Hidex Automatic Gamma Counter

User Guide

Note! This equipment must be installed and used in accordance with the manufacturer's recommendations. Service must be performed by personnel properly authorized by Hidex Oy. Failure to follow these instructions may invalidate your warranty and/or impair the safe functioning of your equipment.

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1 System Introduction

1.1 General description

Thank you for choosing the Hidex AMG Automatic Gamma Counter (Hidex AMG).

Hidex AMG is a high performance automatic gamma counter controlled by PC software and conveniently operated by means of a touch screen. To measure nuclides emitting gamma radiation, the user just needs to load racks of sample vials into the counter and specify an appropriate measurement template. A measurement template includes specification of counting time, counting window and counting efficiency, and is usually nuclide-specific. Measurement of background and its subtraction from count results allows the calculation of corrected counts or counts per minute (CPM).

Fully loaded, the counter accepts 12 large or 22 small vial racks on the conveyor. The bigger racks hold 6 vials of up to 28 mm diameter, while the smaller racks hold 10 vials of up to 13 mm diameter.

The device transfers vial racks automatically to the load position from which the vials are moved one by one to the detection chamber and back to the rack after the measurement. Hidex AMG reads each barcode to identify the specified protocol.

The detector unit is located under lead shielding and consists of a three-inch diameter sodium-iodide crystal, a three-inch photomultiplier tube and detector electronics.

An optional balance unit allows automatic calculation of activity per mass of sample. If samples are identified with the help of sample vial QR codes then with an optional sample vial QR reader these ID's can be incorporated in the results improving traceability.

The counter software can also import any required sample data, and, after measurement, result files can be automatically exported to Microsoft Excel®.

An optional Security module provides support for 21 CFR part 11, including user account management and a full audit log.

For users who prefer not to use a touch screen, the user interface can alternatively be operated with a PC keyboard and mouse.

Note! This user guide presupposes that a touch screen is being used, and therefore employs terms like "touch" or "gently tap". When a keyboard or mouse is used these terms should be understood to mean place the curser at the location referred to and click with the left mouse button.

1.2 Purpose of this document

The user guide will provide the information you need to get the most out of your Hidex AMG.

Chapter 1 provides a brief description of the product, while chapter 2 deals with system unpacking and installation, and includes instructions for starting up and shutting down.

Routine operation is explained in chapter 3. *Operating the instrument*.

To provide more comprehensive information there are then dedicated chapters on specific features and options. There are also chapters on troubleshooting and routine maintenance and, for your convenience, a list of radionuclides is included.

Note! This handbook has been prepared for software version 1.8.0.0. Later releases will include additional functionality, and certain operations may be subject to change.

2 Unpacking and Installation

2.1 Instrument environment requirements

Standard laboratory conditions usually provide a suitable operational environment. However, there are few matters that are useful to keep in mind. The laboratory temperature should ideally be constant and around 22 ºC, with humidity preferably between 40% - 65%. Also avoid keeping the instrument in direct sunlight. Depending on the stability of the mains supply, utilizing an Uninterruptible Power Supply (UPS) is recommended. With the optional balance the air-conditioning needs to be taken into consideration.

2.2 Unpacking the instrument

Each instrument can be supplied with an external PC. The computer is integrated with the touch screen, which can be placed beside the instrument on the laboratory bench.

All the necessary cables and accessories are delivered with the instrument. Please make sure that the instrument and PC/touch screen are turned off before connecting the cables.

Please follow the instructions to unpack the instrument

- Cut bands, open box and remove packaging material around the instrument.
- Remove the smaller boxes containing auxiliary components.
- Unpack the auxiliary components, such as cables, power supply, etc.

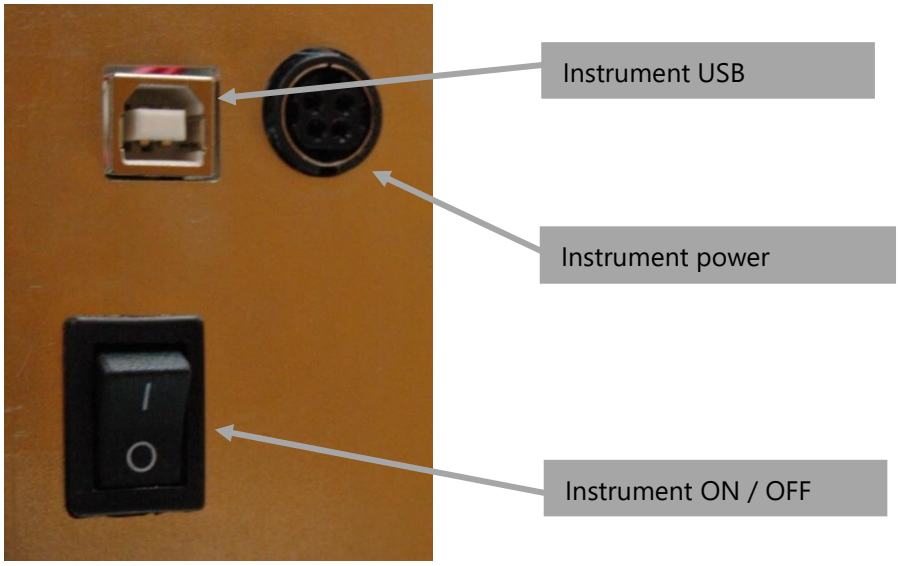
The package includes the following items:

- Hidex AMG instrument and standard set of racks and holders for the samples.
- USB stick with user interface, service software and user guide.
- Power supply 100-240V/24V including mains cable kit for Europe, UK, or US.
- USB cable (instrument/computer).
- Hidex AMG Quick installation guide
- Touch screen computer with user interface, service software and user guide (optional)

Place the Hidex AMG instrument on a suitably strong and firm structure at roughly table height. The instrument weighs approximately 198 kg. The computer and touch screen can be set up next to it.

2.3 Powering up and connecting the instrument

1. Connect the power supply (transformer unit, supplied with the instrument) to the instrument, and connect the power box to the mains using a grounded connection.



Note! Whenever disconnecting the power cable, please note that the connector is equipped with a cable strain relief, and must only be detached by releasing the lock, sliding the connector mantle backwards.

2. Switch the instrument ON/OFF button to ON.

3. Connect the PC power supply (transformer unit, supplied with the PC) to the computer, and connect the power box to the mains using an earthed connection. Turn the computer on.

4. Connect the USB cable from the instrument to the computer (see picture above).

The Hidex AMG instrument is now set up and connected to the PC and touch screen; both the instrument and PC are switched on.

5. Start the Hidex AMG Service communication from the Windows Service listing. If you do not know how to do this, please see section 11.2.

6. Start the user interface by touching the Hidex AMG User Interface icon on the touch screen.

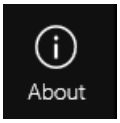
If you are the first user of the software, and if the Hidex AMG Security module is installed, please consult chapter 6 of this manual.

If you are using a printer, install it according to the manufacturer's instructions. All printers compatible with Windows 7 or later are suitable (USB or network connection).

The Hidex AMG user interface software is factory installed on the PC supplied with the instrument. The software is designed to be controlled by touch screen or alternatively with a standard keyboard and mouse (supplied with the computer). If you wish to use a standard PC keyboard and mouse, please connect them to the computer (note that some models are equipped with wireless keyboard and mouse).

3 Operating the instrument

3.1 Instrument information

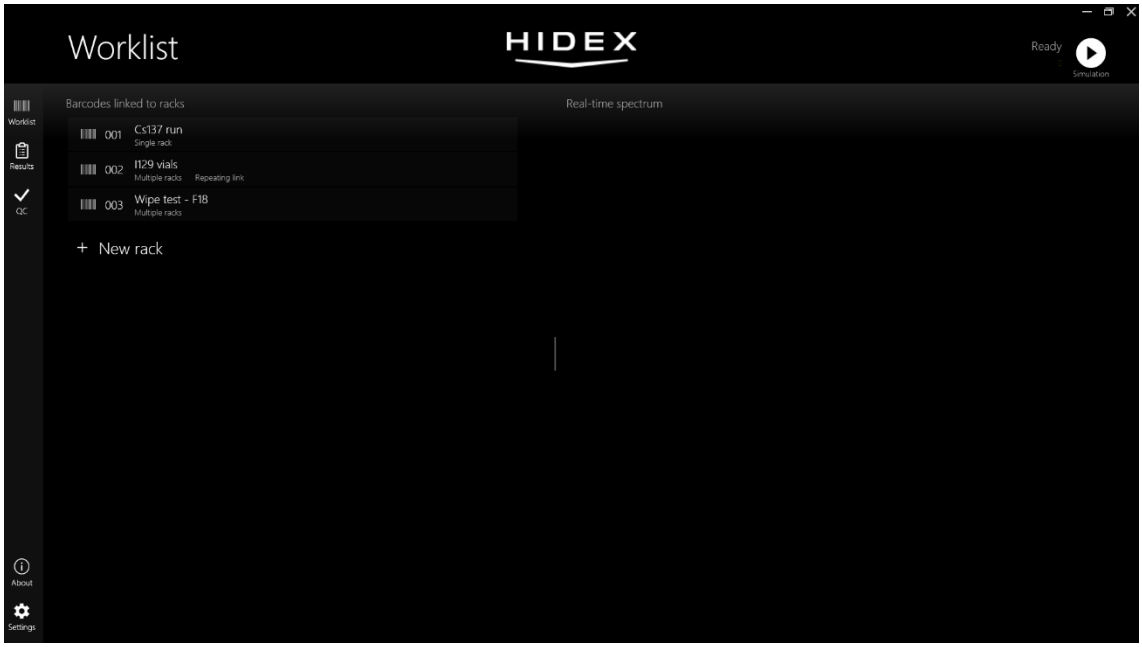


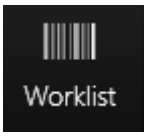
Instrument information can be found in About view.
The about view can be accessed by tapping on About button on the left side of the software user interface.

In the about view basic information of the instrument, including serial number and user interface version information can be found there.

3.2 Opening the Worklist view

When you start the software, the first screen that appears is the Worklist view.





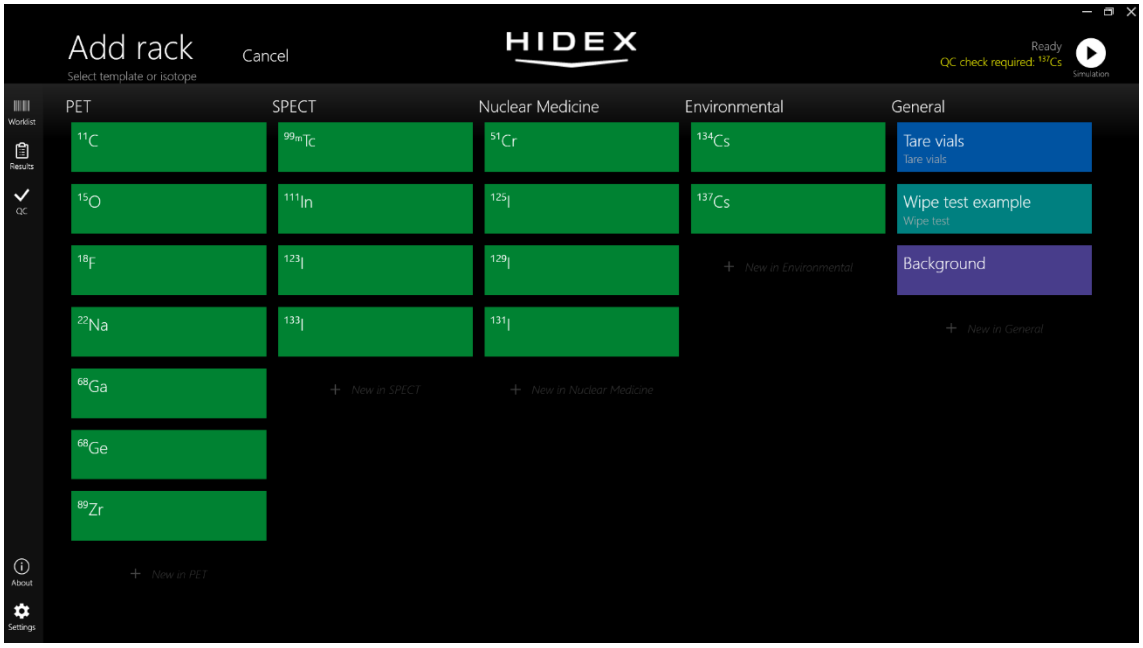
This view can always be accessed when tapping on Worklist button on the sidebar.

It is assumed that when you start the software, you will usually have one or more racks of sample vials that you have prepared and wish to count.

3.3 Selecting a counting template for your rack of samples

Supplied with your counter are several templates containing default settings for measuring various nuclides. These can be used as a basis if you want to create your own template. You can see the choices available by tapping the + New rack button on the screen.

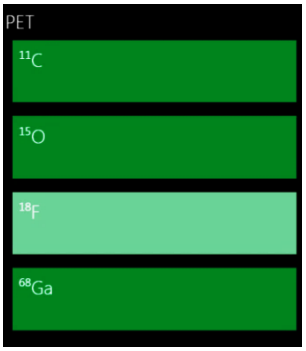
In the image below we see the templates initially supplied with the product as factory settings. You can choose one of the existing templates by simply touching the appropriate green box. Alternatively you can modify a template or create a new template and save it with a different name.



The templates are grouped into four application areas:

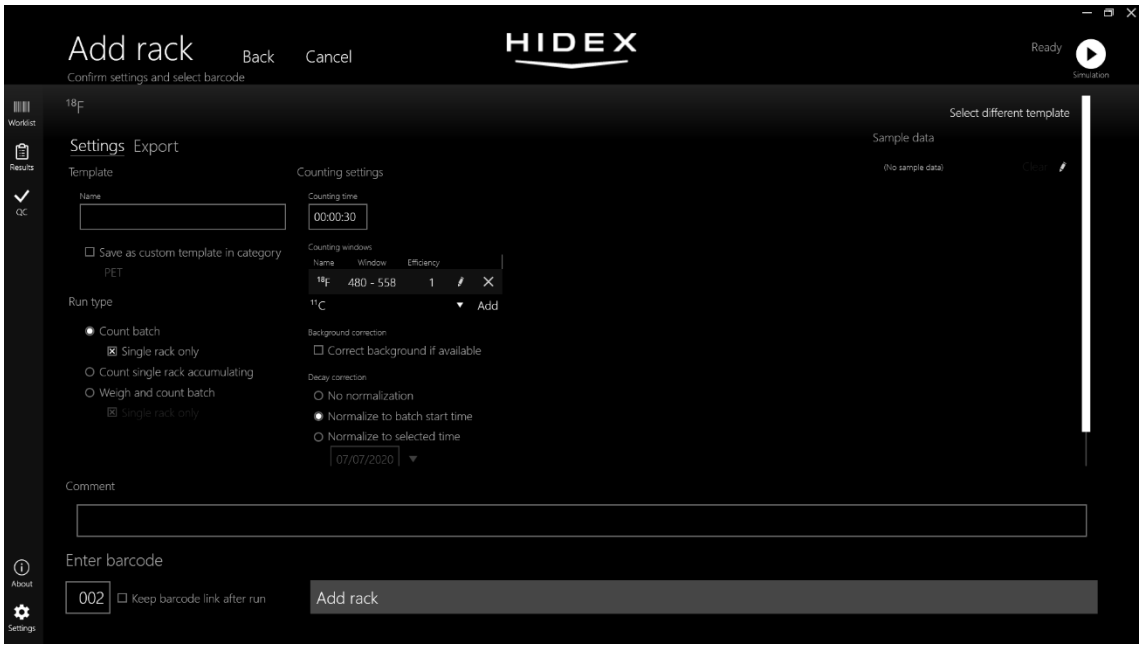
- PET (positron emission tomography)
- SPECT (single-photon emission computed tomography)
- Nuclear Medicine
- Environmental

The fifth grouping, on the right, *General*, is for templates that allow you to make tare settings, show custom templates, QC templates and background run settings. More information about tare settings and use of balance is to be found in chapter 8 *Balance* on page 49.



For the moment, let us assume that we are working with a PET application and wish to measure the ^{18}F nuclide.

Tap lightly on the appropriate ^{18}F template area.



You are now given the opportunity to accept the default settings for the ^{18}F template, or edit it to meet your specific needs.

If you wish to make edits, you can specify a name for the modified template.

3.4 Specifying run type

Under Run type, you will see that there are four options:

- Count batch
- Count single rack accumulating
- Weigh and count batch. (with balance option)

3.4.1 Count batch

Count batch is used if you do not wish to measure the mass of the sample.

The Single rack only box should be checked if there is just one rack of samples; if this box is not checked, multiple racks will be assumed.

If the number of samples you have ready to be measured with the same template extend to more than one rack, you should specify multiple racks. You then need to attach a specific barcode ID plate to the first rack. All consecutive racks following without their own barcode ID will then be measured with the same template and results saved into the same file.

If you have specified, multiple racks, you will be reminded of this when you look at the Results view. A blue dot will be visible next to the time.

The counter will continue to apply the template to new racks until a new barcode ID plate is recognized or a stop rack has been introduced.

Note! Results will only be exported when the batch is closed with a stop rack or the batch has been manually closed from the results view.

3.4.2 Count single rack accumulating

Sometimes there may be a time interval between the arrival of your samples for counting.

If, for example, you wish to count one or more racks using a particular template one morning, and know that more samples will be arriving in the afternoon, choose Count single rack accumulating.

