Chapter 1: Introduction and Overview

1.1 About Qualifier

The Qualifier Type 7830 PC software provides the perfect solution for post-processing and documentation of buildings acoustics measurements made with Investigator Type 2260 running Building Acoustics Software BZ 7204 or Room Acoustics Software BZ 7207.
The Qualifier Light Type 7831 provides post-processing and documentation of room acoustics measurements made with Investigator Type 2260 running Room Acoustics Software BZ 7207.

Data Transfer

On the spot or back in the office, you can transfer data from Investigator to the PC. Transfer is either direct, via the RS-232 serial interface, or indirect, via PC-cards. A Serial Interface Cable AO 1442 is available for data input to a PC via the serial interface.

When data are transferred, the job and partition groupings that were made with the Investigator are maintained in Qualifier so that the data structure is the same. Each project contains one or more jobs, a job being a complete set of source room, receiving room, background noise and reverberation time measurements for each partition measured.

Qualifier Calculations

Qualifier Type 7830 works with the same bookkeeping system as the Investigator. This means that when you have transferred data to the PC you see the same results as in the Investigator, including selected measurement standard, excluded positions and other set-up parameters. Qualifier will then let you change the standard, include/exclude any measurements, and calculate a wide range of building acoustics parameters suited to your country's standards. See Chapter 6 for details of the implementation of standards in Qualifier.

With Qualifier, you can display reverberation measurements as 3D multispectra. This provides a complete overview of the frequency-dependent reverberation characteristics.

Using Qualifier's spreadsheet-like data tables or graphs, you can also manually adjust data used in calculations, for example, to change receiving room levels or reverberation times. The results can be observed immediately, and if they are not suitable you can easily undo the changes - at no time are your original measurement data lost. Reverberation times that are calculated using ensemble averaging can also be modified by using the mouse to draw a new line across a displayed decay curve. For diagnostic purposes, the reduction curve can be modified and the single value adjusted accordingly.

Because manual input of data is possible, simulations of walls and rooms can be made.

Flexible Reverberation Averaging

Reverberation time measurements can be averaged in two ways:

- Ensemble averaging
- T20/T30

You can freely switch between the two types of averaging at any time and any display of T2 is automatically updated. See section 2.1.3, Job Icon, for details.

Documentation

Extensive report generation facilities and templates are available. These allow items such as graphs, text and company logos to be entered into a report and sent to the printer. You can also export graphs or sheets by copying and pasting via the clipboard.

Reports are automatically saved as a part of the project, but you can also save the reports separately as rich text files (.rtf).

1.2 Use of the Protection Key

Protection Key

Qualifier Type 7830 requires a protection key including the proper license for full functionality. The key, included with the program, fits the PC's parallel (printer) port between the PC and any printer cable. It does not affect your printer.
If you already have a key but no license, then use the License Utility.

When you run the program, it searches for the protection key. If the key is detected, the program runs with full functionality and you can save projects and report files. If no key is detected, the program will only run in demo mode.

Demo Mode

This mode is activated if the software does not detect the protection key. You can work with demo data from the DEMOJOB1 and DEMOJOB2 directories to see how the program works, but cannot import new data.

1.3 About Help

Accessing Help

Qualifier's Help system can be accessed:

- from the **Help** menu, by selecting **Contents** and then, for example, File Management
- by pressing **<F1>** to get help on the selected item
- by clicking on and then on the item for which you require help
- by pressing **<Shift + F1>** and clicking on the item for which you require help
- by clicking on the **Help** button in a dialog box

Structure

Qualifier's help system comprises a number of separate, but interconnected, help files. These are:

- Main help contents. This contains the context-sensitive help, information on technical support, etc. It allows access to any other part of the help system.
- On-line user manual.
- A glossary.

The **Index/Find** facilities provided in the help work in two ways:

- If you access help from the context-sensitive items or by using the **Help**, **Contents** menu item, the search list covers the entire help system.

- If you access help from the **Help**, **On-line Manual** menu item, the search list is limited to the contents of the manual.

The texts in the title bar, for example "Qualifier Type 7830 Help" or "Qualifier Type 7830 On-line User Manual", tell you which part of the help system you are currently using. This makes it far simpler to keep track of where you are in the system.

The browse buttons, **<<** and **>>**, work within specific, related parts of the help. For example, you can browse through topics related to the **File** menu or through the chapter contents or chapters of the manual.

The **Back** and **Glossary** buttons are independent of the part of the help system in use.

Context-sensitive Help

This is the type of help called up, for example, by pressing **<F1>** for a particular menu item or by clicking on the **Help** button in a dialog box. It gives immediate assistance whenever you require help in using the program. The help topic called up will help you to make selections in dialog boxes, give information about the function of a menu item, clarify uncertain points, etc. You can print each topic separately.

