDF. In the event of contact, the MiniTRACE CSDF could be contaminated and the contamination could be spread.

2.4.3.5.4 Surface contamination with a wipe test

To work with this menu select “BQCM2” mode. For further details see Figure 3. The wipe test is a common method for measuring surface contamination. It is an indirect measurement technique; only nonadherent surface contamination can be determined. This test is useful if external radiation levels are too high, if surfaces are inaccessible or if the radiation would not be detectable. In these cases activity on the surface is sampled on wipe test smears. They provide an efficient, convenient means of sampling contaminated areas with radioactivity on

either wet or dry surfaces. Afterwards the activity on wipe test smears is measured with MiniTRACE CSDF.

The surface contamination is measured in “Bq/cm²“ and it is proportional to the net counting rate and a calibration factor. The calibration factor is a function of the instrument's efficiency for the specified radionuclide, the area wiped, the source efficiency and the removal factor. Frequently the removal factor is unknown.

Note: Use only the supplied measuring cup and holder. Otherwise the result will be inaccurate.

Procedure:

- Perform a background measurement and go to the “BQCM2” menu.
- Take one wipe test sample from the filter roll by tearing along the perforation. Do not disconnect the filter from the foil.
- Protect yourself against contamination by using the rubber gloves and the tweezers.
- Wipe very carefully with the supplied filter over the averaging area.
- In Germany the averaging area should not be larger than 100 cm^2. Please check the guidelines in your country.
- Put the filter in the filter cup with the side that is possibly contaminated facing up.
- Put the filter cup in the measurement device.
- Position the CSDF on the measurement device. The lid must be open.
- Now you can start the measurement.
- After measurement is done, remove the wipe test sample from the cup carefully, if you have found any contamination.
- For the exact procedure see ISO 7503-1 “Evaluation of surface contamination” or your national guidelines.

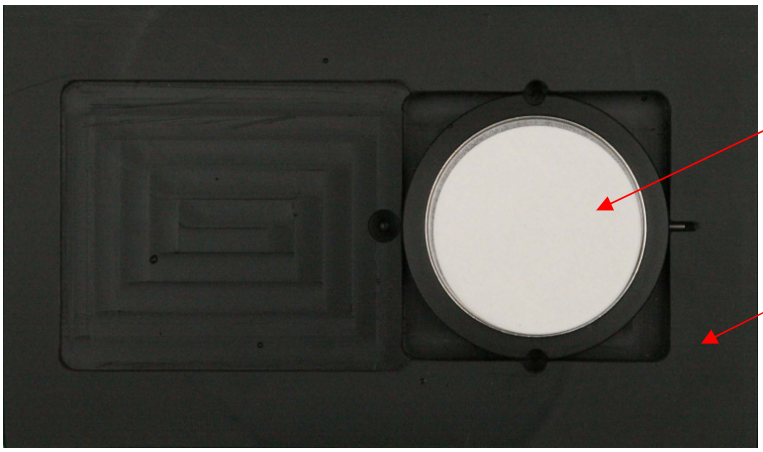

Figure 7: Measuring device for wipe tests

Figure 8: Wipe test measurement

Calculation of the final result:

$$net\ value[Bq/cm^2] = measured\ value_{\ total} - measured\ value_{\ of\ the\ backgound}$$

Note: To determine the background value put the CSDF in the measurement holder. It is not necessary to use a new (uncontaminated) wipe test sample; put only the measurement cup in the measurement holder.

Example:
Measurement result of the background: 5 Bq/cm²
Measurement result of surface measurement: 105 Bq/cm²

Net value = 105 Bq/cm² – 5 Bq/cm² = 100 Bq/cm²

$$Final\ result = \frac{net\ value\ [Bq/cm^2]\ x\ 15.5\ cm^2}{wiped\ area\ [cm^2]}$$

Example:
Net value = 100 Bq/cm²
Wiped area = 100 cm²
Area of the window of the GM-detector: 15.5 cm²

$$Final\ result = \frac{100\ Bq/cm^2\ x\ 15.5\ cm^2}{100\ cm^2} = 15.5\ Bq/cm^2$$

2.4.3.6 Count up mode

To work with this menu select “CNTUP” mode. For further details see Figure 3. This mode is the summation of pulses at a predetermined time interval. The following time intervals are available: 60, 120, 300, 600 (10 min.), 1800 (30 min.) and 3600 (60 min.) seconds. When you select the count up mode, the display will indicate which measurement interval has been selected. To keep this measurement interval, wait three seconds. To change the measurement interval, press the mode button. The end of the measurement is indicated by an acoustic signal (beep).

Figure 9: Counting up measurement

This menu is very helpful in conveying to students an insight into the statistical correlations between the radioactivity measurements.

2.4.3.7 Food measurement

The instrument is calibrated to measure Cs-137 contamination in liquid or solid food. The results are only precise if the food is contaminated with Cs-137 and when determined using the procedure described here.

For more information about radionuclides in food and limits for radiation in various products see Chapter 2.4.2.

To check radioactivity in food, only two steps are necessary:

1. Determination of the background radiation (control measurement)
2. Food measurement

All measurements must be carried out with the lid closed.

Note: Due to limited sensitivity the instrument is not suitable for verifying official limits for baby food. With any measurement errors, the manufacturer cannot be held responsible for any damage.