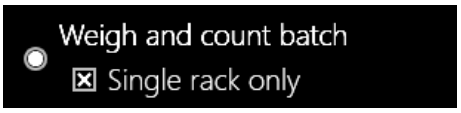
After counting the available racks, you can then use the counter for other jobs until the afternoon samples arrive. Then the new racks can simply be loaded onto the conveyor, and the results will be added to those for the previous rack.

When accumulating results in this way, you must remember to put the specified barcode ID plate on each rack that you want measured with the same template.

As your samples are processed, a blue dot will be visible in the Results view next to the time, and the text, Accepting additional racks will appear under the details of the sample that is currently being counted.

Note! Results will only be exported when the batch has been manually closed from the results view.

3.4.3 Weigh and count batch

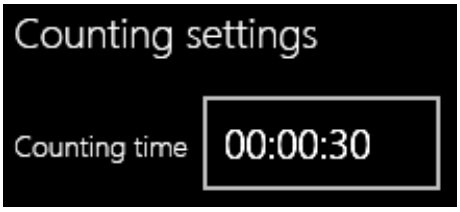


If your Hidex AMG instrument is equipped with a balance, and you have already obtained the tare measurements, Weigh and count batch will allow you to measure both mass and activity.

Use of this setting is similar to that of Count batch and Tare batch (see also chapter 8 *Balance, page 49*).

3.5 Counting settings

3.5.1 Counting time

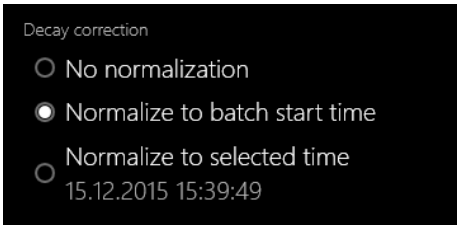


The default setting of 30 s can be overwritten with a longer or shorter counting time specified as hh:mm:ss.

Minimum time for a measurement is 1 s and the longest is 49 d.

3.5.2 Decay correction

There are 3 possible choices regarding decay correction.



You can choose not to correct for the decay of your samples by choosing No normalization.

With Normalize to batch start time (the default in templates) you will perform decay correction to the start of measurement of the first vial of the batch.

If you wish to have normalization based on a specified sampling time then the option Normalize to selected time should be used. Then you can supply both the date and time for which the decay correction should be calculated.

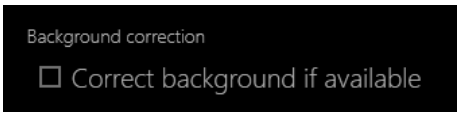
Default templates for nuclides are factory made to include half-life time definition and this is automatically used with decay correction when one of these nuclide templates is used.

Note! Correction is made from the measurement end time for the specific vial.

3.5.3 Background correction

Results may be background corrected once the background measurement has been performed.

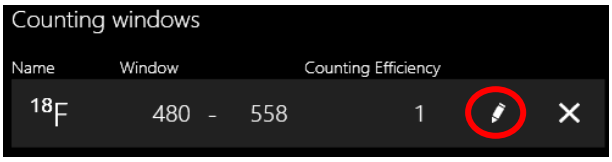
To subtract the background from the sample results this needs to be defined in the template settings before the actual measurement. When using background subtraction the most recent background run is used for the correction. Only the background counts for the area of the defined counting window in the template will be used.



It is possible to choose to use background subtraction for the sample result.

Note! The background run needs to be run before the actual measurement. The most recent background run will be used for subtraction.

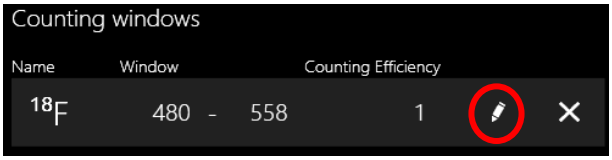
3.5.4 Counting windows



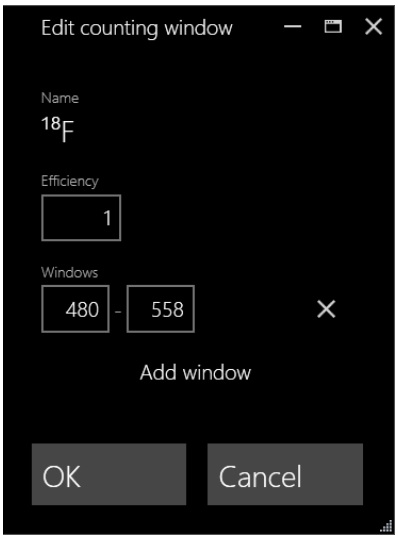
Under **Counting windows** you can adjust the default values for the window and the counting efficiency. Just tap the **Edit pen** and type in new values. Remember to accept the values and save them.

You can also use the **Add counting window** button to specify a specific window. (see *Working with multiple counting windows*).

3.5.5 Counting efficiency



Under **Counting windows** it is also possible to adjust the default values for the counting efficiency. Just tap the **Edit pen** to open the settings.



Type in new values and tap **OK** icon to accept them.

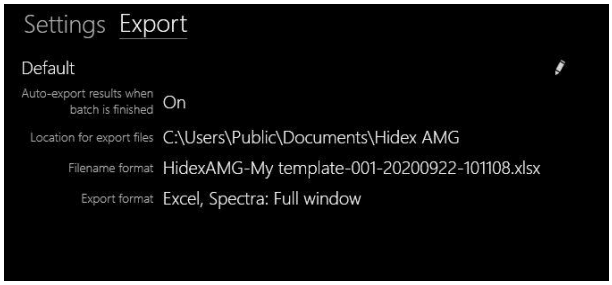
If you wish to make permanent changes to counting efficiencies this can be done from the factory settings. This is explained later in section 3.11 Permanent edits to default factory templates.

Note! Efficiency value is by default 1 (equals 100%). Isotope efficiency is put in absolute efficiency.

3.6 Results export settings

3.6.1 Default export settings

From Export tab it is possible to view the default export settings and if needed edit them to be template specific.



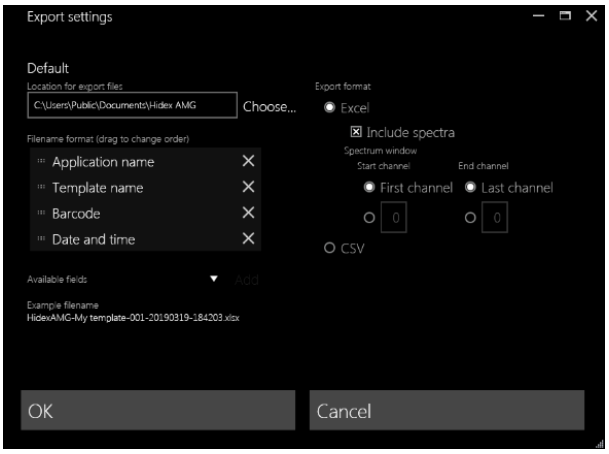
There is a default folder to which the results are exported.

The folder is in the user documents folder.
C:\Users\Public\Documents\Hidex AMG.

The default setting includes automatic export when a batch is finished. Export settings can be made template specific.

3.6.2 Template specific export settings

By tapping on the Edit pen it is possible to edit the chosen export path, result file format and also result file naming format.



By tapping on Choose... you can browse to find the folder you want. The location can be set to be template specific.

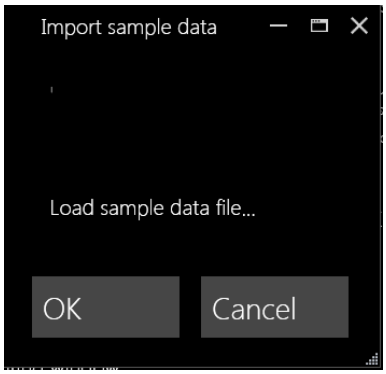
In the settings it is possible to set the format of the export file name by simply dragging and dropping the required components. Unwanted parts of the file name can also be removed from the format.
The corresponding file name is shown under the listing.

Export settings also cover file format. It is possible to choose Excel XLS- format consisting of spectrum information, in the wanted window region or it is possible to choose CSV- format, comma separated values.

In the settings it is also possible to specify whether the results will be automatically exported or not.

3.7 Importing sample data

In template settings, you will see an own section for **Importing sample data** that can be access by tapping on edit pen.

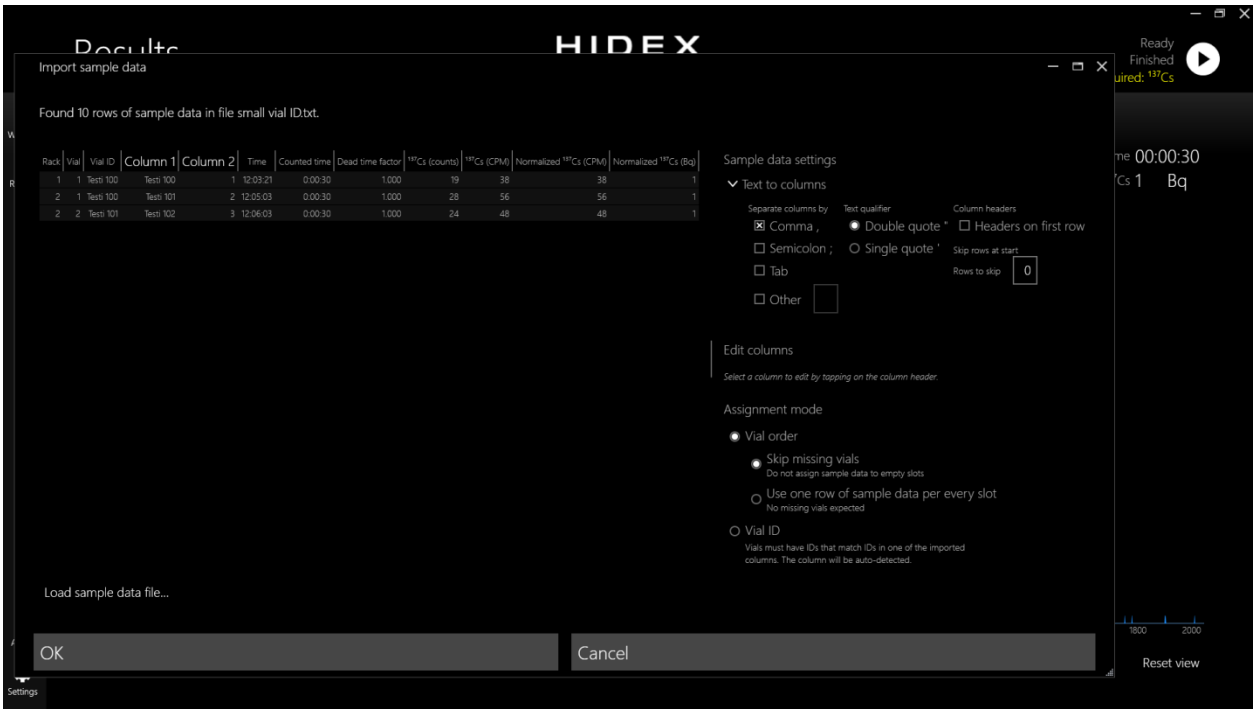


Sample data in Excel, CSV- or TXT- format may be imported by tapping **Load sample data file...**

Choose the appropriate file from your computer. The imported sample data will then be visible on screen.

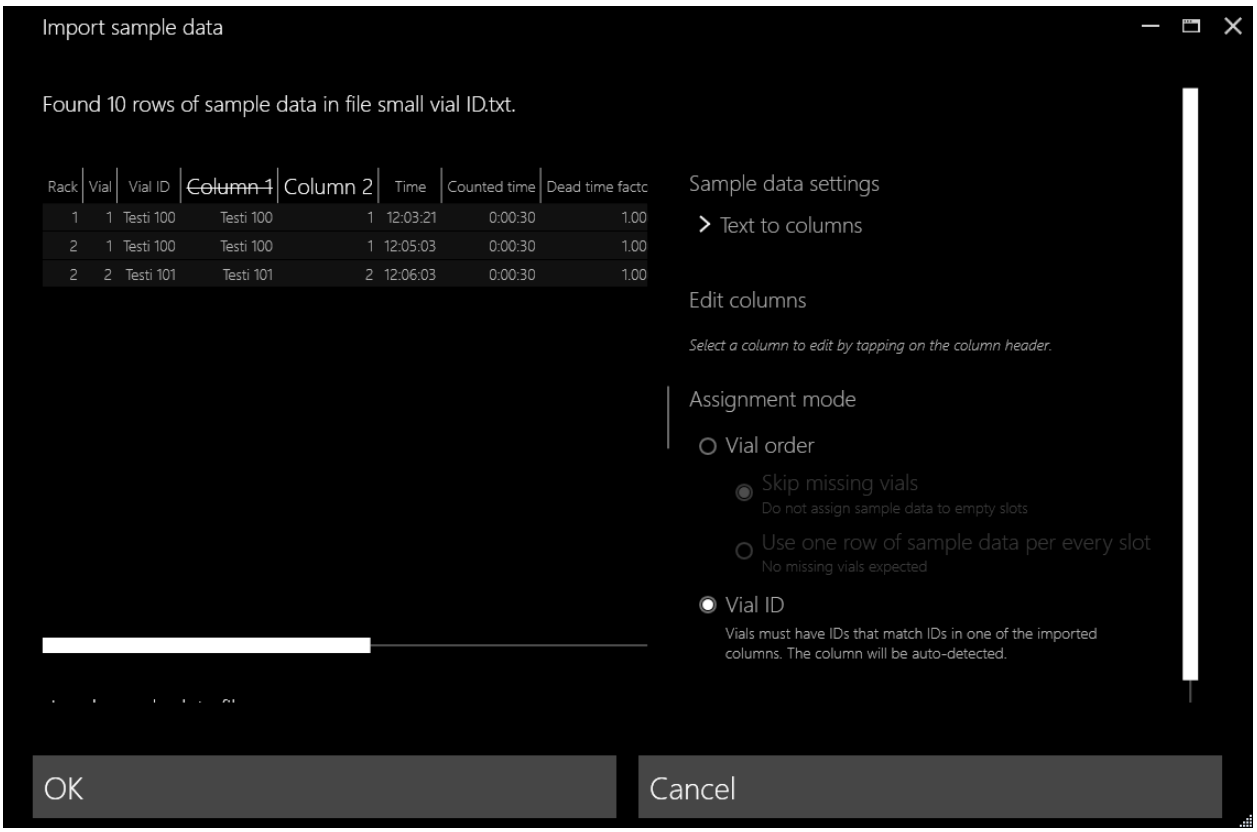
3.7.1 Sample data settings

To separate the sample data correctly under sample data settings it is possible to adjust ***Text to columns*** settings according to Excel settings and also edit the columns with specific names. Assignment mode is chosen according vial order and decide what kind of action will be taken if an empty vial position occurs within the sample batch.



An example configuration of importable sample data is provided with the Hidex AMG, this can be found on the Hidex USB.

If an optional sample vial QR reader is used it is possible to assign additional sample ID information according to Vial ID. Then the vial ID's are recognized in the imported sample data file. The vials must have matching IDs as imported in the file.



3.7.2 Replicate sample data

In case replicate samples are measured it is possible to in addition to sample data information to define replicate samples so that results statistics will be calculated with the results.

When wanting to define replicates, create a data file with replicate information in one column. This can be done by naming all replicates with the same sample ID.

When the sample data file has been imported into the software and a specific template the identification of replicates is done by tapping on the wanted column and then specifying that in this column is sample ID column.
When measuring the software will then show replicate statistics separately including the number of replicates, calculating the average value for the samples and cv% of the replicates. A separate sheet consisting of replicate results will be exported in to the excel result file.

3.8 Accepting the template settings

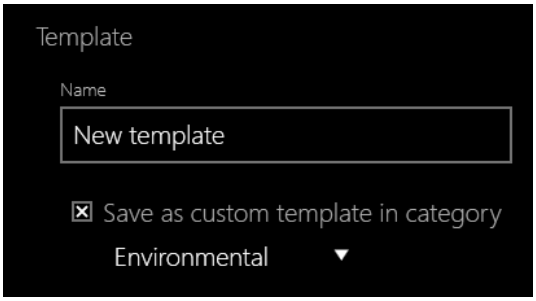
3.8.1 Keep barcode link after run

Before you accept the template settings, you can choose whether the link between this template and the barcode you are going to choose will be permanent.

Keeping the **Keep barcode link after run** box checked (the default setting) ensures that vials placed in the specified rack will always be measured with the specified protocol. If the box is unchecked, the template will be run once and then deleted from the worklist.

On the worklist linkage will be shown as **Repeating link**.

3.8.2 Saving as custom template



If you plan to use an edited template more than once, the **Save as custom template in category** box should be checked (see the section on *Creating a custom template*).

When a template is saved in this way a new template box is created in the library with the specified template name.

3.8.3 Add rack

Having made all the appropriate settings, you are now ready to link to a rack by touching **Add rack.**

The next available barcode, which is here 002, will be associated with your rack. If you wish to supply a different rack code, before touching **Add rack**, type the required code into the barcode box.

After you have accepted the settings with **Add rack**, you will be returned to the updated **Worklist screen**, from which you can run the rack.