On-line User Manual

The on-line user manual gives more detailed information about Qualifier Type 7830. As with a printed user manual, the on-line user manual contains chapters and sections. Each chapter is a single topic that you can print as a complete entity, but you can jump to any section from the contents list.

1.4 About this Manual

This manual is structured in the same way as a traditional printed manual. Each chapter is a single topic and, if required, can be printed as such.

To access a chapter, you can go to the contents list and select it by clicking on the chapter title. Alternatively, you can browse through the chapters using the browse buttons.

To access a particular section or subsection of the manual, you can again do this from the contents list, or you can use the Search facility to go directly to the appropriate section or paragraph.

Chapter 2 describes how to create a project, input data and save the project. This chapter also contains information about the Project View and how it is built up.

Chapter 3 describes how to display data and how to change the display to give the best presentation.

Chapter 4 is about calculations - how to change the standard used, how to set the calculation parameters and how to display the results. The chapter also describes how to edit data.

Chapter 5 concerns report generation. It describes the report templates available and tells you how to create, design, print and save reports.

Chapter 6 gives a detailed overview of building acoustics parameters and standards as implemented in Qualifier. The information is mainly sorted according to country. Please note that because of the extensive tables included here, the chapter should be printed in landscape page orientation.

⬛ Chapter 2: Inputting Data

2.1 Creating a Project

Whenever you work with Qualifier, you work within a project that contains all the measurement data, calculations and reports for a complete set of building acoustics measurements. Only one project can be open at a time.

You can input data to a project either directly from 2260 Investigator using the RS-232 interface, or you can open files from disk/PC-card (PCMCIA).

2.1.1 New Project

If Qualifier is not running and you want to start a new project, all you have to do is start the program from Windows. Qualifier always starts up with an empty project.

If you are already working on a project and want to start a new one, then do one of the following:

- click on ⬜
- press **\<Ctrl + N\>** on the keyboard
- select **File, New Project**

If you have not saved the current project, the software prompts you to do so. A new, empty project then opens, as illustrated in Fig.2.1.
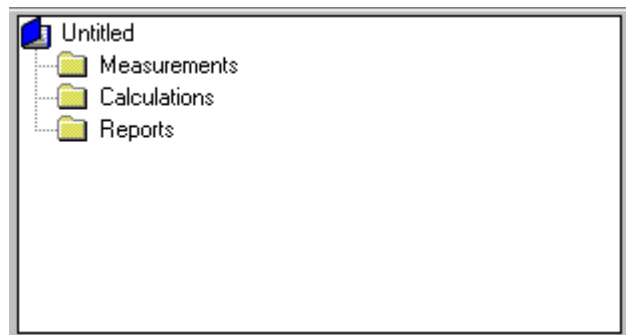

Fig. 2.1 A new, empty project in the Project View

2.1.2 Qualifier Project Structure

Most of the work you do with Qualifier can be done from the Project view. When you import data into the project, you will see that the Measurements folder in Fig.2.1 opens and that a new job icon is inserted ✅. To the left of the Measurements folder is a small minus sign, "-", while to the left of the job icon there is a plus sign, "+". If you click on these you can collapse or expand the respective part of the project tree. If the expanded tree is larger than the window, scroll bars are added.

The Project view is shown by default when you start a project and to work with the project efficiently, it can be advantageous to keep the view open at all times. If, however, you are working with a number of graphs and want more space to display them, you can click on the Project Tree button in the toolbar, 🔲 , or deselect the **View, Project View** menu item to close the window. This toggles the view on and off

(shown and hidden).

Fig.2.2 shows an example of the Project view after data has been input and copied to the Calculations branch (see section 4.2.1) and some of the branches expanded. In the figure, you can see that the tree has six levels.
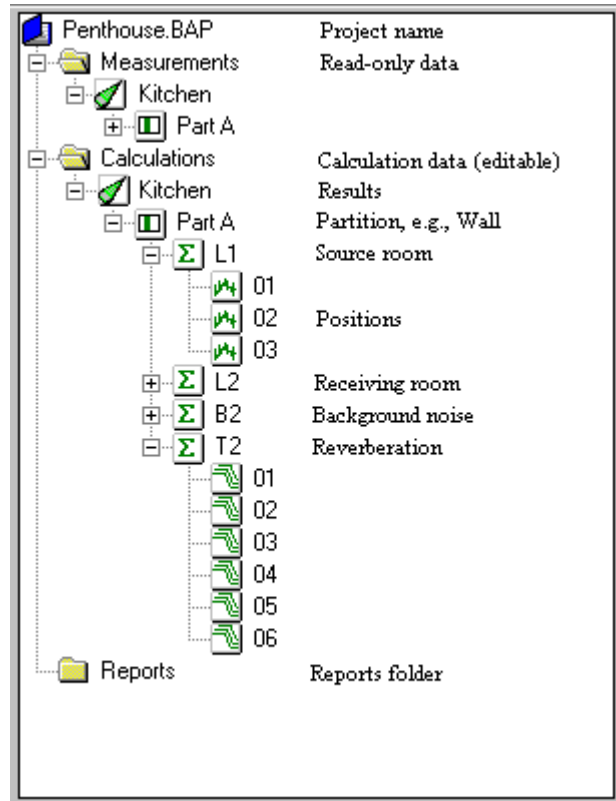