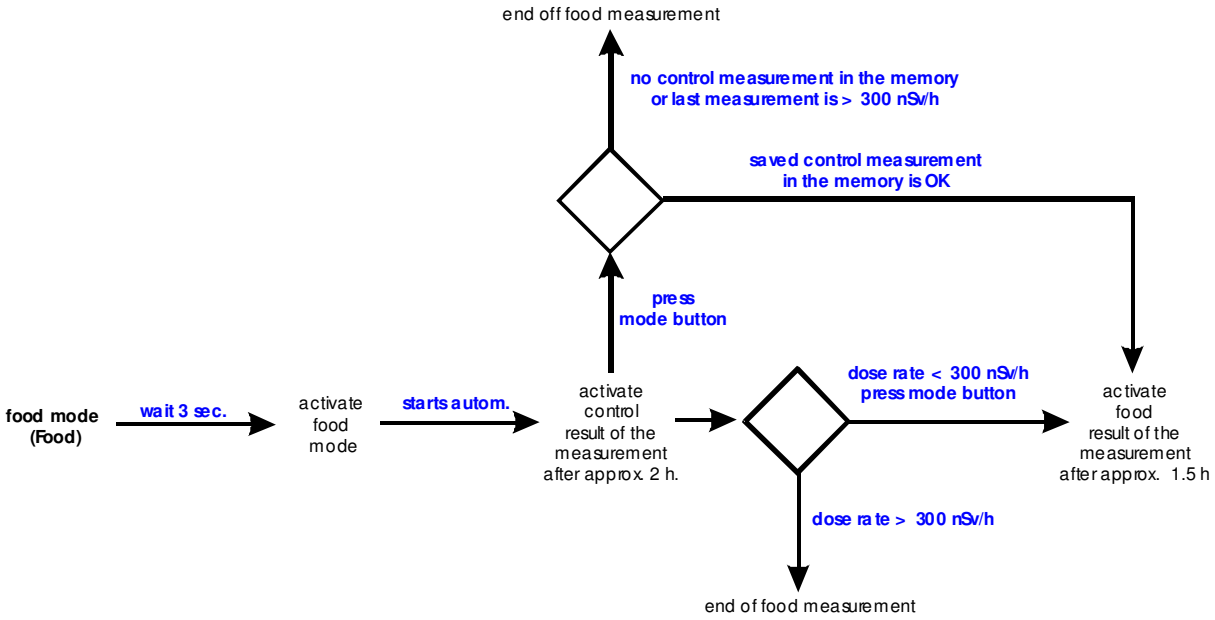

Figure 10: Food measurement flow chart

Note: You can change the duration of the background (control) measurement using the MiniTRACE software. But note: the shorter the measurement, the higher the uncertainty. If you work with a 2-hour measurement time, the result will contain a 1-sigma uncertainty of 30 % at a background level of 0.1 µSv/h. Be sure to use an area with a low radiation background, as the lower the background level the more certain the result. If you do need to measure with a high background level, try to use a lead castle to shield the measurement system from background radiation. If your background level is higher than 0.3 µSv/h, food measurement will be blocked and you will get an error message (C ERR) on the display.

True value	At 100 nSv/h	At 200 nSv/h	At 300 nSv/h
500 Bq/L	500 +/- 30 %	500 +/- 40 %	500 +/- 50 %

Table 3: 1-Sigma statistical uncertainty with different background dose rates

Figure 11: Food measurement

If you measure something other than a liquid the sample will need to be prepared. Solid food must be mashed and the measuring cup filled precisely to the 0.6 l mark.

Note: The calibration is only valid with the supplied measuring cup and holder. Otherwise the result can be incorrect.

Measurement steps in detail:

Step 1: Determination of the background radiation (control measurement)

- Place the empty cup and the MiniTRACE CSDF in the measurement device.
- Go to the "Food" menu.
- MiniTRACE will start with the measurement of the background. The display will indicate how long this measurement will take (in seconds). The result of the background measurement will be given in the dose rate unit "µSv/h". You can interrupt this automatic measurement by pressing the mode button. On the display the last measured value will be shown. If no value is available in the memory of the MiniTRACE, you will get an error message (C ERR). In this case, you will need to conduct a background measurement. We recommend not interrupting background measurement if you have changed measurement location, or if the last background measurement was conducted on the previous day.
- Background (Control) measurement takes about 2 hours (7,200 seconds) and is important for the accuracy of the final result.

Figure 12: Display for background (control) measurement in the "Food" menu

- The end of the background (control) measurement is indicated by a 1 second beep. On the display "C ok" is shown.

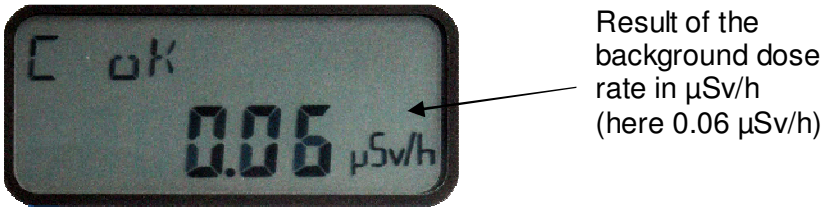

Figure 13: Result display for background (control) measurement in the "Food" menu

For further measurements the background (control) measurement is only required once at the beginning. Do the background (control) measurement:

- If you change the location of the measurement.
- For measurements on another day.