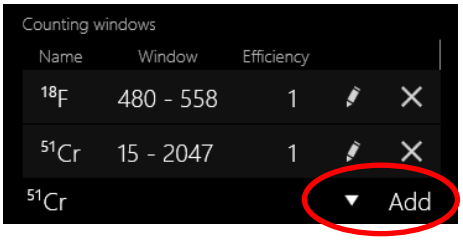
3.9 Other template editing possibilities

3.9.1 Working with multiple counting windows

As mentioned earlier, Hidex AMG supports the use of multiple counting windows. By counting a sample in two separately specified windows you have the freedom to focus on specific regions of interest or process multiple nuclide assays.

For example, if you want to measure a sample with multiple nuclides present (in this example ^{137}Cs and ^{51}Cr), first proceed as described earlier (in section 3.3 *Selecting a counting template for your rack of samples*, page 11) choosing a template for one of the nuclides, eg ^{137}Cs.

After making any required modifications to the template, below counting windows section, touch the arrow.



From the dropdown list touch ^{51}Cr and then tap on the text **Add**.

The dropdown list includes all default factory set nuclides.

The full list of available additional counting windows includes a custom window, **Free**. When selection a Free window it can be set to any desired window. You can also give a name to the new window setting.

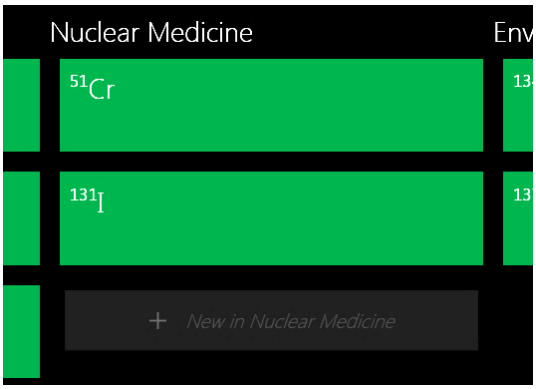
Note! Decay correction cannot be implemented with the custom Free window.

3.9.2 Creating a custom template

If you find that no suitable template is available for your samples (see *Selecting a counting template for your rack of samples*), you may create one.

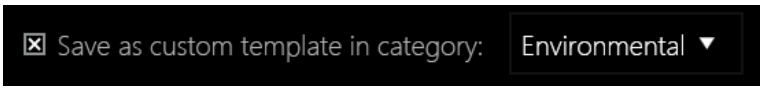
First choose New rack to get to the screen showing the currently available templates.

If, for example, you wish to create a new template for Nuclear Medicine, tap on the appropriate button,
+ New in Nuclear Medicine.



Supply appropriate values for the desired counting time, and edit the counting window and efficiency values. Then supply a name for the new template. You will receive on-screen guidance if you make an omission or incorrect setting.

If you plan to use the new template just once, and with a particular set of samples the Save as custom template in category box should not be checked.



If, however, you wish to save it, the box should be checked before you tap OK to approve the settings. The new template is then available for use and a rack barcode may be linked to it.

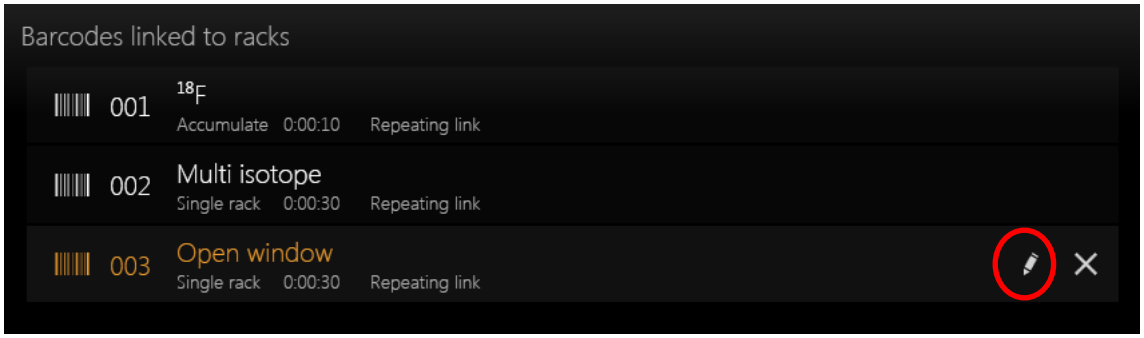
The new custom template will also be available for future use via the Add rack screen.

3.10 Editing templates

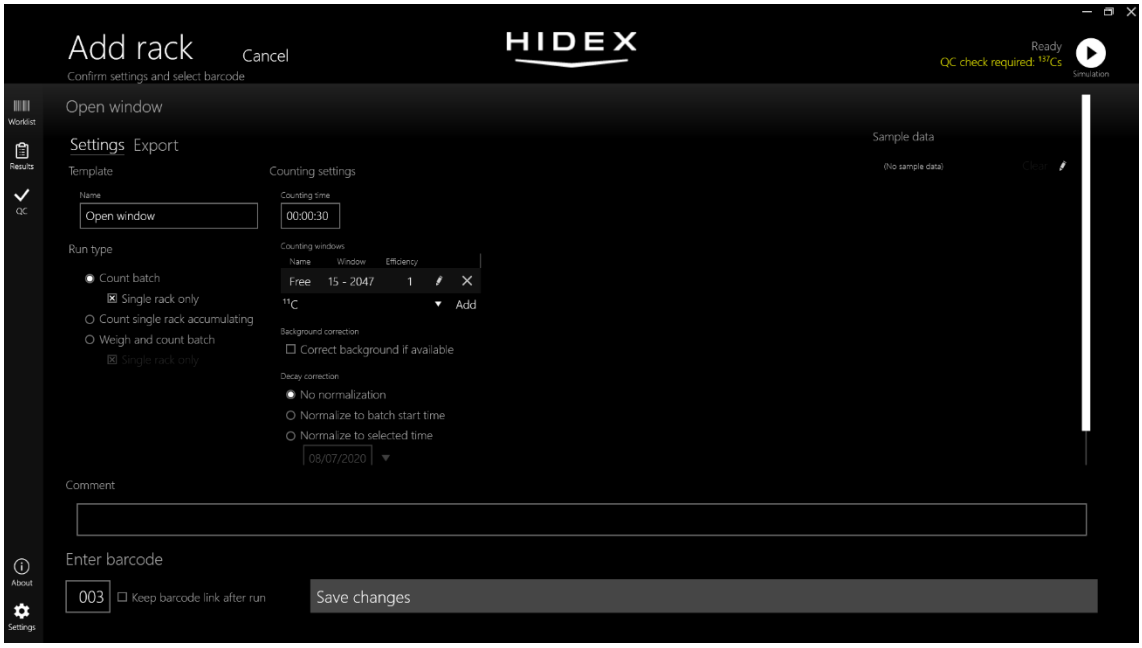
3.10.1 Editing templates on the worklist

It is possible to edit saved templates that have a barcode linkage directly from the Worklist view.

Activate the desired template by tapping on it to highlight it. Then tap on the Edit Pen image.



Tapping on the **Edit Pen** image will open the template settings. It is possible to edit every setting from here. When all necessary changes have been made, tap **Save changes**.



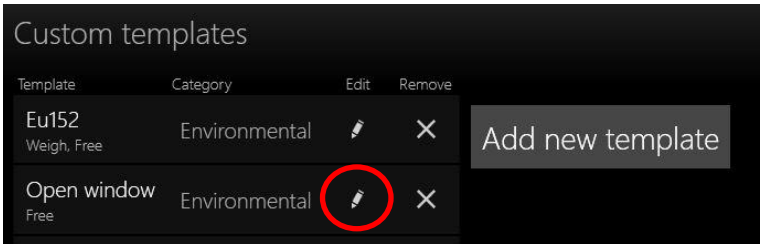
Note! Changes can be made during a measurement, but will **not** come into effect until the next measurement that is started after changes have been made.

3.10.2 Editing saved custom made templates

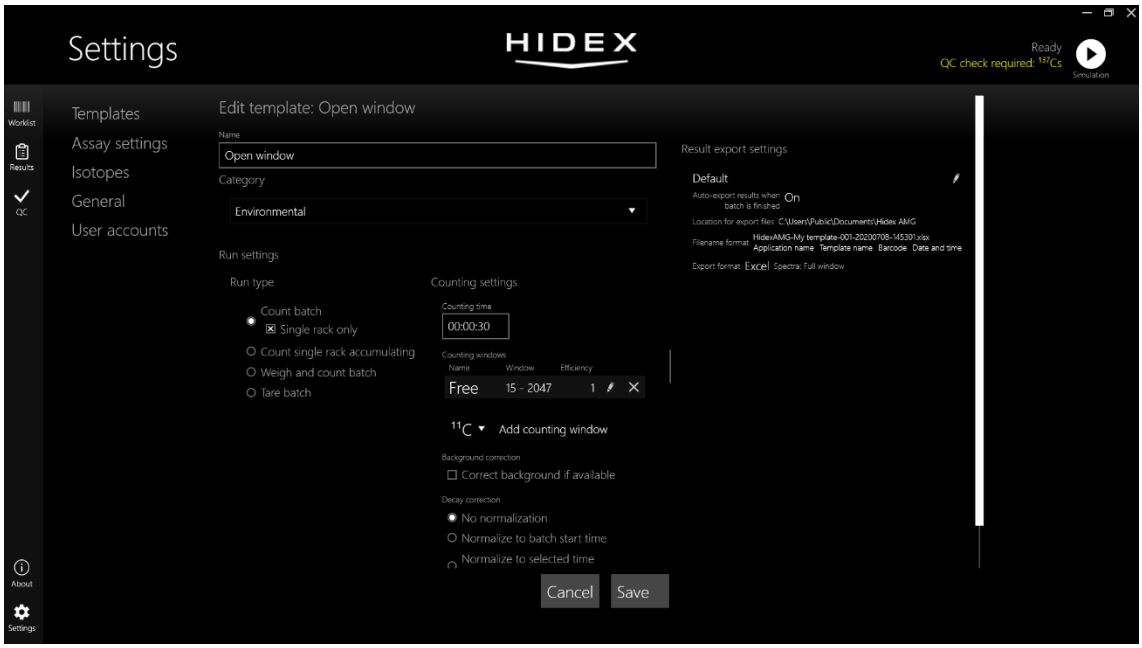
Custom made templates that are saved in the library can be edited from the **Factory settings view**.

Open the **Factory settings view** by tapping on **Settings**. Then open the **Templates** tab.

To make changes to a specific custom made template open up the template by tapping on the **Edit pen**.



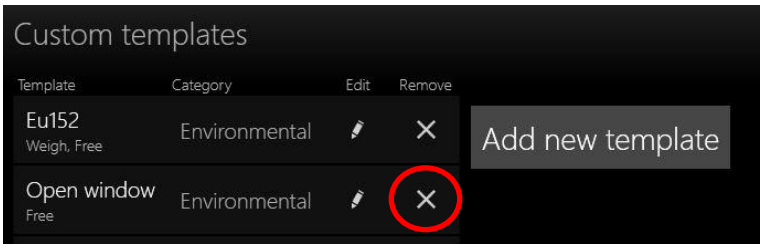
The settings for the specific template are opened. Make the necessary changes and then remember to save by tapping **Save**. Next time the template is used the new settings are used.

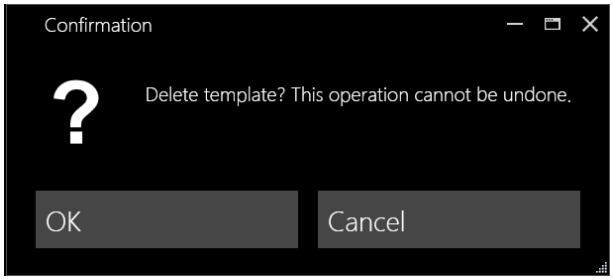


3.10.3 Removing saved custom made templates

Removing an existing custom made template is also done from the **Factory settings view**. Tap on **Templates** to open up the listing of all custom made templates.

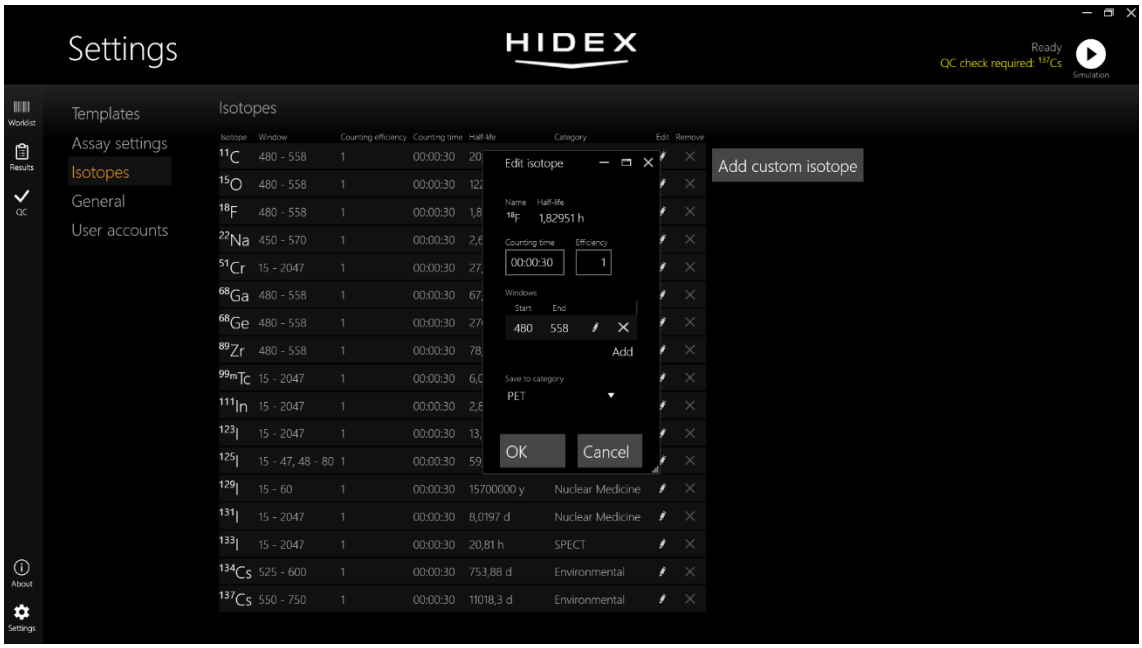
To permanently remove a specific template choose the wanted template and tap on **X** to **Remove** it. Confirm the removal of the template. When you go to the **Add rack** view the next time the template will have been removed from the library.





3.11 Permanent edits to default factory templates

Should you wish to make lasting changes to the supplied templates or create a custom template, you need to access the table of nuclides by opening the Isotopes tab from the Factory settings view.



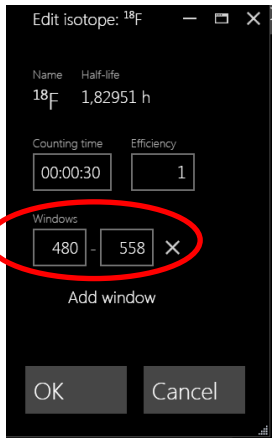
You can then edit any nuclide by touching the Edit Pen button for it and making the desired changes. Remember to tap OK to save changes.

Note! The changed settings will only come into effect directly, also into existing templates with default isotopes.

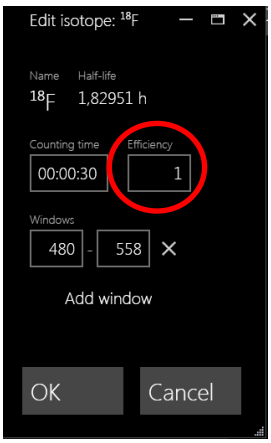
3.11.1 Default counting window

You can make changes to the default counting window settings provided when choosing an isotope in the Add rack view and template settings.

Set the lower and upper window channel and counts will be reported from this region of interest in the result files.



3.11.2 Default counting efficiency



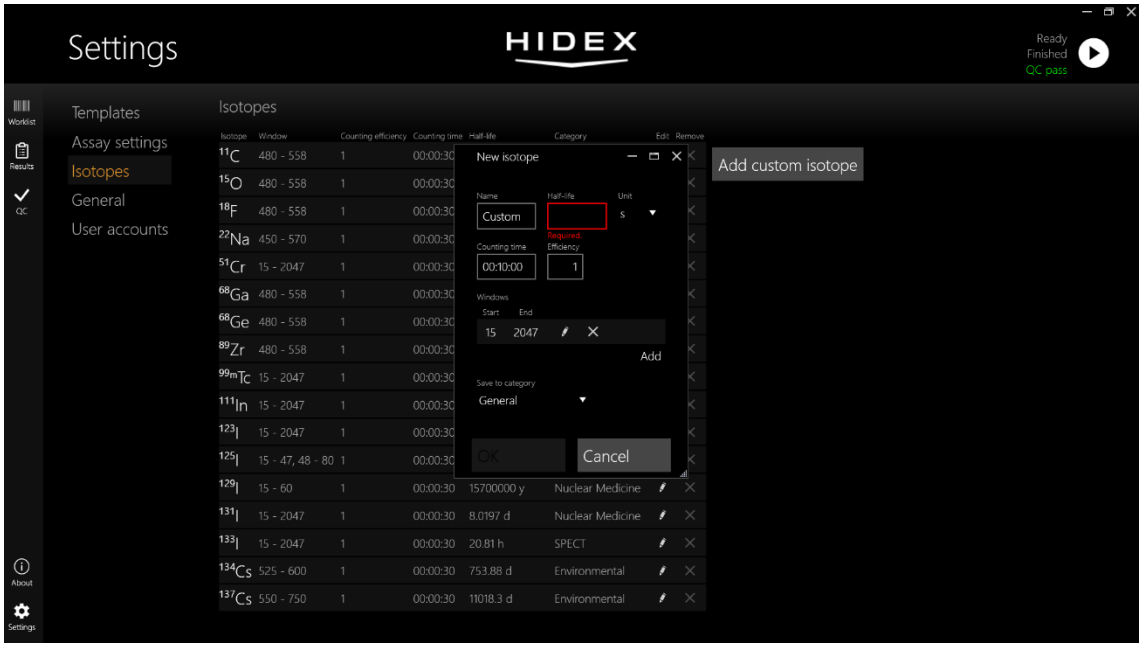
The efficiency value is input and in measurements where the isotope windows is used afterwards the new defined counting efficiency is also used.