Fig. 2.2 Example of project with data imported and copied to the calculations folder

Level 1: Here called "Penthouse" with the extension .bap. This is the **project** level. When you open a new project, the default name is "Untitled". Otherwise the name is the same as the file name under which you save the project.

Level 2: Here there are three folders, "Measurements", "Calculations" and "Reports". When you save a project, you automatically save all data in these folders.

Level 3: Here called "Kitchen". This is the **job** level. When, for example, you input data directly from 2260, you put it in the Measurement folder as a job containing all the data from all the measurements you made with 2260. In the Calculations folder, this level contains the results of calculations of building acoustics parameters for the room.

For the Reports folder, this level contains any reports you have created.

Level 4: This is the partition level. Each job contains a folder for each partition for which there are data. The partition folder contains the results of calculations for that partition.

Level 5: Depending on whether you have measured airborne or impact sound, this level contains up to four folders; L1, L2, B2 and T2. The folders contain averages of the measurements at all positions that you include in the average.

Level 6: This level contains the actual measurement or calculation data for each measurement

position. You can use the <u>right-hand mouse button</u> to choose whether or not to exclude data from the average, or double click to display the data.

Note: Measurement data is *read-only*; you can edit calculation data.

2.1.3 Properties

With the exception of the Project and the Measurements, Calculations and Reports folders, each item in the project tree has properties attached to it. To display the corresponding Properties dialog box, highlight the item, click the right-hand mouse button and select **Properties** from the mouse menu. The properties vary from item to item as described below.

Job Icon

The properties here are shown in three tab pages: General, Standard and Notes.

General
The General page is structured as follows.

> **Job:** This gives the name of the job, the measurement task, for example airborne sound insulation, and the dates and times at which the first and last files were saved by 2260 Investigator.
>
> **Measurement setup:** This indicates the 2260 bandwidth and frequency range used for the measurement and the standard used for the measurement. Note: The partition properties also have a Setup page which displays in details the setup for each partition.
>
> **Reverberation time averaging mode:** This is fixed to T20/T30 if the properties are measurement properties. If you select job properties from the Calculations job instead, the option buttons allow you to select ensemble averaging also:
>
> - **Ensemble averaging** - In this case the decay curves are averaged before the reverberation time is calculated. If you view the T2 graph (double-click on the T2 folder), you can display T20/T30 average, decay curve average and multispectrum average.
>
> - **T20/T30** - Here the reverberation time is calculated for each decay curve before averaging. If you view the T2 graph, you can display T20/T30 average, and the reverberation time at each position.
>
> You can freely switch between the two types of averaging at any time during calculations and any display of T2 is automatically updated. The type of averaging you select also affects the graph displayed in reports if the report includes T2 positions/multispectrum. See <u>Report icon</u>, below.

Standard
The Standard page allows you to select the standard to be used for calculations and to see the parameters that are available for that standard for airborne or impact noise.

> **Note:**
>
> - You cannot change the standard in Measurement properties. It is only in Calculation properties that this option becomes available.
>
> - When the selected standard is NEN, additional parameters become visible - Sz;vg, T0 and Vtot (Vtot is read only)

To select a standard, use the drop-down Perform calculation according to list to select the standard you want, e.g., Sia (Switzerland), and click on it.

The spectrum list on the left displays the parameters calculated (and available) in the current standard. The right-hand list displays all single values available for the selected parameter. The list selection does not have any effect when you press **OK** (i.e., it has no effect if you highlight items in the list - all parameters are calculated for the selected standard).

Notes on Job Properties:
These notes will appear in the report if selected in the report template properties.

My note
Enter notes relevant to the job.

Client
Enter name and address of the organisation or person who ordered the test.
This note also appears in forms for **ISO**, **SS**, **DIN** or **ÖNORM** standards.

Name of institute
Enter the name of the institute or organisation that has performed the measurements.
This note also appears in forms for the **ISO** and **SS** standards.

Art der Prüfung
Select kind of test.
This note only appears in forms for **DIN** or **ÖNORM** standards.