Step 2: Food measurement

The measurement result is always given in “Bq/L”. For a result in “Bq/kg” you will need to carry out two steps:

1. Weigh the food. To do so, subtract the weight of the measurement cup (0.148 kg) from the total weight.
2. Convert the result from “Bq/L” into “Bq/kg”.

Formula:

$$\text{Activity}\,[\text{Bq/kg}] = \frac{\text{Measurement result of the food}\,[\text{Bq/L}]}{\text{Net weight of solid food}\,[\text{kg}]} * \text{Volume of the measurement cup from Saphymo}\;\;[0.6\,\text{L}]$$

Example:
The net weight of the 0.6 L chopped food sample is 1.2 kg, and the result of the food measurement was 800 Bq/L.

$$\text{Bq/kg} = \frac{800\ \text{Bq/L}}{1.2\ \text{L}} * 0.6\ \text{kg} = 400\ \text{Bq/kg}$$

- Fill the measurement cup with the food, taking care to reach an exact capacity of 0.6 L by filling precisely to the measuring line in the cup!
- Start the measurement of the sample (food) by pressing the mode button. After approx. 1 minute (“Wait - - - - -“ is displayed) measurement starts automatically. In the display the remaining measurement time (in seconds) is given as well as the possible measurement limit (e.g. L2500) that can be achieved.

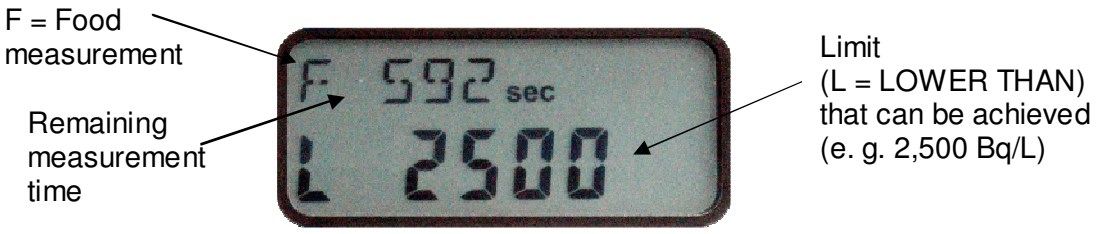

Figure 14: Display in the “Food” menu

- The end of the measurement will be indicated by a beep and in the display the result given in “Bq/L”.

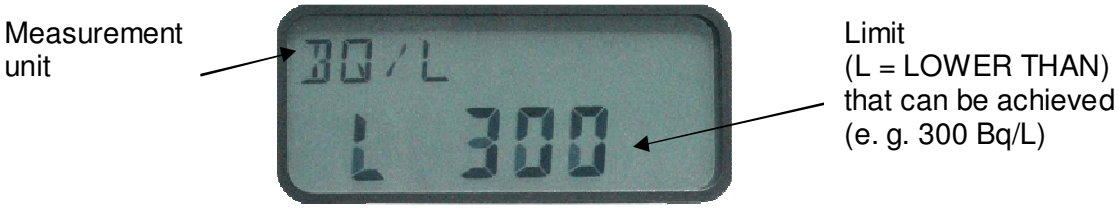

Figure 15: Result display in the “Food” menu

- The mode button enables the user to cancel the measurement and go back to the menu.
- After the end of measurement or canceling of the menu you can start another measurement by pressing the mode button again. If the measurement result is higher than 500 Bq/L, a result is given on the display. If the result measurement is lower

than 500 Bq/L, then either L500 (meaning lower than 500 Bq/L) or L300 (meaning lower than 300 Bq/L) is displayed.

Note: The calibration is for the radionuclide Cs-137.
If you restart the device, you will get the last measurement mode you used. If the food measurement was the last one, you will need to press the mode button 3 times to go back to the main menu.

2.5 Accessories for measuring

MiniTRACE CSDF can be used for contamination measurements such as wipe tests or food measurements or as a survey meter. It is also possible to test the instrument with a test source.

For MiniTRACE CSDF, different accessory sets are available:

- Set for the wipe test (1)
- Set for food measurement (2)
- Set for the test source (3)
- Set for communication (4)

	Set (1)	**Set (2)**	**Set (3)**	**Set (4)**
MiniTRACE CSDF	-	-	-	-
Communication kit: IR transmitter, IR adapter with USB interface, IR support and software	-	-	-	X
Wipe test kit: Measurement device for measurement of wipe test samples	X	-	-	-
Sample dishes for wipe tests (Ø 50 mm)	X	-	-	-
100 wipe test samples	X	-	-	-
Food measuring kit: Measuring cup for liquid or solid food	-	X	-	-
Measuring cup holder	-	X	-	-
Tweezers	X	X	-	-
Rubber gloves	X	X	-	-
Pen	X	X	-	-
Test source with test device	-	-	X	-
Belt case	-	-	-	-
Peli case	-	-	-	-
Transportation box	-	-	-	-

Table 4: List of accessories

Figure 16: Food measurement kit (See Chapter 2.4.3.7)

For measurement of the ambient dose rate equivalent no additional accessories are necessary.

Figure 17: Accessories for the wipe test (See Chapter 2.4.3.5.4)

Figure 18: Belt case

Figure 19: Transparent plastic pouch

This pouch protects the MiniTRACE CSDF against water.