To define the actual counting efficiency there is a radionuclide list in the manual in section *Radionuclides list* providing an estimated open window efficiency for a set of isotopes. When using a narrow isotope peak window then the actual efficiency should be determined by measuring a known activity and calculating the efficiency.

Default efficiency value 1 equals 100%.

3.11.3 Custom isotope

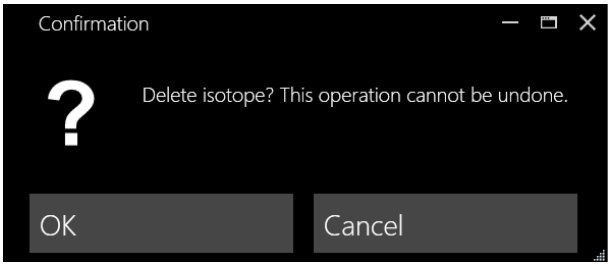
It is possible to create new custom isotopes by opening the Isotopes tab from the Factory settings view and tapping Add custom isotope.



Supply a name, the window values, efficiency and counting time. With the custom isotope the half life time with time unit also needs to be defined in order to activate it.

When you have made these entries, remember to save by tapping on the OK box. The new custom isotope is then added to the Add rack view.

Any user-created isotope can be deleted by tapping the white cross on the right, in the view above. Factory templates cannot be deleted.

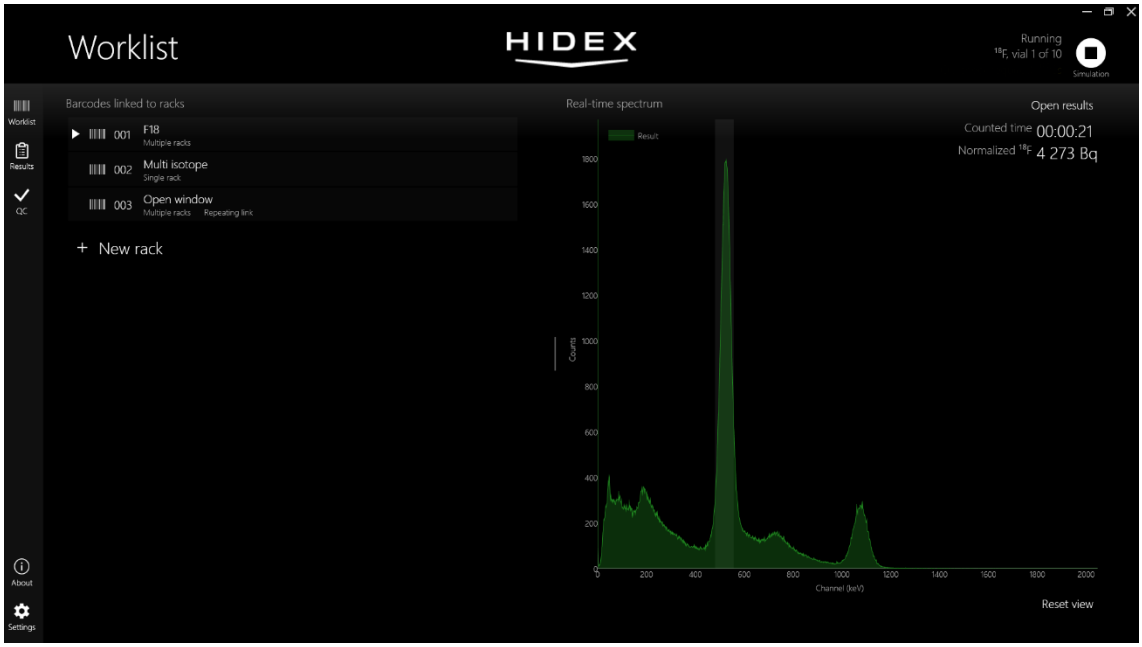


3.12 Performing measurement

To run the rack or racks you have set up, tap the Start button in the upper right corner of the screen.

Counting will start after performing mechanical initialization.

In the upper part of the view the status of the instrument is described. While a measurement is ongoing the information box in the top section of the view will read Running and tell you what vial position of a rack is being measured at that time.



During the measurement it is possible to look at the live spectrum. The spectrum is visible in Worklist view.

You can see the developing results for the sample currently being counted, including a plot of the developing measurement spectrum. The plot remains green while counting is progressing, and changes to blue when the counting time for that vial has been reached.

3.13 Stopping the measurement

If the worklist includes linked templates the instrument will run continuously until a new rack is detected. There are three ways of stopping the instrument.

1. By means of a STOP rack. The STOP rack will be taken into the measurement position and then returned to the conveyor. Counting will terminate.

2. By tapping the Stop button in the top right corner of the touch screen. The current measurement will be terminated and counting will stop.

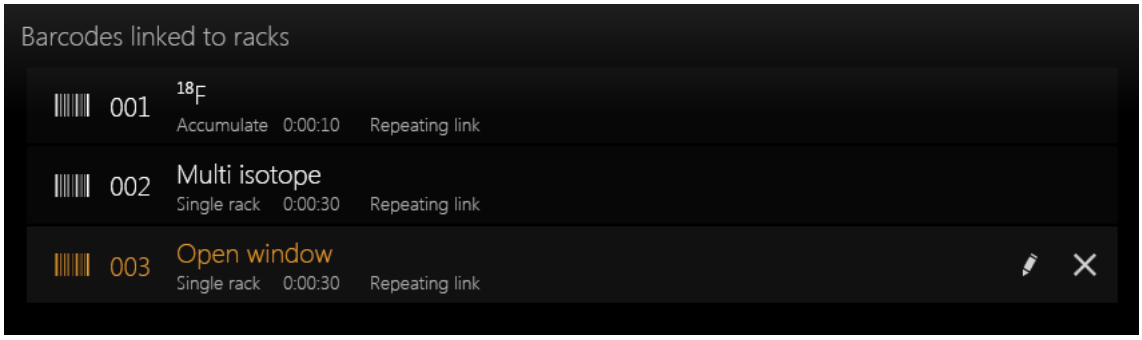
3. Additionally, if the templates used are all single rack measurements saved without keeping the barcode link, the counter will stop when the predefined templates have been run.

3.14 Deleting barcodes linked to racks

☒ Keep barcode link after run

A template with Keep barcode link after run checked, will not automatically be removed from the Worklist view after it has been run.

To remove it, and sever the linkage between that template and that particular rack barcode, go to the Worklist screen.

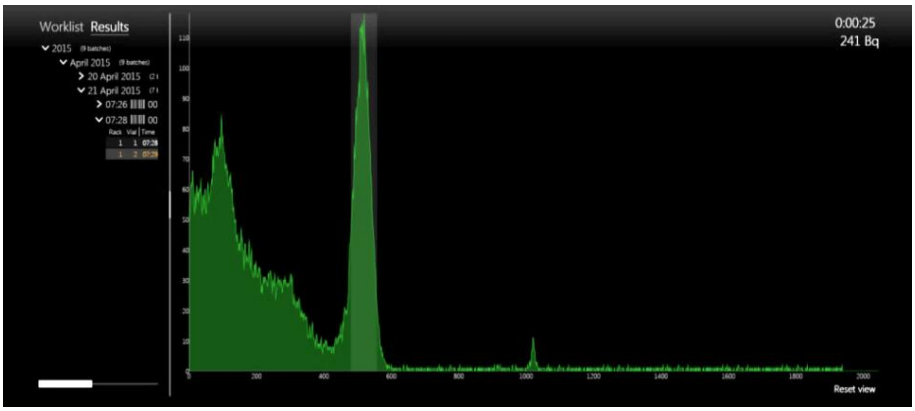


Under Barcodes linked to racks touch to select the barcode link that you wish to delete. Tap the X mark to delete the link.

Note! The template will be deleted directly. There will NOT be a secondary pop-up window for confirmation.

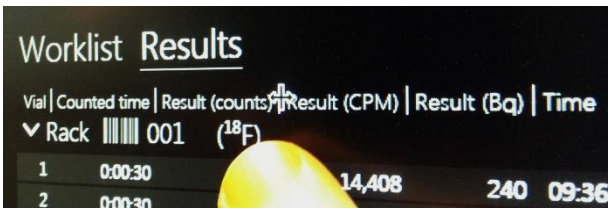
3.15 Adjustments to the Worklist and Results views

In both Worklist and Results views, you can adjust the size of the plot and make other modifications to the layout.



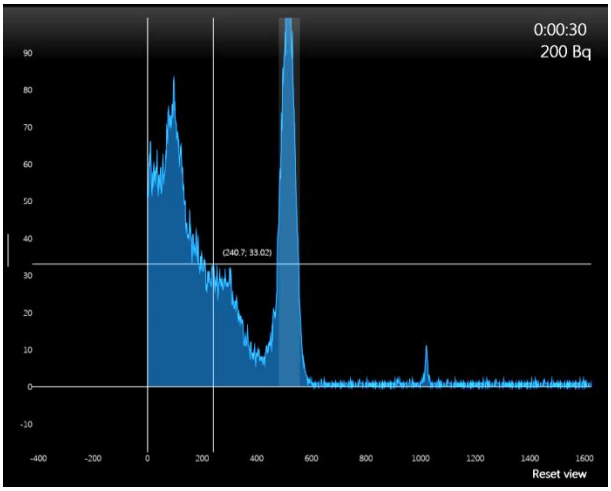
If, for example, you would like to make the plot wider, touch and drag the vertical bar to the left of the plot. When you touch the screen the bar will be highlighted and lengthened and arrows will appear directing you to drag it either left or right.

Other layout changes, for example, changes to the column widths in the results presentation, can be made in a similar way, by touching and dragging.



3.16 Investigating the plot

You can obtain the co-ordinates on a point on the plot by tapping, and can also move the plot by dragging from that point.



To revert to the default position for the plot, tap **Reset view**.

4 Examining and exporting results

4.1 Examining results

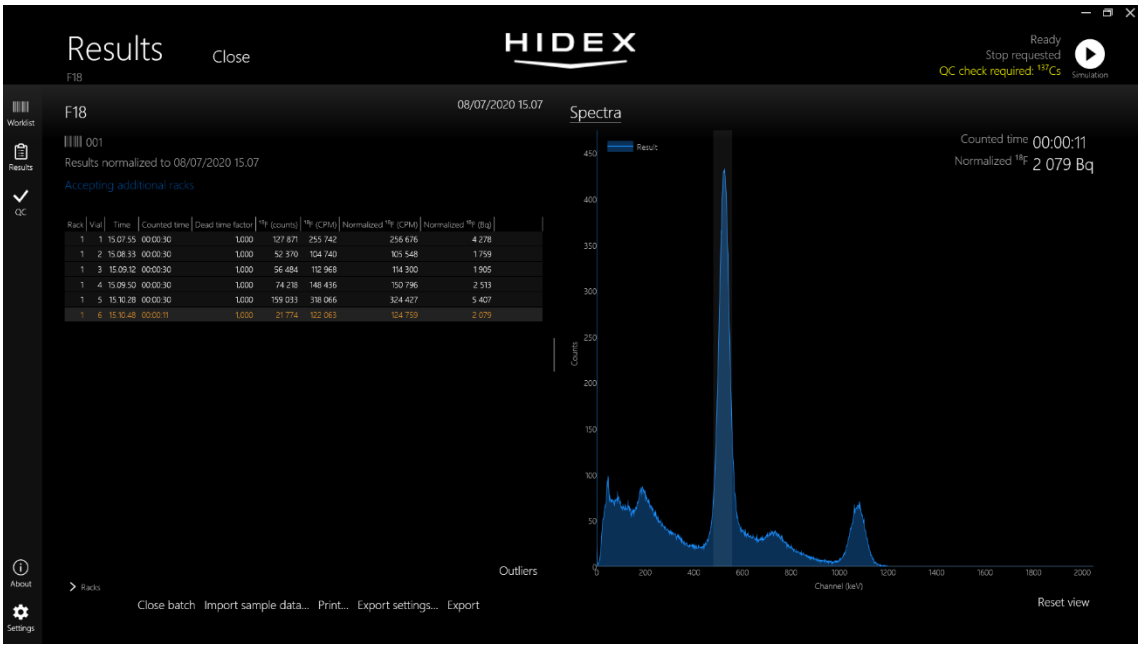
From the Results view it is possible to examine the results with the software and to export the results into an Excel file.

Open results view by tapping on **Results** on the sidebar.

Result view can be viewed either by batch or by racks.

In the basic view the results will be listed according to measurement date and time. The actual results can be opened by choosing the measurement of interest and tapping **Open**.

In the template-specific results view you can see all sample results separately listed according to rack and vial position.



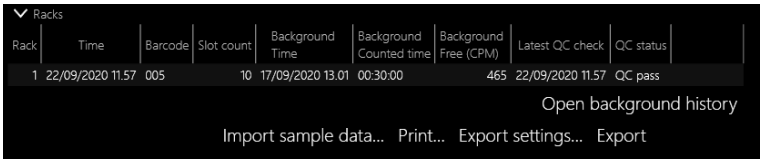
4.2 Results data

In the results, the following values are shown.

Rack number and vial slot position, end time of the measurement of the sample, counted time, dead time factor, raw counts, results in CPM and in Becquerel's. If a background measurement has been done then there will also be background corrected counts. If decay correction is performed the results are also shown as normalized CPM and Becquerel's.

Note! Values shown in the result data are integers. Rounding of values for a specific data is downward to the next integer when the decimal part of the actual value is <0.5 and upwards to the next integer when it is ≥ 0.5.

If a background measurement is done, the values used to correct the results will be shown under the actual sample results.



On the right side of the view the spectrum of a specific sample is presented. The full spectrum is shown with the counting window setting for the specific measurement highlighted in grey. Also results will be shown in the upper part of the spectrum.

4.2.1 Result calculations

In every calculation step all existing decimal places are used. Rounding is only done to show the specific data value.

The Hidex AMG user interface calculates results as follows:

Counts are calculated directly from the spectrum according to the template window (region of interest) setting.

$$Counts = \sum_{first\ channel}^{end\ channel} counts\ per\ channel$$

If background correction is used then the background activity is corrected to the same counting time and also to the specific counting window as the actual sample measurement and then subtracted from the counts to give corrected counts.

$$Bkg\ corrected\ counts = counts - background\ counts$$

$$Background\ counts = \sum_{first\ channel}^{end\ channel} background\ counts\ per\ channel$$

Dead time factor correction is based on the dead time of the electronics and actual activity. The Dead time factor is shown corrected to a maximum of 3 decimal places but calculations are performed using the uncorrected value.

$$Dead\ time\ factor = \frac{counted\ time}{counted\ time\ (\ dead\ time * total\ counts)}$$

To get CPM values the dead time factor and counting time are used. When background subtraction is performed the corrected counts are used to calculate the CPM.

$$measured\ CPM\ = \frac{(bkg\ corrected)counts}{counted\ time\ (s)/60} * dead\ time\ factor$$

If half-life correction is used in the template then decay correction with the set half-life time is used to calculate normalized CPM values. The normalized activity can be calculated to the first sample of the batch or to a specific time stamp. The half-life times are fixed values shown in the isotope listing.

$$A_o = A * e^{-(\,0.693t/T1/2\,)}$$

Where

$$A_0 = normalized\ CPM$$
$$A = measured\ CPM$$
$$T^{1}/_{2}\ = half\ life\ time$$
$$t\ = counting\ time$$

Final activity in Becquerels can be calculated based on the CPM values and defined counting efficiency. With decay corrected measurements the normalized CPM value is used.

$$Activity\ as\ Becquerels = \left(\frac{(normalized)CPM}{60}\right) \Big/ Absolut\ efficiency$$

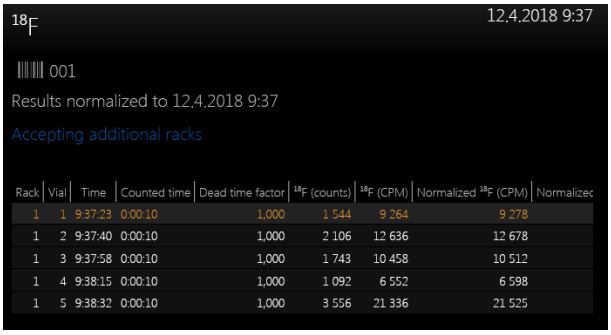
Efficiency can be determined using a standard with known activity

$$\%\ Efficiency\ = \frac{measured\ CPM}{known\ DPM} * 100$$

Note! Efficiency value is not set automatically but need to be specified according sample volume and geometry.

4.2.2 Closing a batch

If you have specified multiple racks, you will be reminded of this when you look at the **Results view**. A blue dot will be visible next to the time.



The text, **Accepting additional racks** will appear in the results file while the batch is open.