Partition Icon

The properties here are shown in three tab pages: General, Setup and Notes.

General:
The General page is structured as follows:

Partition: This gives information on the job name and a label for the partition to which the properties apply.

Parameters: In order to calculate building acoustics parameters correctly, the software needs to know the **volume of the room** in which measurements were made, the **surface area** of the partition (wall, floor, etc.) in question and the **reference value** to be used for reverberation time. The Partition Properties dialog allows you to enter these values if the partition is part of a job in the calculation folder.

T0, the reference reverberation time, is normally 0.5 seconds but may vary with standards. See the relevant sections in Chapter 6 for details.

Calculate: T20 or T30. Here you select whether Qualifier should calculate (and display) T20 or T30. The parameter is set according to the setting done in 2260. This option becomes available only if the partition is part of a job in the calculation folder.

Additional information: This field will display the status of the partition result. If the partition is part of a job in the measurement folder the status will be: *Data Not Available*. Partition results will only be

available in calculation folder.

Info related to Forms: These fields hold information to be reported when using the build-in forms. They only appear when using the **ISO**, **SS**, **DIN** or **ÖNORM** standard.
The **Number of report** and the **Source room volume Vs** are reported in forms for **ISO**, **SS**, **DIN** and **ÖNORM**.
The **Masse** in kg/m2 of the test object, the test codes for **Prüfung Din 52 210-03-/Prüfung ÖNORM S**, the condition description **Zustand** of the receiving room, and the kind **Art** of the receiving room are reported in forms for **DIN** and **ÖNORM**.

Setup:
This page contains information about the measurement setup for each partition. Both the setups for level measurements and reverberation time are displayed. Please note, that these settings are the most recently used. Other settings may have been used within the same job prior to these. In other words, these were the settings when 2260 stopped measuring.

Notes:
This page allows you to add various notes relevant to the partition. If selected in the report template properties these notes will appear in the report.
The "**Description and identification ...**" note also appears in the forms for **ISO**, **SS**, **DIN** and **ÖNORM**.
The "**Bewertung nach DIN 4109**" note only appears in the form for the DIN standard.

Correction Spectrum:
This page lists one or two correction spectra (for single or dual channel measurements) used in 2260 when L1, L2, B2 and T2 were measured.

L1, L2, B2, T2 Icons

The properties here are shown in two tab pages: General and Notes. Only in the calculation folder, the Notes page will become available.

General:
The General page is structured as follows.

Function: This gives information on the job name, the partition, and the parameter L1, L2, B2 or T2 to which the properties apply.

Position count: This gives the number of positions included in the averaging and the total number of measurement positions.

Note: Positions which are excluded from the averaging are indicated by crossing out their icons, and . Use the right-hand mouse button on the position icons and toggle **Exclude from average** to select/deselect positions to be excluded when averaging the data.

Additional information
This field contains information about the result of the averaging. There may be overloaded or underrange values included in the average. For more information, see Status codes.

Notes:
The Notes page allows you to add notes relevant to the average. This note will appear in the report if selected in the report template property.

Status Codes

Status codes are used to give warnings and to indicate errors that result, for example, in the inability of the software to determine the reverberation time. The codes are displayed in the Properties dialog boxes that contain Additional information, and the code with the highest priority is also displayed beside the cursor values at the top of a graph window.

Qualifier uses the following status codes - see Fig.2.3:

Symbol	Meaning	Outcome
E	Excluded data	
M	Manual data input	
*	L1 or L2 (but not both) has been measured serially	
B	Background noise correction limit exceeded	
V	All data underrange	No result
R	T20 has replaced T30 (T30 not available)	
N	No corner found (no noise floor)	No result
y	Noise floor above Y1 limit	No result
t	t1 beyond decay time	No result
Y	Noise floor above Y2 limit	No result
T	t2 beyond decay time	No result
Z	Positive slope (negative reverberation time)	No result
P	Less than 2 points in evaluation range	No result
O	Overload	
C	Copied data	
F	Filter may affect decay (B×T below 8)	
n	Noise floor too close to Y2	
p	Less than 4 points in evaluation range	
%	Difference between T20 and T30 above 10%	
k	Correlation coefficient too small	
U	Underrange	
b	Background noise correction used	
m	Affected by manual input	
c	Affected by copied data	
s	Measured serially	

Note:

▪ The status codes from V to k inclusive are concerned with reverberation time
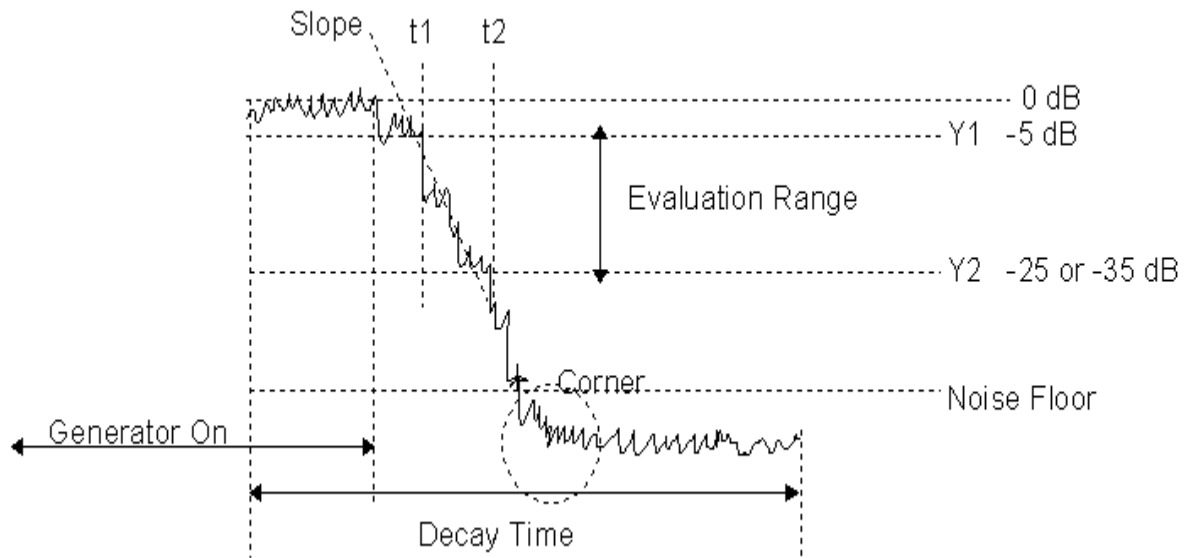
Fig.2.3 Reverberation decay

⚞ ⚟ Position Icon, L1, L2, B2, T2

The Position
This shows the job name, partition, function and position for which the data is valid.

A check box indicates whether or not the position data is included in the averaging over all positions (box is checked when included, and disabled for measurement data). If data is excluded the icon is crossed out, ⚞.

Measurement status
This gives details of how and when the original 2260 measurement was made and when the last calibration was performed. See the User Manual for 2260/BZ 7204/BZ7207 for a description of the terms used.

▤ Report Icon

The Report properties comprise a number of tab pages where you can specify what to include in a report, define user texts to include in a report and save the properties setup as a template for further reports.

Details are given in section 5.2, Report Templates and Properties.

2.2 Input from Type 2260

To transfer data from Type 2260 Investigator directly into a project, open the project and

- select **Insert, New measurement (via RS232C)** from the menu bar

- click on the ⚟ icon in the toolbar

- select the mouse menu on the Measurements folder

This item allows you to transfer data from 2260 Investigator directly to your PC via an RS-232 link on the computer's COM port. The COM port settings are configured via the Setup button or the Communication Setup item in the Tools menu.

Press the **Next** button and you will be guided through the data transfer process. Data is transferred directly into the Measurements folder of your current project.

2.3 Input from Disk

To transfer data from a PC-card or file on disk into a project, open the project and do one of the following:

- select **Insert, New measurement (via PC-card)** from the menu bar
- click on the icon in the toolbar
- select the mouse menu on the Measurements folder

This item allows you to transfer data from 2260 Investigator to your PC via PC-card. The PC-card needs to be inserted into the PC-card socket on the computer. You can also use this item to import Type 2260 jobs that have been saved on the local hard disk or network.

Use the standard Windows file Open dialog box to locate the job file (*.JOB) that you want to load into Qualifier. When you click Open, the data is transferred directly into the Measurements folder of your current project.

Note: If you manually copy files to another destination, keep the directory structure intact. **Do not** mix job files in the same directory.

2.4 Saving Projects

When you save a project, you save everything that can be shown in the project tree, i.e., all measurement data, (edited) calculation data, reports, etc., and any other settings you have changed, for example the standard used for calculations.

To save a project (the file extension for projects is .bap), do one of the following:

- click on
- Select **File, Save** or **Save As** from the program menu
- Press **<Ctrl + S>** or **<Ctrl + A>** on the keyboard

If you select Save As or are saving a project for the first time, the Save As dialog box opens where you can specify the drive, path and file name to save the project under.

If you exit Qualifier without saving, the software prompts you to do so.

Note: Reports can also be saved as separate files. See section 5.4.2.