Note: Do not immerse the MiniTRACE CSDF in water; it is only splash-resistant.

Figure 20: Transportation box

We recommend that during transportation by aircraft, the instrument be carried on board as hand luggage. If this is not possible, you can also protect the instrument by using an airtight case, such as our transportation box. Saphymo GmbH takes no responsibility for any damage that may occur due to failure to comply with this warning.

Figure 21: Peli Box

We recommend that for transport in general, as well as for storage, the instrument be protected from damage using our Peli Box. Saphymo GmbH takes no responsibility for any damage that may occur due to failure to comply with this warning.

Figure 22: Emergency case

The emergency case accommodates accessories for everything listed in Table 4.

Figure 23: Test source (see Chapter 2.5.1)

Figure 24: Communication kit with MiniTRACE

Note: Use only the supplied accessories for measurements. Otherwise the result can be inaccurate.
For calibration, the Co-60 source is positioned exactly 3 mm away from the grid.

2.5.1 MiniTRACE function test using a small test source

A small test source is fixed in a sample, see Figure 23.

The test source consists of:

- Radionuclide: U-238
- Activity: 25 Bq (+/- 20%)
- Half life time: 4,468 10^9 a
- Dose rate of the MiniTRACE CSDF, positioned in the measurement device: approx 1 µSv/h.

Figure 25: Dose rate of the test source

To use the test source to check the MiniTRACE, do the following:

1. Open the lid and position the MiniTRACE CSDF in the measurement device.
2. Select the “CMEAN” menu (mean value of the count rate).
3. Measure the environmental background for approx. 60 minutes.
4. Put the test source in the measurement device.
5. Open the lid and position the MiniTRACE CSDF in the measurement device.
6. Select the “CMEAN” menu (mean value of the count rate).
7. If you use the “CMEAN” mode you will see the statistical uncertainty in the upper left corner. We recommend measuring to a value of less than 3 % statistical uncertainty; see Figure 26.
8. Subtract the count rate for the environmental background from the value you got with the source.
9. Record the final result.

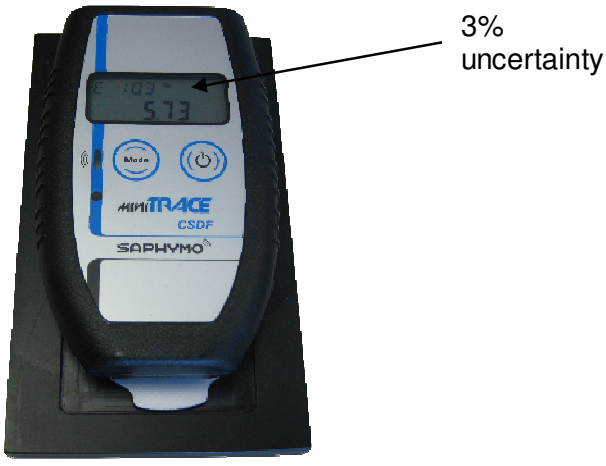

Figure 26: “CMean” menu

$$\text{net value[cps]} = \text{total value[cps]} - \text{background value[cps]}$$

You will need to carry out this procedure when the MiniTRACE is first delivered and then every six months.

Alternatively, you can also do it with the “RMean” menu.

Note: How often this needs to be carried out depends on your national law and your requirements. In Germany it should be every six months.

You will also have to carry out this procedure if you would like to recalibrate your Mini-TRACE. Recalculate the calibration factors and set the new factor via the software in the line "CF correction dose rate" for the dose rate and/or "CF correction Bq" for activity. The correction for activity [Bq] will need to be done for each radionuclide. The default value is set to 100, meaning 100%. If measurement result was too low, you will need to set the value higher than 100; if it was too high you will need to set the value lower than 100.

2.6 The design of the instrument

The following images show the design of the instrument.

Key:

1. Detector: (diameter: 53.4 mm)
2. Case fastening
3. Circuit board
4. Circuit board fastening
5. Battery compartment
6. Buttons
7. LCD display
8. ASIC
9. Counter tube centering ring (diameter: 65.0 mm, CSDF model energy filter is mounted here)

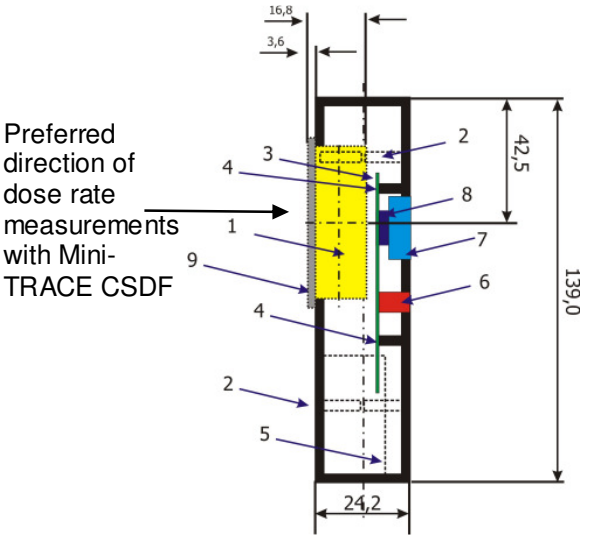

Figure 27: Side view

Key:

1. Detector (diameter: 53.4 mm)
2. LCD display
3. Infrared receiver/ sender
4. Beeper
5. Battery compartment
6. a button (menu)
   b button (On/Off).
7. Case fastening
8. Circuit board

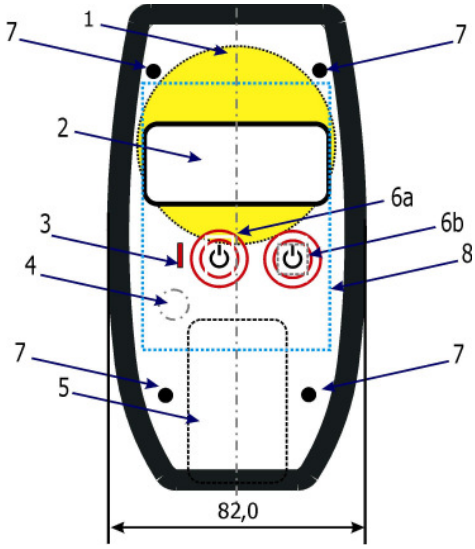

Figure 28: Front view

2.7 Protective rubber casing

Please note that due to the feet of the protective rubber casing, the distance between the counter and the surface to be measured may be increased by approximately 2 mm. This can influence the precision of the measurement result.

Note: The calibration factors for contamination measurements are valid for a 3 mm distance between grid and surface.

Figure 29: Protective rubber casing

3 Standard calibration for Co-60 and Cs-137

A Co-60 plane source is used to calibrate the instrument in the factory. It is DKD certified and meets DIN ISO 8769. The certificate and further details can be found in the appendix.

Each instrument is assigned its own calibration factor based on Co-60. This calibration factor is calculated without the protective rubber casing. For more information see the calibration certificate.

For calibration, the Co-60 source is positioned exactly 3 mm away from the grid.

Additionally, Cs-137 radiation exposure is also carried out on the MiniTRACE CSDF to calculate the calibration factor for the ambient dose rate equivalent. For more information see the calibration certificate.

Users can also conduct their own calibration, but will need the “MiniTRACE” user software (see the separate software manual).

For the MiniTRACE CSDF, default calibration factors for different radionuclides are stored in the instrument for the activity (Bq) and surface contamination (Bq/cm^2) modes. See Table 6 and Table 7. These factors are not calculated for each instrument.

The calculation of the internal calibration factors for the displayed Bq/cm^2 unit is based on ISO 7503-1. 4 π calibration is used for the Bq unit.

Note: Additionally individual user calibration factors can be set by MiniTRACE software to adjust the calibration. For further information, see the separate software manual.

4 Maintenance and care

4.1 Changing the batteries

Before changing the batteries, turn off the instrument.

To change the batteries, open the battery compartment on the back of the case.

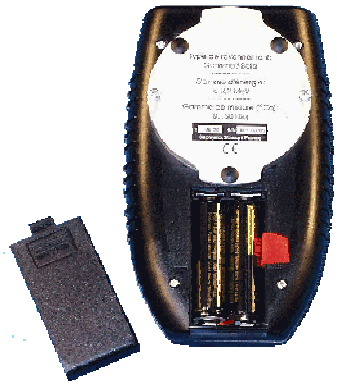

Figure 30: Changing the batteries

Now the batteries (type: MN 1500, LR6, AA) can be replaced. The diagram in the battery compartment indicates how to place the batteries correctly. The instrument is protected against damage to its polarity and thus cannot be harmed by the incorrect placement of the batteries.

4.2 Cleaning (Decontaminating) MiniTRACE CSDF

4.2.1 Removing the grid

Be very careful when removing the grid. First, close the protective lid, in order to avoid damaging the counter tube (with a screwdriver, for example). Now the two screws that hold the grid in place can be loosened.

Figure 31: Removing the grid (part 1)

Once the screws have been loosened, the grid and lid can be removed together and cleaned without danger or difficulty. To screw the grid back on, keep the lid closed to protect the counter tube.

Figure 32: Removing the grid (part 2)

4.2.2 Cleaning the case

Do not use a solvent. Instead, clean the case using a damp cloth.

4.3 Technical properties and functions

Properties	Model CSDF
Display unit:	µSv/h, cps, Bq, Bq/cm², Bq/l
Display and measurement range:	Dose rate: 0.00 µSv/h to 5,000 µSv/h Pulses: 0.0 to 10,000 cps Activity (depends on the radionuclide): 0 to max. 100,000 Bq Surface activity (depends on the radionuclide): 0 to approx. 5,000 Bq/cm² Food: 500 to 100,000 Bq/L (related to Cs-137, 30% statistical uncertainty for 1 Sigma, at 0.1 µSv/h background radiation)
Gamma sensitivity (Cs-137)	4.3 Counts/sec./µSv/h
Energy response for dose rate measurements [µSv/h]	24 keV to 1,253 keV +/- 40%, lid has to be closed, see Figure 33
Detector:	Geiger-Mueller pancake, max. diameter: 53.6 mm; active diameter 44.5 mm, active counter tube surface 15.55 cm², window: 2.0 mg/cm²
Grid:	0.8 mm thick stainless steel, easily removable, 80% transparent
Distance between grid and detector surface	3.6 mm
Measurement intervals:	Automatic adjustment from 1 to 60 seconds Adjustable in Count up mode by buttons
Display:	6-digit 7-segment LCD display plus 5-digit alphanumeric display for alarm and status reports
Alarm thresholds:	See Chapter 2.2
Alarm:	Visual and acoustic. The frequency of the beep will increase according to the level of the alarm threshold.
Acoustic registration of impulses:	Can be activated by buttons and MiniTRACE Software
Reference source:	Co-60 meeting DIN ISO 8769 (DKD certified). Cs-137: Source number: CDC 7915
User calibration:	Possible using infrared interface.
Battery life:	Typically 2,000 hours
Energy supply:	2 batteries (type: LR6, AA, MN 1500), protected against changes to polarity.
Operational temperature range:	-10°C to +40°C (14°F to 104°F)
Weight; Dimensions	320 g incl. batteries; 82 mm x 24 mm x 139 mm
Compatibility:	IEC 60325, IEC 60846 (partially), IEC 61000-3.
Accessories (optional):	User software for change of settings by infrared communication. Infrared reader. Accessories for food and wipe tests