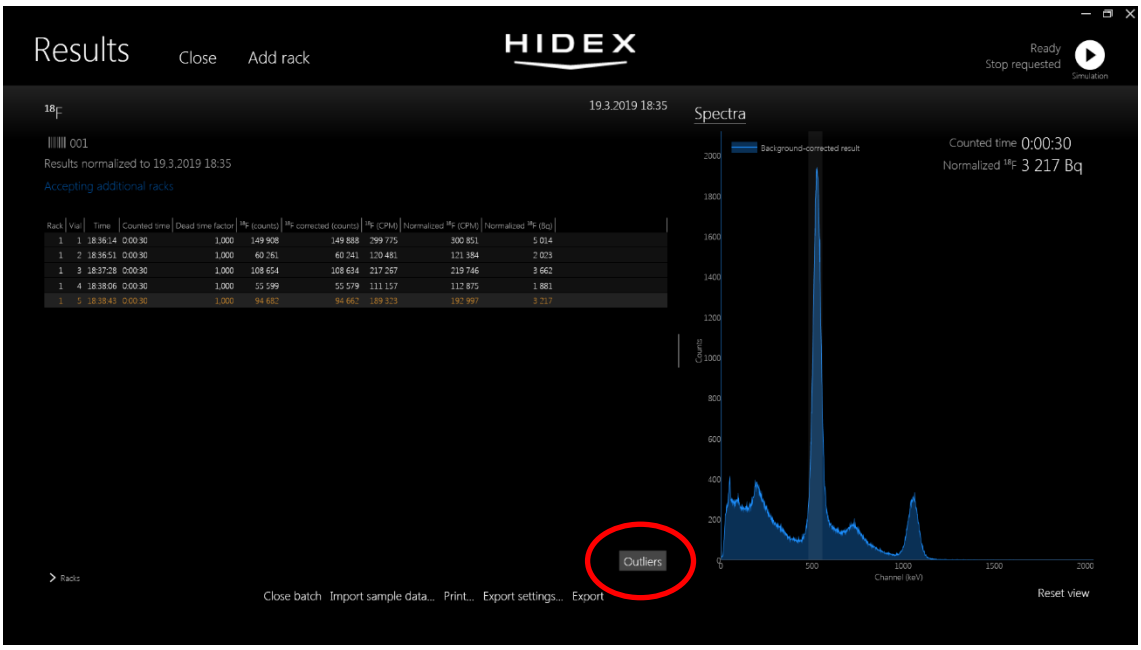
At the end of the batch it is possible to close it manually. In the opened result view in the bottom of the result list the batch can be closed by tapping on **Close batch**.

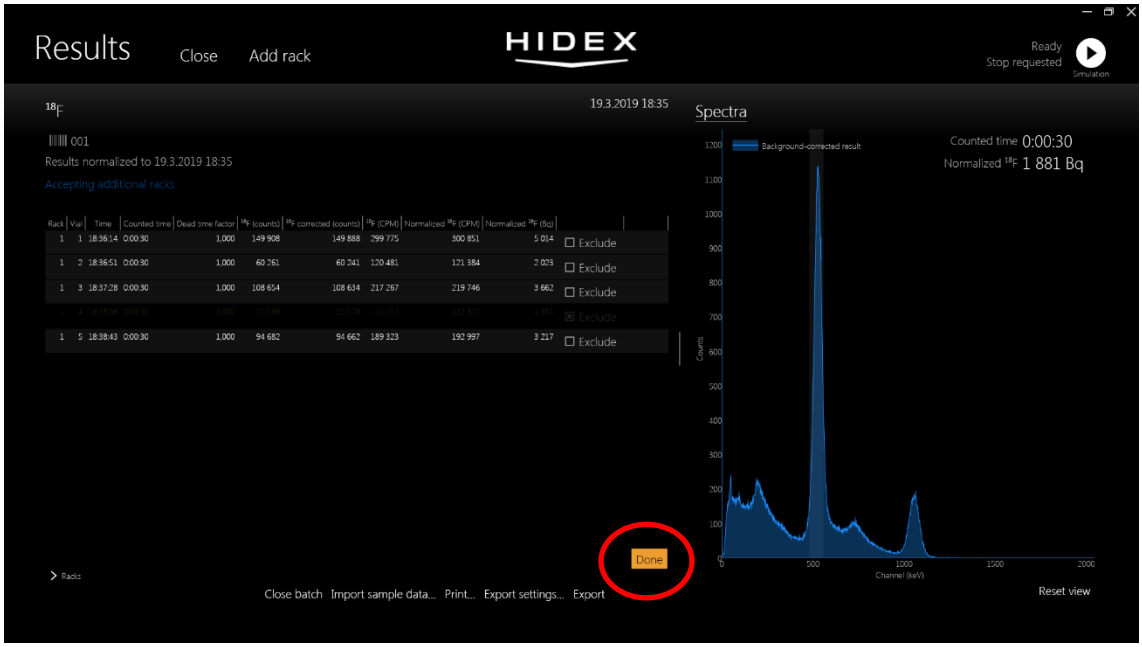
If you do not close the batch manually the counter will continue to apply the template to new racks until a rack with a different barcode ID plate is recognized, a stop rack has been introduced.

Note! Accumulating templates need to be closed manually to create autoexport.

4.2.3 Identifying outliers

Before exporting results, you might wish to examine them in **Results view**, and tag any possible outliers. Do this by tapping **Outliers** under the listed results.





An additional column will appear, in which you can specify which results to tag. Mark the result or results that you consider to be outliers by checking the appropriate **Exclude** box. Finally, accept the change by tapping **Done**.

After tagging in this way, the result line will remain visible on screen but in low-contrast format.

4.2.4 Selecting tares

If the instrument has the optional onboard balance the initial tares need to be linked to the actual measurement results.

Detailed instructions on how to do this can be found in section 8.2 *Combining tare and actual sample mass*.

4.2.5 Importing sample data after measurement

Sample data can also be imported after the actual measurement.

In the results view tap on Import sample data. Browse for the correct file and open the file. There is an example file in the Hidex folder.

With optional sample vial QR reader it is possible to import sample data based on vial ID. Result batch must have vial barcodes to enable the option. The barcode column is auto-detected.

4.3 Exporting results

4.3.1 Editing export settings

It is possible to change default settings for a template from the results view even after the measurement.

By tapping on Export settings... export settings are opened.

Two alternative formats are available for exporting the results, Excel and CSV format. The CSV format is a fixed export but with Excel exporting you can modify the settings.

By default the open window is always exported so that it is possible to view the full spectrum. It is also possible to narrow done the spectrum into the wanted area by entering a start and the end channel value to be exported. At this point the export file will only include the spectrum values for that specific area.

From the export settings the export location may be defined separately and whether the export will be automatic after the batch has been closed or not.

Naming of the result file can be determined template wise. File names include the instrument name, measurement date, template name and barcode identification and have the default format, *HidexAMG-template name- barcode-yyyymmdd*.

The order can be changed, and a desired set of template details can be chosen. Details are chosen from a template-specific listing, and the order can be changed with a simple drag and drop function.

Details can also be added later by choosing from the detail drop down list.

4.3.2 Manual results export

Having completed your measurements and reviewed your results, you can export the measurement results to Excel by tapping the **Export** button under the results in **Results view**.

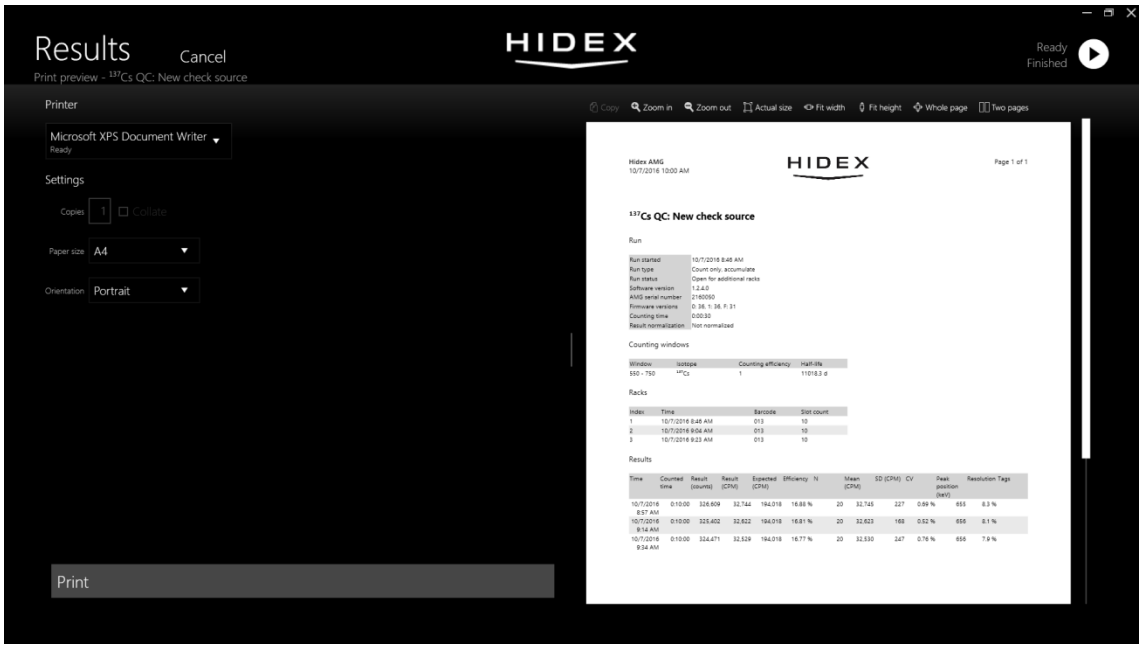
All the results will be exported, including those that you may have tagged (see *Identifying outliers*, above). The results file will be saved in a folder called Hidex AMG. Tapping **Export** will also open simultaneously the results file in Excel on your computer.

4.4 Printout

From **Results view** it is possible to print the results.

To open the printout function, choose the desired result data by tapping on it and Open the results.

In the bottom part of **Result view** the **Print...** option is available. Tapping on **Print...** shows you the print settings.



The settings, on the left side of the view, include basic printer option, number of copies, paper size and paper orientation.

On the right side the actual printout can be seen. Above the view different fitting options are shown. The result printout includes all the same data as the result export file has.

Note! In the current software version, printing is **not** automatic but needs to be done manually with each result file.

5 Quality control

With quality control procedures we can monitor the function and performance of the instrument. It is possible to set up a QC protocol for certain isotopes and background measurement. The different options are explained in following section. Calibration procedure that is linked to the quality control is explained in the next section 6.

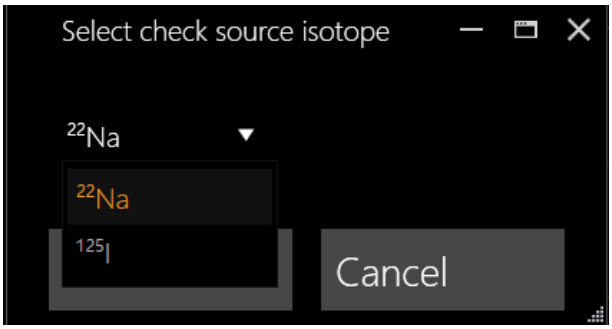
5.1 Check sources

5.1.1 Setting up QC measurement

To be able to perform QC measurement, the first step is to specify the appropriate settings.

Access the QC settings and view by tapping on QC button. All existing QC function can be found in this view at all times. Check sources can be created for isotopes that have default QC settings defined. All check source settings, target values and tolerances are configurable.

To create a new check source tap on New check source and from the drop-down menu choose the wanted isotope. It is possible to create a QC template for Cs-137, I-129, I-125, Na-22 isotopes.



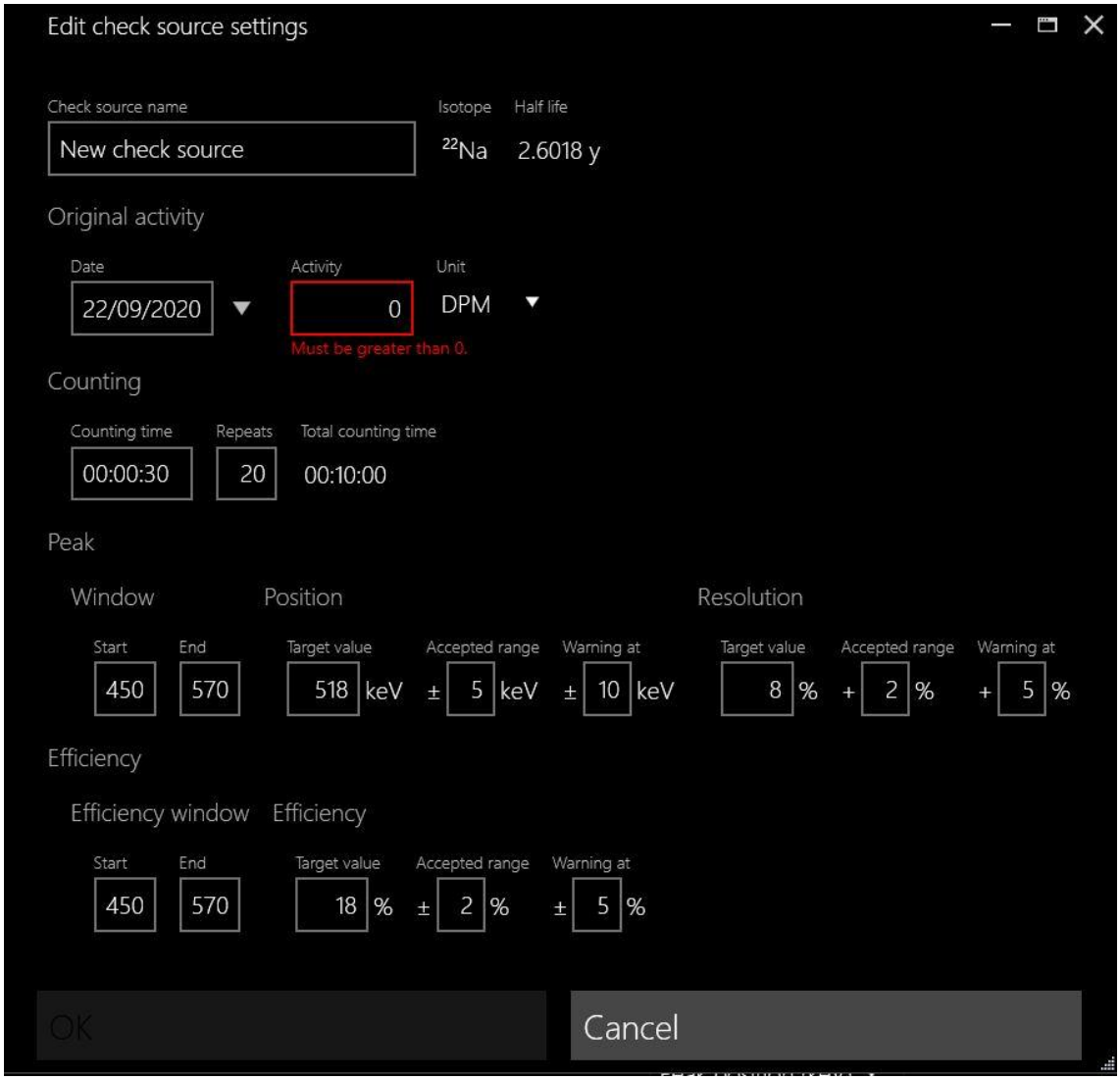
Once you have chosen the wanted isotope tap on OK.

All possible settings for the check source are created for definition. Start by opening the wanted check source.

Note! Cs-137 is needed for general instrument calibration.

Check source settings

In the check source view all the possible settings related to that specific isotope standard is shown.



In the QC settings you can specify the standard with a **name**. For the QC to work original **reference information** needs to be defined. Then it is possible to set the required counting time or accept the default setting that is here shown as 30 seconds. The default number of repeats for QC measurement is 20, but this, too, can be changed.

Note! Remember to check and input all the details for correct calculations.

QC limits

For the QC procedure to give warning information limits need to be checked and defined. Default values are shown and it is possible to define the limits for peak position, efficiency, and resolution.

Accept the QC settings and standard information by touching **Save**. Now the QC protocol has been set up for your wanted isotope and updated on to the QC listing. This procedure can then be repeated for other isotopes.

Note! There can only be one check source open for an isotope at once.
Note! It is possible to change settings until the first measurement. After the initial run the settings are fixed for that check source. To change settings a new check source needs to be created.

The criteria for ^{137}Cs, ^{129}I, ^{125}I and Na22 QC values are:

Isotope	Criteria
^{137}Cs (window 550-750)	
Peak position	662±10 channels
Efficiency	18% ± 5%
Resolution	10% + 5%
^{129}I (window 15-60)	
Peak position	31±4 channels
Efficiency	> 56%
Resolution	< 32%
^{125}I (window 15-80)	
Peak position	29±4 channels
Efficiency	> 75%
Resolution	< 32%
^{22}Na (window 15-80)	
Peak position	511±10 channels
Efficiency	> 16%
Resolution	< 12%

5.1.2 Running QC

QC measurements are run the same way as any template once it has been created. Open to add a new rack. A template is created into the library.