Chapter 3: Displaying Data

3.1 Displaying a Graph

There are two ways of displaying a graph in Qualifier:

- select an item in the project tree and double-click on it with the mouse
- select an item in the project tree, click the right-hand mouse button and select **View It** from the popup menu

This opens a window that displays the data for the selected item in graphical or tabular (sheet) form. (If no graph is available for the item, double clicking has the effect of expanding or collapsing the branch of the tree and **View It** is greyed).

Colors

For all graphs and sheets, the color used for points on a graph, entries in sheets, etc., depends on whether data has been edited or affected by edited data (e.g., an average), and whether or not the data is excluded.

If you want to change the colors used for edited or affected data, select **Tools, Configure Options**:

Color for: Use the drop-down list to select:

- **Manual data input** - lets you select the colors which will be used to indicate that you have edited data manually.
- **Affected by manual input** - lets you select the colors which will be used to indicate that data values have been influenced by other data which has been manually edited. For example, if you edit a value in a position spectrum, the corresponding point in the averaged curve changes color.
- **Excluded data** - lets you select the colors which will be used to indicate that data is excluded from the average calculation.
- **All other data** - lets you select the colors which will be used to display data that do not fall into one of the above three categories. This is the default color.

The colors you select in the rest of the dialog will then apply to which of these four catagories you select.

Pressing the **Reset all** button will reset all four color schemes to factory settings.

Curve handles: Lets you select the color to be used for edited or affected points in a spectrum or lines on a reverberation decay.

Sheet cell: Lets you select the foreground and background colors for edited or affected data displayed in spreadsheet form using the Sheet tab, e.g., L1 averaged over a number of positions.

3.1.1 Tab Pages

In order to display graphs in various formats, and in order to save display space on screen, graphs may be made up of a number of tab pages as illustrated in Fig.3.1.
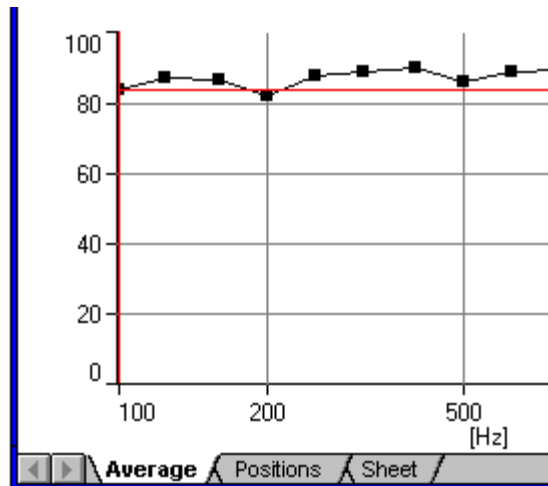
Fig.3.1 The tab pages of a graph for averaged L1

The graphs and tab pages available depend on a number of factors:

- whether you are viewing measurement or calculation data
- whether you are viewing sound levels or reverberation times
- whether you have selected ensemble or T20/T30 averaging for calculation of reverberation time (in the Calculations job properties)
- whether you are viewing data for a single position or the average of a number of positions
- whether you are viewing results of calculating building acoustics parameters

To view a graph, click on the tab at the bottom of the window. See also section 3.2, Using the Mouse and Keyboard in Graphs.

3.1.2 Positions

There are three tabs that display spectra at measurement positions: **Position, Positions** and **Average**.

Position
This is available when you display L1, L2 or B2 data for a single measurement position. The graph is a spectrum of noise level (dB) against frequency (Hz) over the full measurement frequency range. These graphs can be displayed from either the Measurements or Calculations folder.

Positions
This is available when you display L1, L2 or B2 data from the corresponding folder in the Calculations branch of the project tree, or when you display T2 data with T20/T30 averaging selected in the Job Properties. The graph shows the superimposed spectra of noise level (dB) or reverberation time (s) against frequency (Hz) for all measurement points and the full measurement frequency range.

Average
This is available when you display L1, L2 or B2 data from the corresponding folder in the Calculations branch of the project tree. For all measurement points that are not excluded, the graph shows the averaged

spectrum of noise level (dB) against frequency (Hz) over the full measurement frequency range.

3.1.3 Sheet

The Sheet tab, displays data in spreadsheet form. It is available when you display L1, L2 or B2 data from the corresponding folder in the Calculations branch of the project tree. It displays the numerical values of the noise levels at all measurement positions, the averaged values and the standard deviation at all measurement frequencies.

Sheet is also available when you display T2 data from the corresponding folder in the Calculations branch of the project tree. It displays the numerical values of averaged reverberation time at all measurement frequencies.

3.1.4 Multispectrum

There are two tabs which display multispectra: **Multispectrum** and **Multispectrum Avg**.

Multispectrum
The Multispectrum tab is available when you display T2 data for a single measurement position. It shows a 3D view of the decay curves at all frequencies. The axes are time (s), frequency (Hz) and noise level (dB). These graphs can be displayed from either the Measurements or Calculations folder.