Table 5: Technical data

Note: Calibration values and technical data are only valid when the protective rubber casing is not in use.

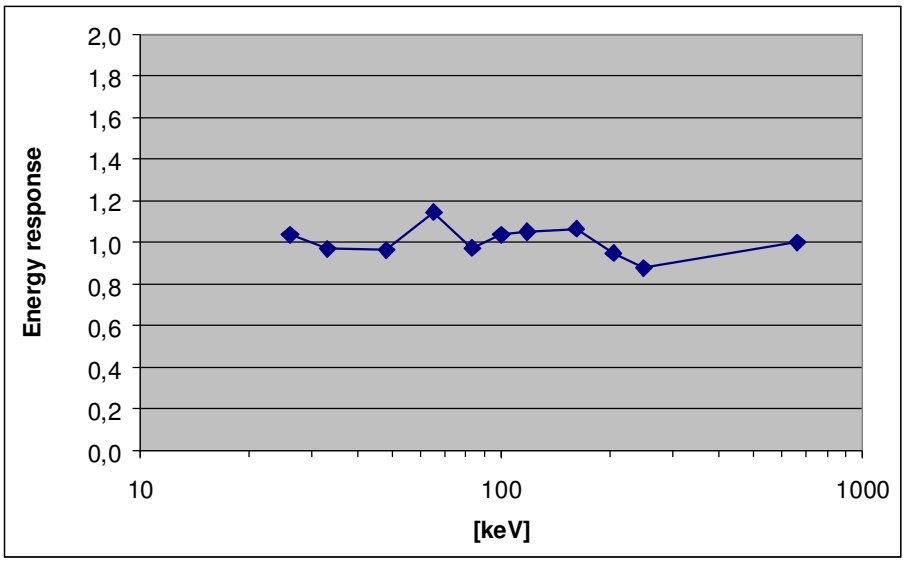

Figure 33: Energy response of the MiniTRACE CSDF (based on Cs-137, with lid closed and GM tube energy compensated)

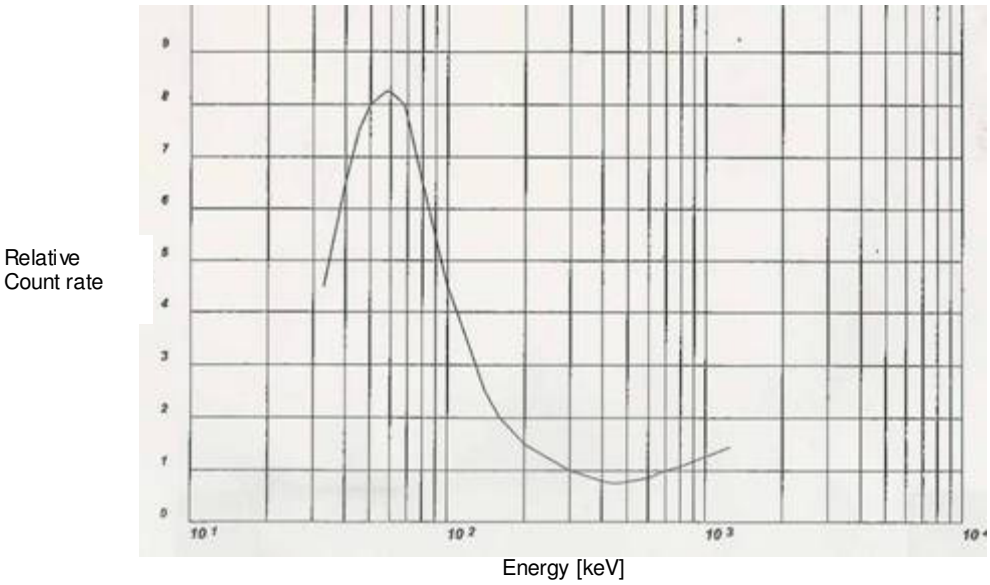

Figure 34: Energy response of the MiniTRACE CSDF (with open lid, NOT energy compensated)

4.3.1 Calibration factors and efficiency

Radionuclide	Lid closed [%]	Lid open [%]	1 cps = x Bq
C-14	0	7.1	14
Cl-36	0	18	5.6
Co-60	0.88	15	6.7
Sr-90	7.7	60	1.7
Cs-137	0.6	23.0	4
Am-241	0.015	13	7.7
U-238	1.3	47	2