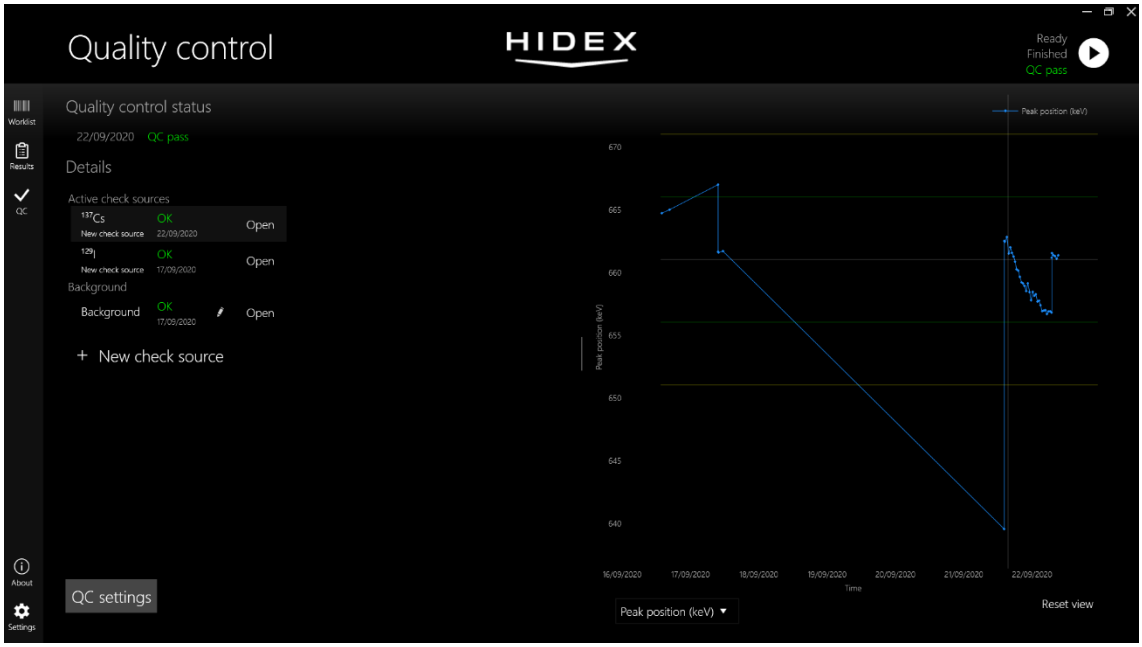
Tap on the box and in the settings view specify a barcode to be used. Remember to Add rack. Add the standard on to the rack to be measured and start the measurement.

A live spectrum of the QC measurement can be seen on worklist view. It is also possible to follow the measurement from the QC view.

The settings you have made will be used whenever you run the QC protocol and cannot be changed with the readymade QC protocol unless deleted or a new check source has been defined.

5.1.3 QC results

When QC template is run a result is added onto the QC listing view. In the QC standard view the status of all QC actions are shown.



If you wish to look more closely on a specific standard, then tap on that and open by pressing Edit pen. This opens the QC results for that specific standard.

In the QC results we can find a listing of all made QC run for that isotope. It is possible to look at the results measurement by measurement, statistics, measurement info in different tabs.

QC tab

In this tab the measurement calculation for the reference will be shown including counting results, peak position, efficiency, and resolution information giving the overall status of the measurement. If the set warning limits are exceeded, then this information is also shown in the QC tab.

Statistics tab

In this tab statistical calculation are shown. These include repeat information, mean value, standard deviation, cv%, chi^2-value and standard error% of the measurement.

Note! The statistical information will only be shown after a completed measurement.

Info tab

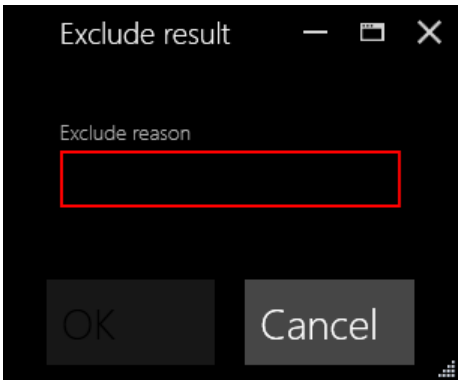
In this tab comments made to the measurement will be shown and in addition the notes of the system and reference source being used.

If a new standard is acquired, it is possible to change the standard into a new one simply by tapping on **New check source**. Only one check source can be open for one isotope at a time.

NOTE! If a new standard is created the results will also be added on to the same QC isotope result view. A note will be made to indicate the change of standard into the results.

Excluding/Including a result

It is possible to exclude and/or include a result from the results view. By tapping on **Show row actions** a check box is opened for each results where it is possible to exclude or include back a result into the listing and into the history plot.



When excluding a comment is required to give reason for the action.

The reason will be added into **Info** section on the specific measurement data.

When a result is excluded it is erased from the history plotting. A result is still not deleted form the listing and can be included again if necessary.

Time range view

The result view also includes a time range selection. By choosing the wanted time range only wanted results are shown in listing and history plot. This can also be used in exporting and printing function.

Export and print

Exporting and printing is done the same way as a standard measurement. Included in the QC results are all above mentioned tab information but also the latest measured spectrum of the isotope and history plot of the chosen value.

QC status

QC status is shown on the software view continuously. It can be overviewed in QC section but also under the start button. QC status is also shown in standard measurement in the same section as background information.

The status of an isotope is always related to the latest QC measurement. **QC check required** is an indication that either the time interval between QC measurements has been exceeded or there is no measurement done with an activated check source. Overal status is an overview of all open check sources.

The status can be

- Pass
  - When all parameters are good the status is **PASS**.
- Warning
  - If one of the parameters are off but within the warning limits the status is **WARNING**.
- Fail
  - If any of parameter value is outside the warning limits, then the status is **FAILED**.

If QC status is **Warning or Fail** it is suggested to start with **running Cs-137 calibration**. In case the calibration does not help then refer to Hidex and qualified service engineers.

5.1.4 Ending and creating a new QC template

Once a QC template is activated and run for the first time with a specific standard the reference information cannot be changed.

To be able to change the standard information it is necessary to create a new check source. The default settings will be opened in a pop-up window to activate.

Note! Only one isotope check source can be open at once.

To finish the current QC template at the bottom of the QC results view you will see End QC. It is possible to close and end the QC for isotopes I-125, I-129 and Na-22. If you tap this, the QC file will be closed for the defined standards and cannot be re-measured. After this it is possible to setup a new QC template.

Note! Cs137 isotope is needed for calibration and thus needs to be active all the time and can only be updated into a new standard, not deleted.

5.2 Background monitoring

Background measurement provides a check of instrument stability and check for detector contamination. Background measurement should typically be performed each week since the background may vary from day to day depending on laboratory conditions.

The background is the environmental background and no vials are taken into the detector and measured. To obtain corrected results when you measure samples, you first need to specify a background rack and run it once.

5.2.1 Settings for background measurement

Background counting settings are activated and edited in the QC view.

To be able to measure background, you need first to specify the appropriate settings. To do this you must access the QC view. This will open when you tap on QC button on the sidebar.

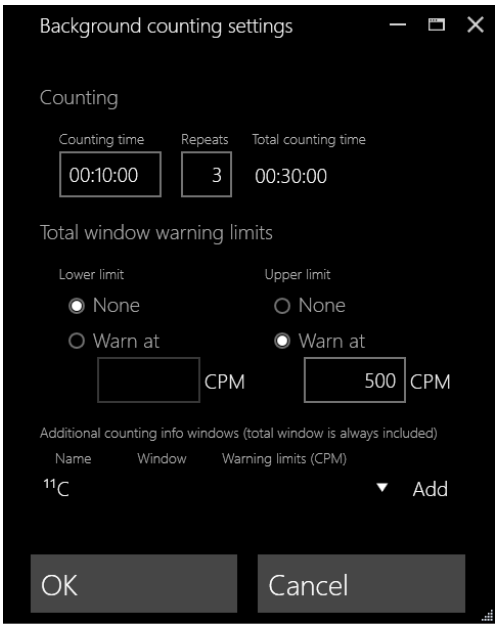
The Background settings will open by tapping on Edit pen and default settings are shown. All settings can be edited in here.

It is possible to adjust the counting time, number of repeats for the background measurement.

Minimum counting for a background run is 5 minutes.

In addition, warning limits can be activated for both lower and upper limit.

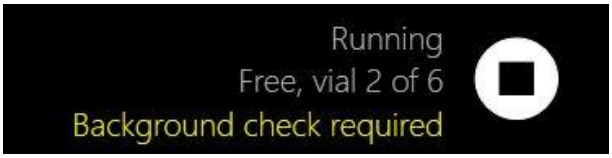
The default window is always the open total window. If wanted, additional windows can also be set up with or without warning limits to follow.



Accept the settings by touching **OK** at the bottom of the display.

The settings you have made will be used whenever you run the background, and will remain in force until you overwrite them with modified settings.

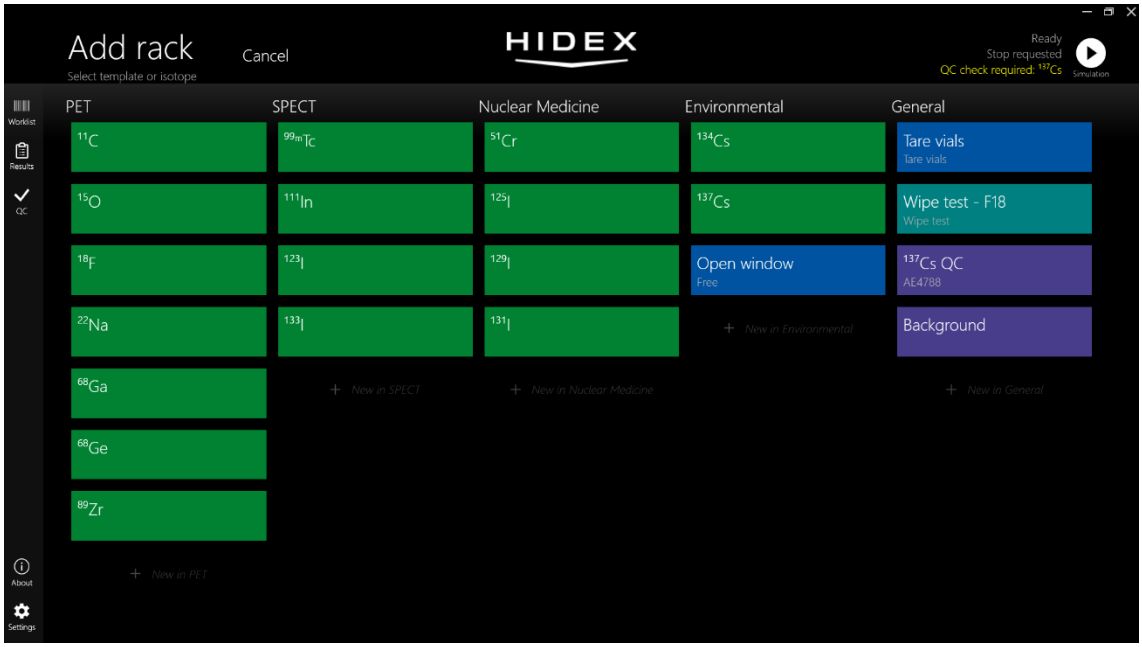
Before the first measurement a notification **Background check required** is shown on the software top bar.



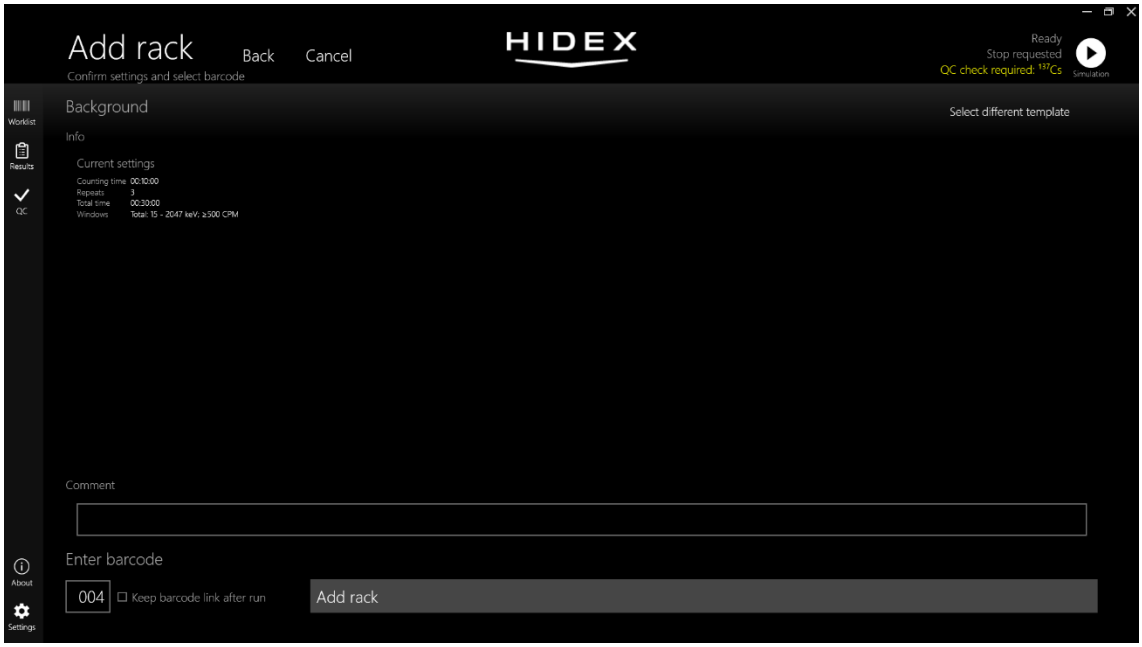
Note! The status will be unknown until a background measurement has been performed.
Note! The background status is also taken into consideration in the overal QC status.

5.2.2 Run background

Touch **+New rack** in **Worklist view** to obtain the **Add rack view**, shown below.



To start the background measurement, you need to allocate a rack with a defined barcode to the background template. Do this by touching **Background box** and then in settings specify the appropriate bar code number. Create the template by tapping on **Add rack**.



Once the template is on the worklist, start the run by touching the START button in the top right corner. During the measurement, the developing background spectrum will be shown in the **Worklist** or **Background** view.

5.2.3 Background results and history log

When measuring the background, a history log of the results will be made. In **Quality control view** background measurement results can be opened by tapping on **OPEN** the background. A view with all the background measurements done with that specific software so far will be shown.

Time range view

In the history log the results will be logged according to date of measurement.

It is possible to export background results from the history view.
The result view also includes a time range selection.
Choose the wanted time frame above the measurement listing from the drop down menu.

There are several choices from past 24 hours to a full year. Also the time range can be custom set.

This can also be used in exporting and printing function.
When the time range has been chosen then choose whether or not to include the spectra and tap on Export.

Bakground status

Background status a part of the overall QC status. The specific background status can be overviewed in QC section.
Background status is also shown in standard measurement in the same section as QC information.
The status can be

- Pass
  - When all parameters are good the status is PASS.
- Warning
  - If background values are outside the warning limits, then the status is WARNING.

If Background status is Warning it is suggested to start with running the background. In case the calibration does not help then refer to Hidex and qualified service engineers.

QC check required is an indication that either the time interval between QC measurements has been exceeded or there is no measurement done with an activated check source.

5.2.4 Background subtraction

Results may be background corrected once the background measurement has been performed.

To subtract the background from the sample results this needs to be defined in the template settings before the actual measurement. When using background subtraction the most recent background run is used for the correction. Only the background counts for the area of the defined counting window in the template will be used.

More information on background subtraction settings can be found in the section on template settings, below (section 3.5.3).

5.3 Exporting and printing quality control measurements

Exporting a check source result or background result same procedure applies as for a standard measurement. Exporting and printing of a quality result is done from the specific results view.

When exporting results from a specific check source or background measurement with the results also the wanted history plot and the latest measured spectrum is included. In adiition, when exporting a background result a pop-up window is presented to define whether spectrum information is wanted or not.

Export settings can be edited separately for all QC templates if wanted.

6 Instrument calibration with ^{137}Cs

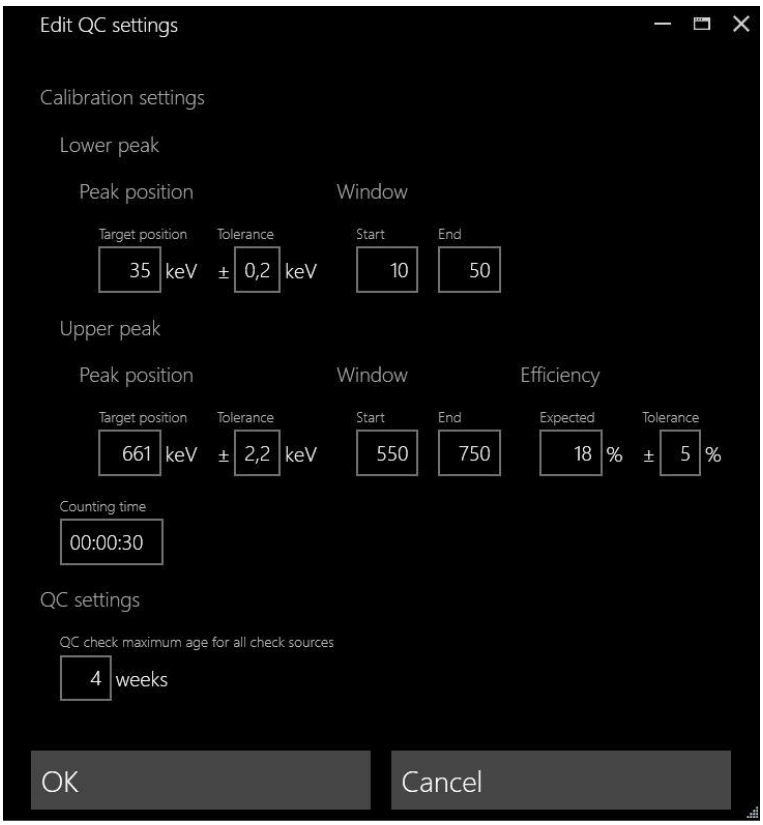
The software has an automatic calibration feature that can be used with a ^{137}Cs check source.