Multispectrum Avg.
The Multispectrum Avg. tab is available when you display T2 data from the corresponding folder in the Calculations branch of the project tree, but only if ensemble averaging is selected in the Job Properties. It shows a 3D view of the averaged decay curves at all frequencies. The axes are time (s), frequency (Hz) and noise level (dB).

3.1.5 Decay Curves

There are two tabs which display decay curves: **Decay Curves** and **Decay Curves Avg**.

Decay Curves
The Decay Curves tab is available when you display T2 data for a single measurement position in the Calculations branch of the project tree, and you have selected T20/T30 averaging for the calculation of reverberation time in the Job Properties dialog box. It shows a graph of the decay curve (level versus time) at a single frequency. A drop-down list at the top of the graph lets you select the frequency to display. Two red dotted horizontal lines marks the evaluation region: from steady state - 5 dB and 20/30 dB down.

A full line is drawn on the graph in red. This is the line used for the calculation of the reverberation time that is shown at the top of the graph (e.g., T(30) = 0.54s). For most standards, the line starts 5 dB down the decay curve and then the software looks for a value for T(30). If a value cannot be found, then T(20) is calculated. For Dutch standards, T(20) is always calculated.

As long as you do not edit the data, a value for the correlation is also displayed at the top of the graph. This lets you see how well the line drawn fits the data. If the correlation is low, you may want to edit the line, by extending it or changing its gradient (the value for the correlation can then no longer be calculated). See section 4.2.5, Editing Data.

Decay Curves Avg.
The Decay Curves Avg. tab is available when you display T2 data from the corresponding folder in the Calculations branch of the project tree, and you have selected ensemble averaging for the calculation of reverberation time in the Job Properties dialog box. It shows a graph of the average of the decay curves (level versus time) at a single frequency.
The display facilities for Decay Curves Avg. are the same as for Decay Curves.

3.1.6 T20/T30

There are two tabs which display T20/T30 reverberation time curves: **T20/30** and **T20/T30 Avg**.

T20/30
The T20/T30 tab is available when you display T2 data for a single measurement position. It shows a graph of the reverberation time against frequency. The cursor position and reverberation time can be read from the top of the window.

T20/T30 Avg.
The T20/T30 Avg. tab is available when you display T2 data from the corresponding folder in the Calculations branch of the project tree. It shows a graph of the averaged reverberation time against frequency. The cursor position and reverberation time can be read from the top of the window.

3.1.6 Results

Results
The results tab is available when you view the graph for a partition. The graph displayed (and graphs available for display) depends on the standard you have chosen for your calculations. To change the standard, select **Standard** page of the Job Properties dialog box, available from the popup menu on the job icon in the Calculations folder.

At the top of the graph is a text box with a drop-down list. Use this to select the spectrum you wish to display (e.g., D, DnT, R´ for ISO 140).

Immediately above the graph is a text line showing a single-valued function such as Dw. To view different single-valued functions, move the mouse cursor to the text line so that it changes to a sideways pointing arrow ➡. Clicking the mouse then toggles through the available functions.

The graph also includes the shifted curve. To switch between results and reference curve, move the mouse cursor to the text line so that it changes to a downward pointing arrow. Clicking the mouse then toggles between the reference curve and results.

Sound Levels
The Sound Levels tab is available when you view the graph for a partition. It shows L1 Avg., L2 Avg. and B2 Avg. for the selected partition.

Reverberation
The Reverberation tab is available when you view the graph for a partition. It shows a graph of the averaged reverberation time against frequency.

3.2 Using the Mouse and Keyboard in Graphs

This section describes how you can use the mouse and keyboard to affect the *display* of graphs. How you use them to edit graphs is described in section 4.2.5.

Autoscaling

If the graph has a Y-axis in dB or seconds, you can change the range displayed.

If you move the mouse cursor to the y-axis of a graph, it turns into a double-headed arrow. A single click of the mouse autoscales the y-axis to a "round" value (steps of 10 dB or 1 s), while double-clicking set the maximum value of the y-axis equal to the maximum value displayed and the minimum value of the y-axis equal to the minimum value displayed.

Alternatively, you can click the right-hand mouse button within the graph area to open the Y-axis dialog box. The **Autoscale** and **Autoscale (Exact)** buttons correspond to the single and double clicks described above, or you can enter a maximum level in dB and the dB range to be covered or the maximum and minimum values to be displayed for a scale in seconds.

The settings are saved with the graph in the project file and remembered the next time you display the graph.