Table 6: 4 π-Efficiency [Bq]
MiniTRACE CSDF for different radionuclides

Radionuclide	Calibration factor [Bq/cm^2/cps]	Efficiency [cps/ Bq/cm^2]
C-14	0.607	1,65
P-32	0.086	11,64
Cl-36	0.105	9.57
Co-60	2.469	0.41
Sr-90+	0.094	10.65
I-131	0.103	9.71
Cs-137	0.090	11.15
Am-241	0.240	4.19
U-238	0.240	4.19

Table 7: Calibration factors and efficiency
MiniTRACE CSDF based on ISO 7503-1

Note: For the 4 π calibration and for calibration based on ISO 7503-1 an individual "radionuclide" can be set by the user via the MiniTRACE software. Its name is "USER".
The user can also change all the calibration factors given above by using the MiniTRACE software. The default value is 100%; the user can set it from 0 to 255. For further information, see the software manual.
MiniTRACE is not suitable for measurement of the I-125 radionuclide.

5 MiniTRACE user software

The MiniTRACE user software lets you read and show the status of the MiniTRACE, set alarm thresholds and carry out calibration.

There is a separate manual describing how to install and use the MiniTRACE user software (also called 'Communication Module for MiniTRACE').

6 Warranty information

12 months from date of delivery, not applicable in case of mechanical defects. If damage occurs during initial transport, this must be claimed immediately after receipt together with a picture. The costs for shipping the instrument to the manufacturer are carried by the customer, return shipping charges are covered by the manufacturer. For return shipping to the manufacturer, a pressure tight box or suitcase must be used.

The warranty is voided under the following circumstances:

- if the instrument has not been handled with due care
- if the instrument has been immersed in water
- if the counter tube has been damaged by a tool or other device or object
- if the instrument has fallen
- if the instrument has been opened (other than to take off the grid or change the battery)
- if the instrument has been transported by airplane without the use of an appropriate transport box
- if the instrument has been treated with detergents or solvents

7 Appendix

7.1 DKD certificate for the Co-60 radiation emitter

DEUTSCHER KALIBRIERDIENST **DKD**

Kalibrierlaboratorium für Messgrößen der Radioaktivität
Calibration laboratory for measurements of radioactivity
Akkreditiert durch die */ accredited by the*
Akkreditierungsstelle des DKD bei der
PHYSIKALISCH-TECHNISCHEN BUNDESANSTALT (PTB)

Deutscher Akkreditierungs Rat DAR
DKD-K-06501

AEA Technology QSA GmbH
Gieselweg 1
38110 Braunschweig, Germany
Phone +49 5307 932-0, fax +49 5307 932-194

Strahler Nr. MT 935

014068
DKD-K-06501
04-09

Kalibrierschein
Calibration Certificate

Kalibrierzeichen
Calibration label

Gegenstand *Object*	**Beta-Großflächen-Referenzstrahler**
Hersteller *Manufacturer*	**AEA Technology QSA GmbH**
Typ *Type*	**CKRB12284**
Strahler-Nr. *Source number*	**MT 935**
Auftraggeber *Customer*	**GENITRON INSTRUMENTS GMBH 60488 FRANKFURT**
Auftragsnummer *Order No.*	**80571**
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	**2**
Datum der Kalibrierung *Date of calibration*	**30. August 2004**

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Der DKD ist Unterzeichner der multi- lateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DKD is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Akkreditierungsstelle des DKD als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.
This calibration certificate may not be reproduced other than in full except with the permission of both the Accreditation Body of the DKD and the issuing laboratory. Calibration certificates without signature and seal are not valid.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Stellvertreter *Deputy*	Bearbeiter *Person in charge*
Deutscher Kalibrierdienst DKD-K-06501	14. September 2004	Dr. Thieme	Schott	Lehmacher / Linke / Schohl / Schott / Schüler

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014068
DKD-K-06501
04-09

Beta-Großflächen-Referenzstrahler

Strahler-Nr.	MT 935
Zeichnung	VZ-0497/4
Nuklid	Cobalt-60
Aktivität	832 Bq
Beta-Oberflächen-Emissionsrate	462 s^{-1} in 2 π steradiant
Referenzdatum	30. August 2004 um 12.00 Uhr MESZ
Abmessungen der aktiven Oberfläche	Ø 45 mm
Gesamtabmessungen	Ø 50 mm x 3 mm
Dichtheits- und Kontaminationsprüfung	Die abwischbare Aktivität beträgt weniger als 0,1 % der Gesamtaktivität, jedoch nicht mehr als 200 Bq. (Wischtest nach DIN 25426, Teil 3, Nr. 6.1)
Datum des Wischtests	13. September 2004
Strahleraufbau	Co-60 ist in die Eloxalschicht einer 0,3 mm dicken Aluminiumfolie eingebracht. Die Dicke der aktivierten Schicht beträgt ca. 6 µm. Die Folie ist in eine entsprechende Fassung eingebaut.
Messmethode	Die Aktivität des Strahlers wurde durch Vergleich mit Referenzstrahlern gleichen Aufbaus bestimmt. Die Beta-Oberflächen-Emissionsrate wurde mit einem fensterlosen Großflächen-Proportionalzähler gemessen.
Messunsicherheit	Die relative Messunsicherheit der Aktivität beträgt 5 %, die relative Messunsicherheit der Beta-Oberflächen-Emissionsrate beträgt 3 %. Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k = 2 ergibt. Sie wurde gemäß DKD-3 ermittelt. Der Wert der Messgröße liegt mit einer Wahrscheinlichkeit von 95 % im zugeordneten Werteintervall.
Radioaktive Verunreinigungen	Zum Referenzdatum wurden radioaktive Verunreinigungen mit den folgenden, auf Co-60 (gleich 100 %) bezogenen Aktivitätsanteilen festgestellt: keine
Qualitätssicherungssystem	Das Qualitätssicherungssystem von AEA Technology QSA GmbH wurde durch Lloyd's Register Quality Assurance (LRQA) nach der ISO 9001 in der Ausgabe von 2000 zertifiziert.
Homogenität	Die Homogenität der Oberflächenemissionsrate ist besser als 10 %.
Bemerkung	Dieser Strahler ist ein der Klasse 2 äquivalenter Referenzstrahler, der alle Anforderungen an die Klasse 2 erfüllt, mit der Ausnahme, daß die aktive Fläche kleiner als 100 cm^2 ist.