6.1 Calibration set-up

The calibration is done with a ^{137}Cs check source. To use the calibration the check source protocol needs to be first set up with reference information. Without reference information the calibration cannot be done.

6.1.1 Calibration limits

Calibration set-up can be found in QC view by tapping on QC settings
By tapping on the button the list of calibration settings will open



There are two calibration target positions:

1. Lower peak
2. Upper peak

These targets can be adjusted by the user in addition to the tolerance.

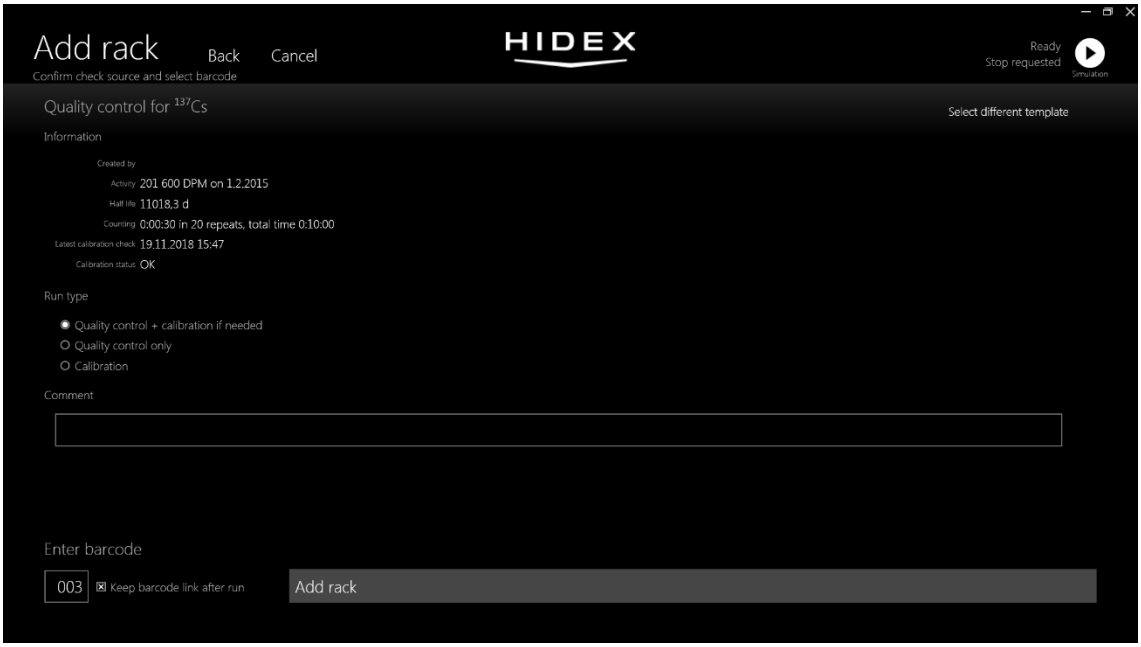
The efficiency is also checked to ensure performance when calibrating the system.

Time interval between QC runs is also set in the QC settings. By default the time is 4 weeks but this can be adjusted as wanted.

Save the QC settings by tapping OK and these settings will be used the next time Cs137 is run with calibration function.

6.2 Running QC calibration measurement

When defining the barcode 3 different **Run type** options are available.



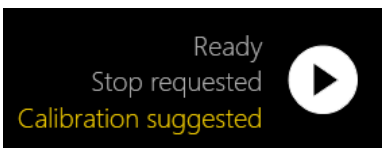
You can choose to run **QC + calibration if needed**. Then in the beginning of the QC run a quick calibration check will be made and if the calibration limits are exceeded then a calibration run will be performed first and then the QC run. This run is the default setting and is recommended.

You can choose to run a standard **Quality control only** and at this point no calibration is made. The QC template will inform after the run if calibration is needed according to the set limits.

It is also possible to choose to run only a **Calibration** run. With this run the calibration is checked and if necessary adjustment will be made. No QC run will be performed with this run type.

6.3 Calibration status

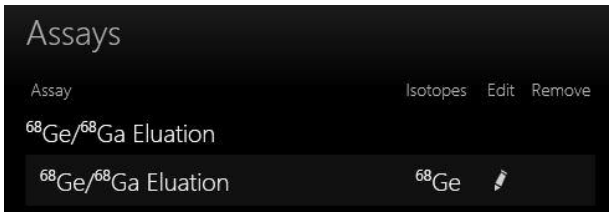
The notification of a suggested or required calibration will be visible in the upper part of the user interface.



When running a calibration run with Cs137 check source calibration information will be added to the cs-137 QC result view as an own tab **Calibration.** In addition in the QC spectrum view calibration information including the peak position deviation will be shown.

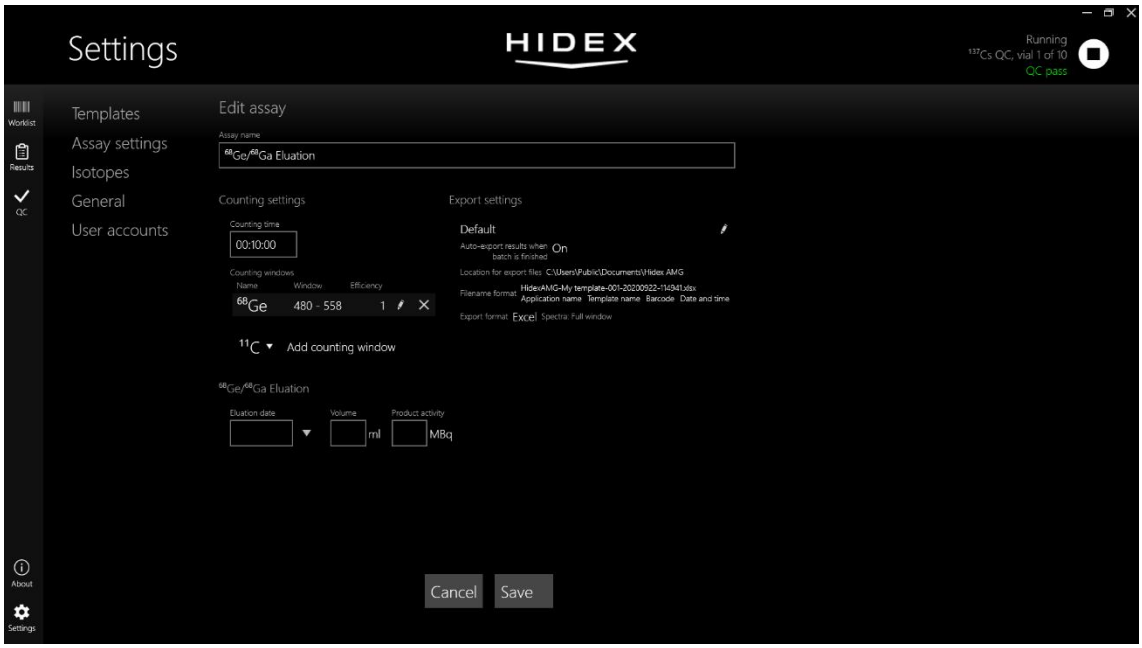
Note! In case the calibration is **not** successful information of this shown in the interface. At this point repeat the calibration. If the automatic calibration cannot be performed then manual calibration is required. Please contact service engineer or local distributor.

7 Working with assay plugins



Plugins are templates that provide details of the specific calculations that your experiment and application require. The available plugins can be accessed by tapping **Settings** and then tapping **Assay settings**.

To activate one of the available plugins, choose one from those listed under **Available assay plugins**, and tap **Edit**.



Supply the desired counting settings and the default values that you would like to have and activate the plugin by touching **Save**.

There are separate instructions for assay plugins.

8 Balance

If your instrument has a balance unit installed you can measure the mass of the holders and vials (i.e. the tare) before measurement, and then measure mass again after the samples have been dispensed. By this means you can obtain precise measurement results in Becquerel per gram or per volume of sample.

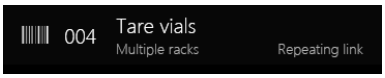
8.1 Measuring the mass of empty holders - Tare

To include mass detection with your measurement of samples, you need to measure first the tare and then the mass of the sample in its vial and rack. The mass of the sample is then obtained automatically by subtraction.

Proceed as described earlier by selecting Add rack from the Worklist view and choosing the Tare batch template.

If you are working with a set of samples requiring more than one rack, de-select the Single rack only box.

Let's say that we wish to tare a batch involving 3 racks of samples, and the first rack will be rack 1.



Place the 3 sample racks on the conveyor and start the tare measurement by tapping the Start button. The results will be presented in the same file in the rack order.

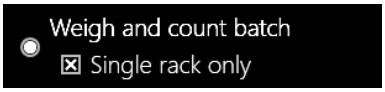
To delete an unwanted tare measurement task, simply tap on the item in the worklist. It will become highlighted in amber and a white cross will appear on its right side. Tap this white cross.

With the tare function you can get the initial weight of the empty vials, but the vials will not be sent to the detector.

8.2 Combining tare and actual sample mass

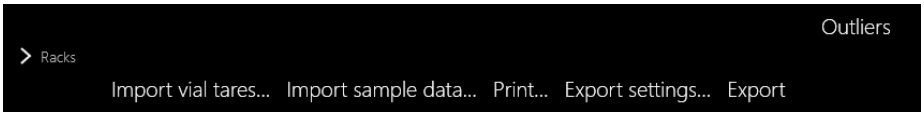
Next it is time to dispense samples and reload the racks. Tap on one of the Add rack buttons and choose your desired counting template as described earlier (see *Selecting a counting template for your rack of samples*).

Choose Weigh and count batch as the run type, and de-select Single rack only if you have more than one rack.



For convenience you may want to keep the same rack barcodes as were used for the tare, but this is not essential.

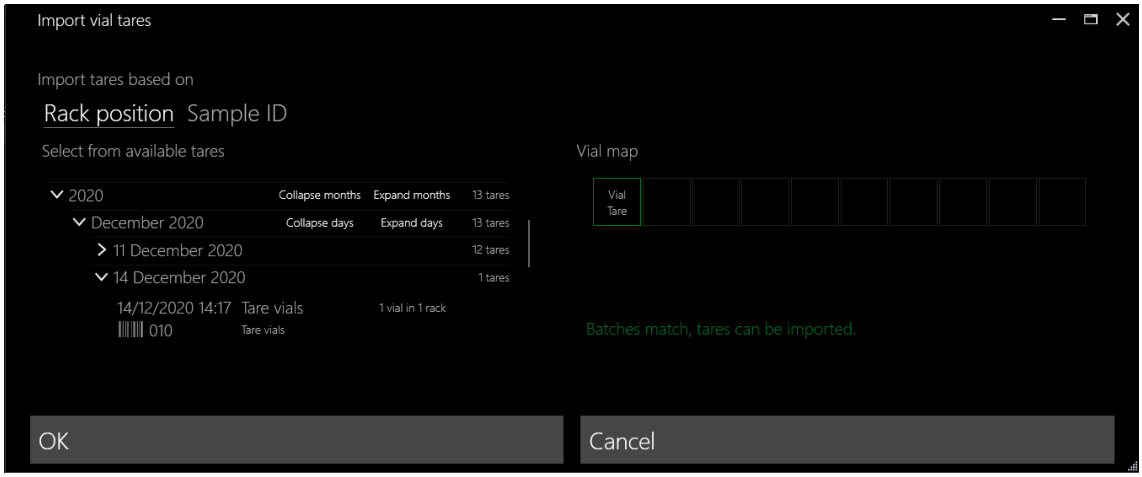
Assuming you do not wish to make changes to the other settings, tap Add rack and start the counter. On the Results view the mass and count figures for each sample will begin to appear when running the measurement.



When counting is complete, in addition to the **Export** button, an **Import vial tares** button appears under the results.

Tapping this will allow you to find the relevant tare figures to combine with your results.

A new window is opened presenting all existing tare results by date.



It is possible to choose the tare according to rack position which is the option when an standard balance unit is used. If an optional sample vial QR reader is used then the tare results can also be linked by matching vial ID.

On the right side of the display you can see details of the target batch. On the left is a list of tare files each marked with the date and time of the run. A green or red text tells you whether the tare file is suitable for use with the target batch. A warning is shown when the match is not exact but they can be used if wanted.

When you have identified the correct tare file, select it by touching it, and then tap on **Link tares**.

You will be returned to the **Results view** and will see that the tares have been combined with the results. Result view and exports display info about the tares used (time, name).

If needed, tares can be switched after linking. **Import vial tares** option in results view is always available.

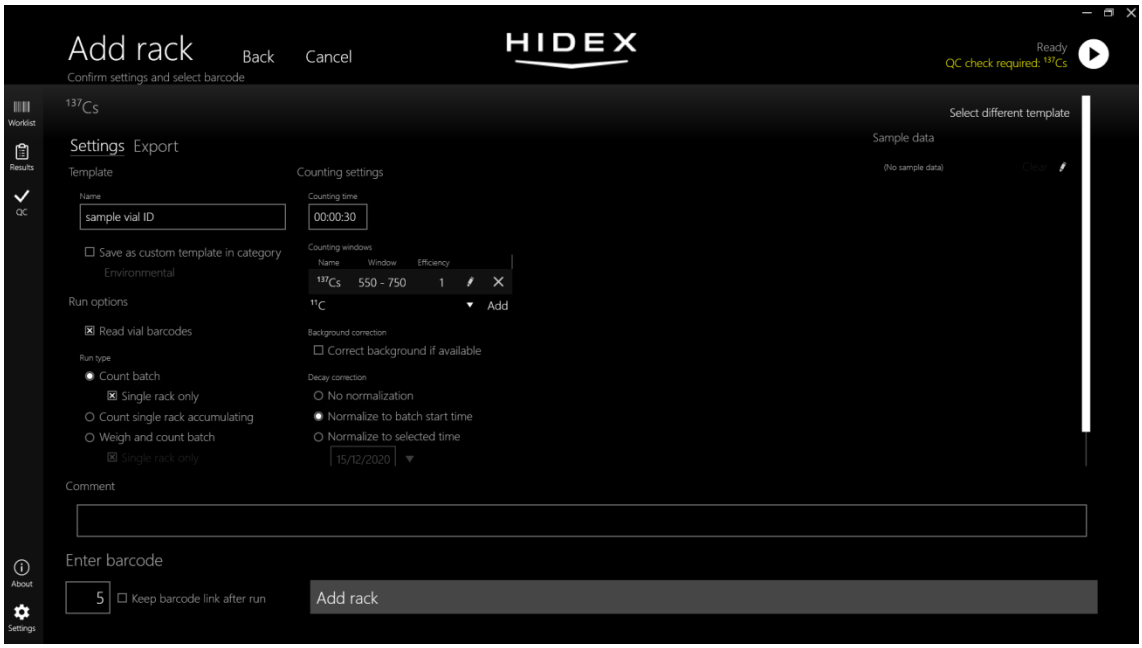
9 Sample vial QR reader

If your instrument has a sample vial QR reader installed you can obtain an individual vial ID for every sample that is measured.

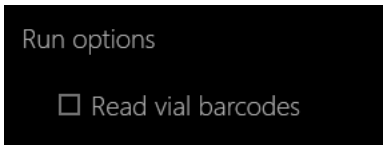
9.1 Template settings

When setting up a template to use vial ID reading there is only one additional setting to take into consideration.

In Add rack view it is necessary to choose in Run options to Read vial barcodes



This option is only available when vial barcode scanner is available.

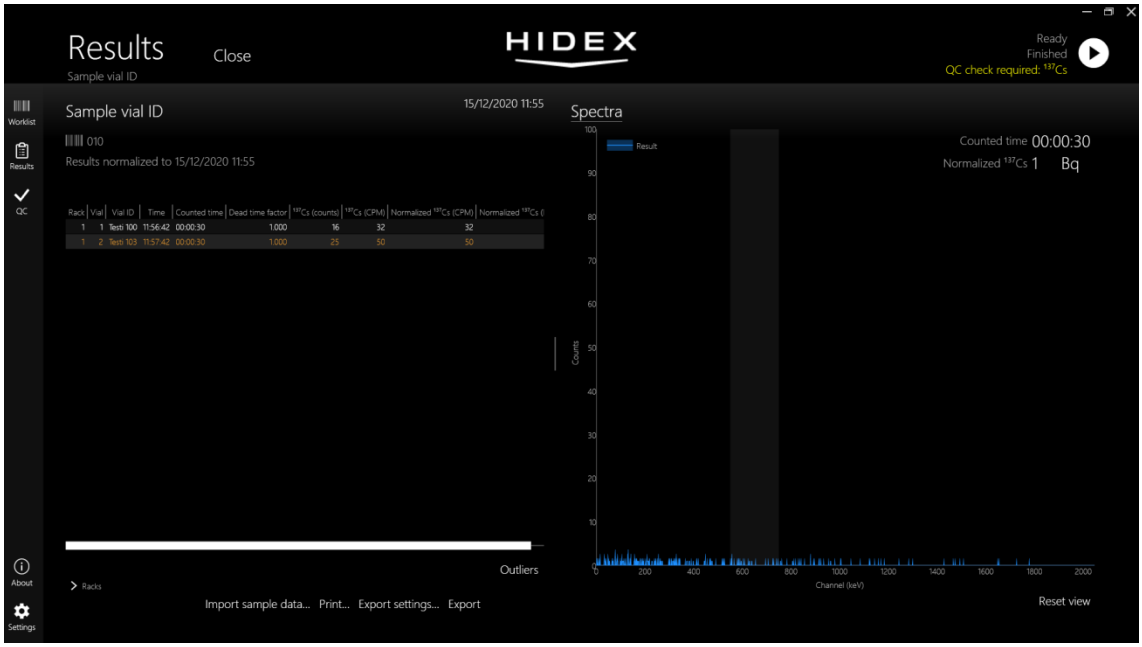


When vial ID are used tick box should be used.