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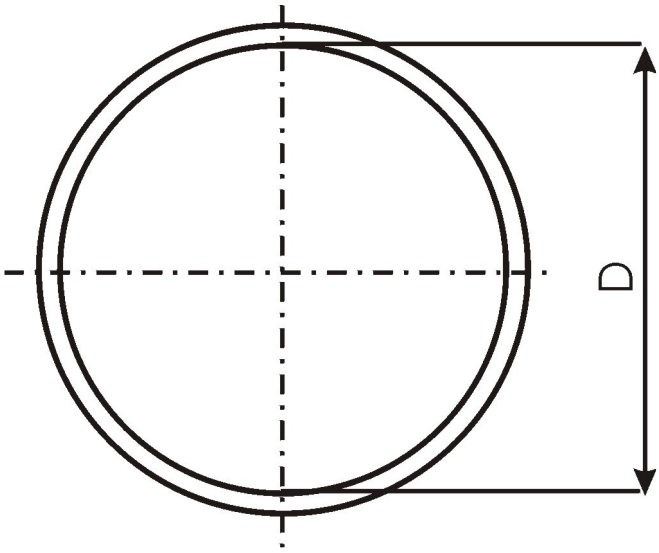
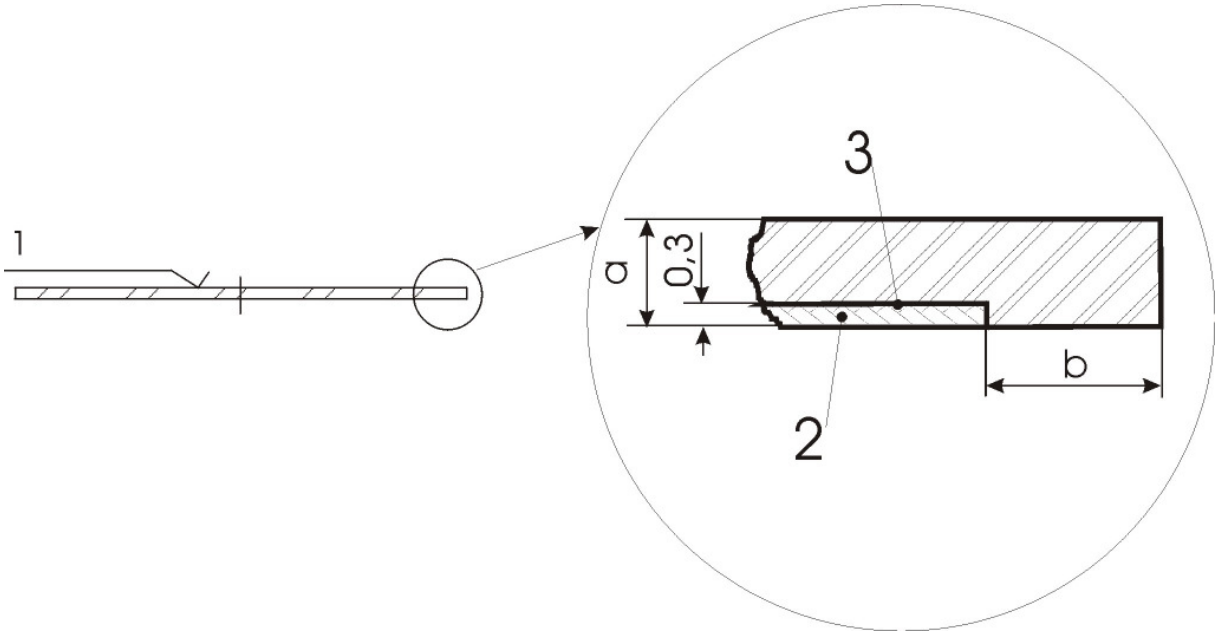
Top view of reference emitter



D: Active diameter = 45 mm
Total size: Ø 50 mm x 3 mm

Cross-section of the reference emitter



1. Imprint
2. Eloxided aluminum foil
   Thickness of the active coating: about 5 µm
3. Attached with Epoxy

a. Thickness: 3.0 mm
b. Inactive ring: 2.5 mm