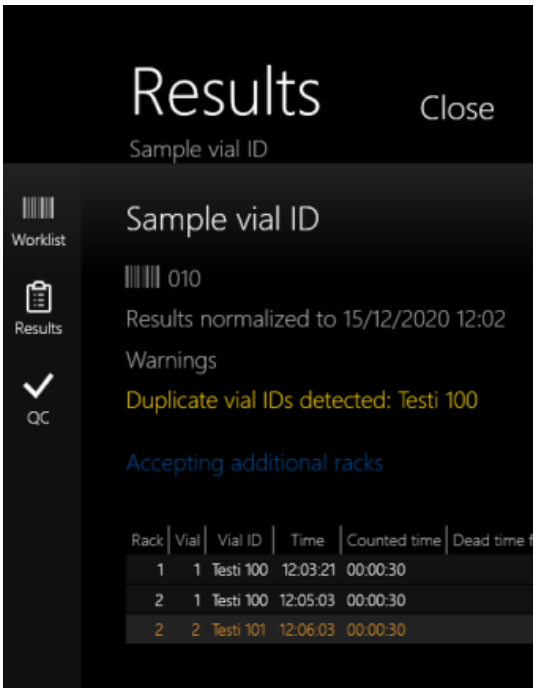
After all other settings are correct template is created by choosing wanted barcode and tapping on Add rack.

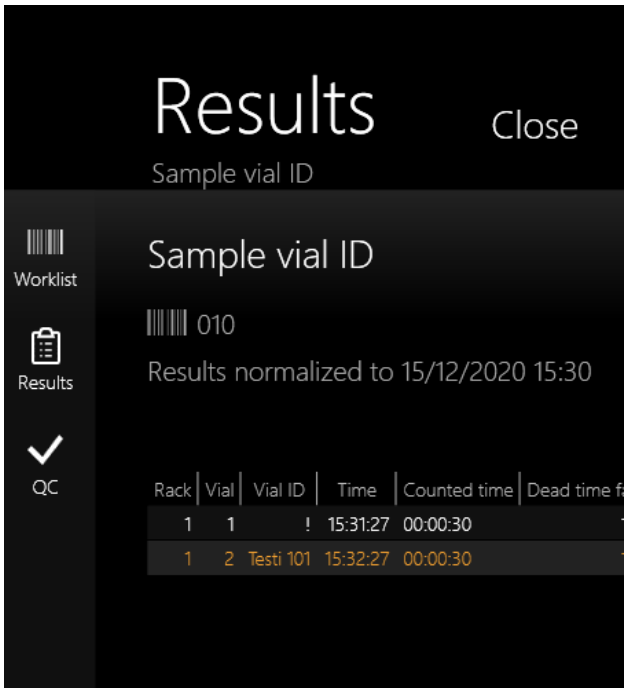
9.2 Results

When using sample vial ID options an additional results column is added in the results view.



If in a measurement there are recognized duplicate vial ID's a **warning is displayed** in results view to inform the user. The same warning information is also added in exports. In case a vial ID reading **fails** or a vial is **without** an ID then the vial ID results is marked with **exclamation** (!) mark.





10 Radionuclide listing

Radionuclides listed below can be measured with the Hidex AMG automatic gamma counter.

Half-life times are according the National Institute of Standards and Technology (NIST), NIST Standard Reference Database 120 by M. P. Unterweger, D. D. Hoppes, F. J. Schima, and J. S. Coursey.

Efficiencies are estimated general values in open window (15-2000 channel) at Hidex factory in Turku, Finland.

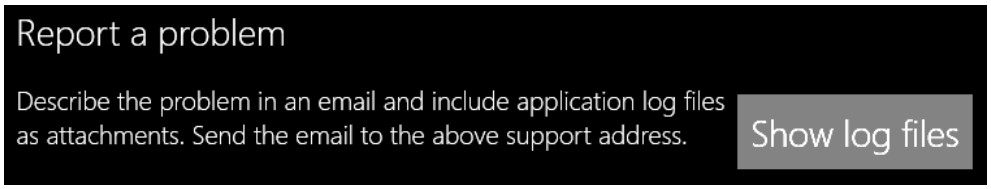
Nuclide	Energy [keV]	Eff.[%]	Half live	Low. W [keV]	High W . [keV]	Res. [%]
^{125}I	29	78	59,49 d	15	80	30
^{57}Co	122	85	272,11 d			
^{51}Cr	322	6	27,70 d			
^{129}I	31	58	15700000 yr	15	60	30
^{76}As	559	19	26,40 hr			
^{195}Au	99	100	186,09 d			
^{198}Au	412	37	2,695 d			
^{133}Ba	356	52	3854 d			
^{139}Ba	166	84	1,38 hr			
^{77}Br	245	20	57 hr			
^{47}Ca	1297	71	109 hr	1000	1500	
^{109}Cd	22	66	462,26 d	15	35	
^{141}Ce	145	52	463,26 d	125	170	
^{58}Co	820	61	70,77 d	735	885	
^{60}Co	1332	26	1952,20 d	1050	1450	
^{134}Cs	795	28	753,88 d	520	850	
^{137}Cs	662	44	11018,3 d	550	750	10
^{171}Er	308	24	7,52 hr			
^{18}F	511	46	1,829 hr	450	570	
^{59}Fe	1290	26	44,507 d	1000	1400	
^{67}Ga	185	85	3,261 d			
^{68}Ga	511	46	67,719 min	450	570	
^{89}Zr	511	46	78,411 h	450	570	
^{153}Gd	147	100	239,47 d	25	170	
^{203}Hg	279	65	46,619 d			
^{123}I	159	85	13,223 hr			
^{131}I	365	41	8,019 d			
^{133}I	530		20,81 h			
^{133}In	245	80	2,804 d	150	500	
^{114m}In	190	40	49,51 d	165	210	
^{42}K	1525	14	12,36 hr	1200	1800	
^{43}K	373	40	22,60 hr			
^{22}Na	511	85	950,97 d	20	1800	

^{95}Nb	766	28	35 d	685	850	
^{86}Rb	1077	10	448 hr	800	1300	
^{203}Pb	279	66	51,923 hr			
^{103}Ru	497	28	39,310 d	400	600	
^{125}Sb	428	35	1007,56 d			
^{46}Sc	1098	18	83,831 d	990	1200	
^{47}Sc	160	86	82,1 hr			
^{75}Se	265	70	119,809 d			
^{153}Sm	103	84	46,285 hr			
^{113}Sn	392	40	115,079 d	350	430	
^{85}Sr	514	23	64,853 d	445	580	
^{87m}Sr	388	38	2,8 hr	345	435	
^{99m}Tc	140	87	6,007 hr			
^{68}Ge	511	46	6504 hr	450	570	
^{11}C	511	46	20,334 min	450	570	
^{15}O	511	46	112,24 s	450	570	
^{13}N	511	46	9,970 min	450	570	
^{201}Tl	70		3,045 d	60	90	
^{64}Cu	511	46	12,9 hr	450	570	
^{45}Ti	511	46	3,08 hr	450	570	
^{188}Re	155		17,001 hr			

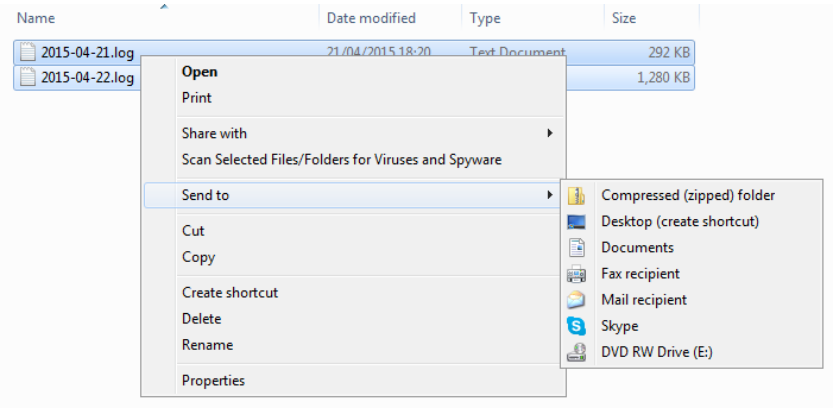
11 Troubleshooting

11.1 Reporting a problem

If you need to report a problem, the Hidex AMG log files will help to find a solution. You can access log files by tapping the Hidex logo to obtain Factory settings view, and then tapping About and Show log files.

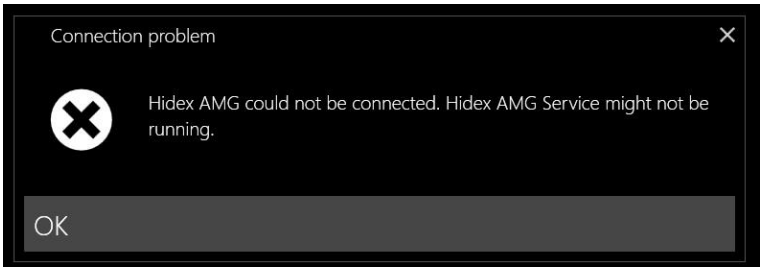


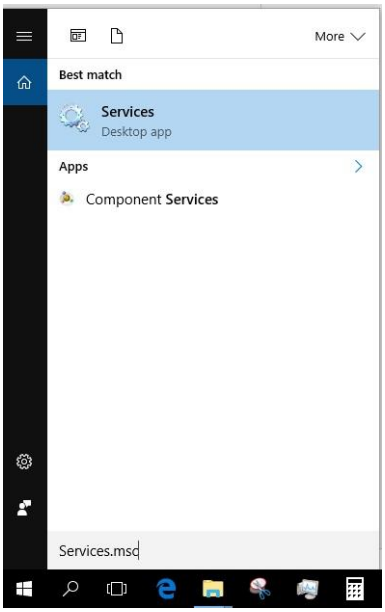
The log files are text files, and if you wish to email them, it is convenient to simply use Windows tools to compress them.



11.2 Restarting Hidex AMG Service

In some cases, the Hidex AMG software can give out an error message saying that Hidex AMG Service might not be running. In these cases, the Service needs to be restarted.

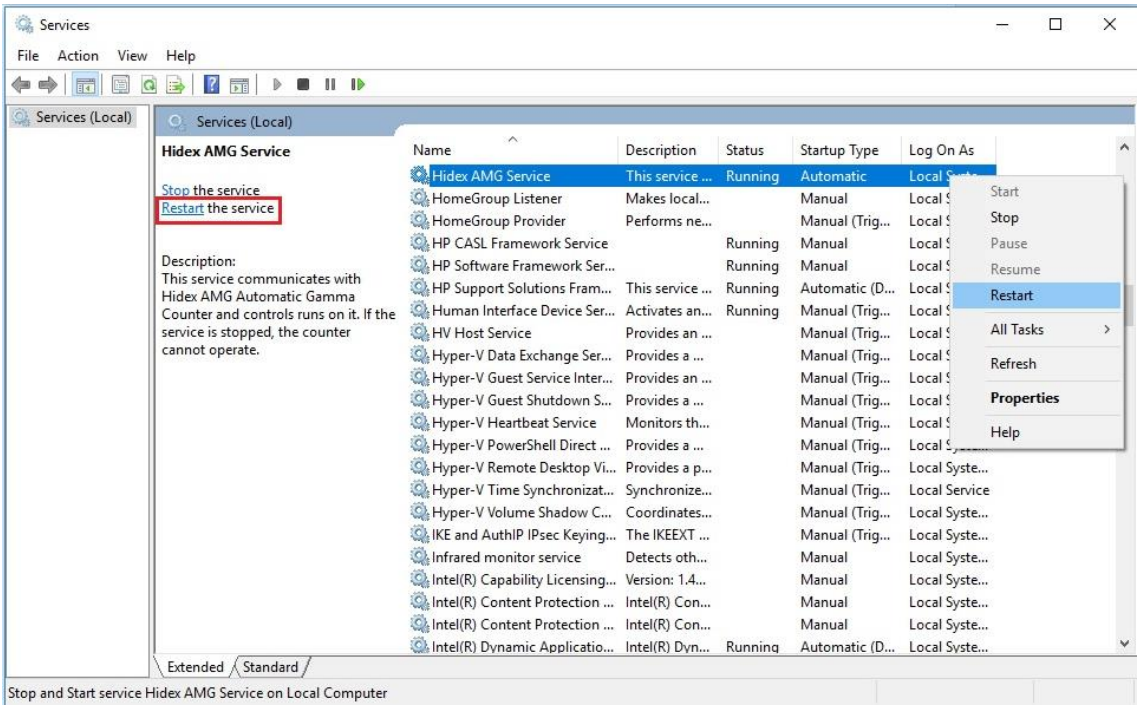




This can be done by searching services.msc from the Windows search.

Opening Services will open the list of all services connected to Windows service.

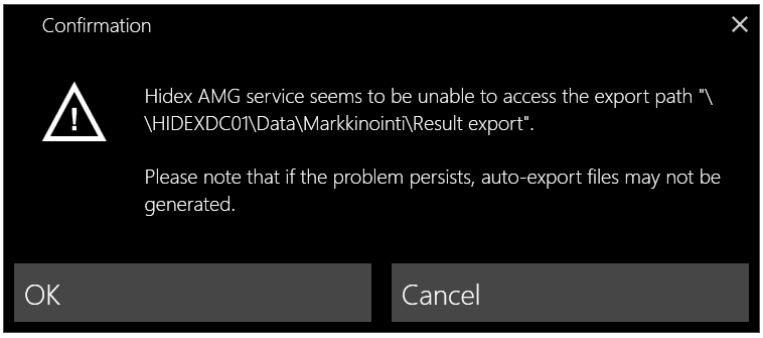
Hidex AMG has its own service communication, called Hidex AMG Service.



Locate Hidex AMG Service from the list. Restarting or starting it can be done either from the menu in the left or by right clicking the Service on the list and selecting restart or start.

11.3 Network auto-exporting problem

In case the write access to the auto-export path is denied a warning pop up window will appear on the software while creating the template.



To use a net server folder as the export location Hidex AMG Service needs to be determined and installed by a user that has administration rights and domain access.

If Hidex AMG Service has been recorded to an administrator with domain rights, then relaunch Hidex AMG Service to get access again to the net server folders. Follow the instructions in section 11.2.

To install and enable auto-export to net server folders please contact Hidex service personnel for further instructions.

12 Routine maintenance

12.1 Cleaning the instrument

12.1.1 Outer case

For reliable daily operation, ensure that the instrument remains free of dust. Clean the outer case of the instrument from time to time using a soft cloth dampened in a warm, mild detergent solution. Abrasive cleaning agents should not be used. Any spillage of saline solutions, solvents, acids or alkaline solutions on the instrument's outer surface should be immediately wiped away. In the event of contamination with a biohazardous substance, a mild sterilizing solution should be used.

12.1.2 Conveyor

The conveyor should be kept clean to avoid dust and dirt from entering the measurement chamber. Clean the surface at least once a week using a soft cloth or tissue paper soaked in a mild detergent solution or 70% ethanol. Wipe up spills immediately. Do not use formaldehyde. If the conveyor has become contaminated with a biohazardous substance, decontaminate according to the section 12.1.3 *Decontamination procedure* described below.

Caution! Do not autoclave any part of this instrument.
Caution! Do not use alkaline or chlorite solutions for cleaning any parts of the measurement chamber, as this may damage the instrument.

12.1.3 Decontamination procedure

Decontamination should be performed in accordance with normal laboratory procedures. It must be performed where infectious substances have been in direct contact with any part of the instrument or, for example, before shipping an instrument for service. Performing the decontamination procedure is also strongly recommended before moving the instrument from one laboratory to another. However, decontamination is not required for the proper functioning of the instrument.

The decontamination procedure should be performed in a well-ventilated room by authorized trained personnel wearing disposable gloves, protective glasses and clothing.

Suitable substances that may be used as decontaminants are:

- Ethanol 70%
- Virkon solution 1 - 3%
- Glutaraldehyde solution 4%
- Chloramine T
- Microcide SQ 1:64

12.2 Software update

When installing a new software, the database from the current previous software version can be loaded to the new software version. This is done with the help of trained service engineers.

13 Version history

Version	Date	Created by	Content
1.0	12.3.2019	SVi	Document numbering, sw update ver 1.5.2.0
1.1	18.9.2019	SVI	Updated according sw ver 1.6.0.0.
1.2	24.9.2019	SVI	Addition of software update information
1.2.1	24.3.2020	SVI	Change of internal sw version into 1.6
Sw 1.7	25.9.2020	SVi	SW 1.7.0.0 update, QC section update
Sw 1.8.	15/12/20	SVI	Sw1.8.0. update, sample vial QR reader, tare flexibility.