Changing Perspective in a Multispectrum

When a multispectrum is displayed, you can use the mouse to change the perspective:

1   Move the mouse cursor to the point of intersection of the graph axes.
    The cursor becomes a four-headed arrow.
2   Press and hold the left mouse button.
    When you do this, the graph cursors disappears.
3   Drag the point of intersection to a new position.
    While moving, only the outline of the graph is displayed.
4   Release the mouse button to re-draw the graph with the new perspective.

To reverse perspective on the frequency axis, i.e., to move the frequency axis from left to right or vice versa:

1   Move the mouse cursor to the point of intersection of the graph axes.
    The cursor becomes a four-headed arrow.
2   Double click the mouse.

Moving the Graph Cursor

You can use the mouse or keyboard to re-position the graph cursor.

To use the mouse, move its cursor to the desired position and click once. The graph cursor moves to the closest valid position.

To use the keyboard, use the left and right arrow keys and, if a multispectrum is displayed, the up and down arrow keys to select the cursor position. To select the extreme left- and right-hand cursor positions, you can also use the **<Home>** and **<End>** keys.

Selecting the Active Curve

If you are displaying a graph showing superimposed curves, you can toggle the curves to make each of them active in turn:

1   Move the mouse cursor to the area above the graph (but inside the window).

     The cursor changes to a downward-pointing arrow.

2   Click the arrow once to make the next curve active.

The active curve is shown in black with square dots to represent the measurement points. Reference curves are shown in red; the other curves are blue and their measurement points are not shown. If the active curve is excluded from averaging the measurement points are dimmed.

Selecting Frequency on Decay Curve Averages

To select the frequency displayed on a graph of averaged decay curves, use the drop-down list to select the frequency you want to display. If you then leave the field highlighted, i.e., do not click the mouse, you can use the up/down or left/right arrow keys to scroll through the various frequencies.

Selecting a Single-valued Function

If you are displaying a Results graph, you can toggle the single-valued functions that are valid for the selected calculation standard:

1   Move the mouse cursor to the area above the graph (but inside the window).

     The cursor changes to a sideways-pointing arrow ➡.

2   Click the arrow once to select the next function.

3.3 Copy to Clipboard

You can copy any graph, sheet, or part of a sheet to the clipboard for pasting into word-processors or spreadsheets.

To copy a graph, make sure that the window you want to copy is the active window and then select **Edit, Copy**, click on , or press **<Ctrl + C>.**

To copy a sheet, highlight the part of the sheet you want to copy (top left-hand corner for entire sheet) and then proceed as for graphs.

3.4 Printing a Graph

As well as including graphs in reports (see chapter 5), or exporting them via the clipboard (section 3.3), you can print them directly:

1   Ensure that the window containing the graph is the active window.

2   Click on

     or

     Select **File, Print** from the program menu.

Print preview is available in the usual way.

Chapter 4: Measurement Data and Calculations

4.1 Read Only Measurement Data

When you input data into Qualifier, it is put into the Measurements folder of the project tree as read-only data. You can view the measurement data at any measurement position, but cannot do any calculations or editing. This ensures that your project always contains the original measurement data.

4.2 Calculations

The Calculations folder of the project tree is where you calculate building acoustics parameters. In this folder you can:

- specify the standard you wish to use for the calculation of building acoustics results
- set a number of building acoustics parameters, such as room volume
- view total results or results for a partition
- view total results or results for a job (NEN only)
- view measurement data at a single position or averaged over a number of positions
- exclude data at single positions from the calculations
- edit data

4.2.1 Copying Measurement Data

Before you can make any calculations, you need to copy your original measurement data from the Measurement folder to the Calculations folder. You can do this in several ways.

The first option is drag and drop:

1. Position the mouse cursor over the ![job icon] job icon in the Measurements folder.
2. Click and hold the left-hand mouse button.
3. Drag the cursor to the Calculations folder.
4. Release the mouse button.

Secondly, you can:

1. Position the mouse cursor over the ![job icon] job icon in the Measurements folder.
2. Click the left-hand mouse button to highlight the item.
3. Click the right-hand mouse button to call up the mouse menu.
4. Select **Add to Calculations**.

Finally, you can use copy and paste:

1. Highlight the ![job icon] job icon in the Measurements folder.
2. Select **Edit, Copy**

   or

   click on ![copy icon] in the toolbar

   or

   press **<Ctrl + C>**.

3   Highlight the Calculations folder.

4   Select **Edit, Paste**

     or

     click on in the toolbar

     or

     press **<Ctrl + V>**.

Any of the above places an exact copy of the measurement data in the Calculations folder for further processing.

4.2.2 Changing the Standard

When data is first transferred to the measurement folder, the standard according to which the measurement was made is also transferred. This is displayed in the General page of the measurement Job Properties. You can change the standard according to which your calculations are made from calculation Job Properties:

1   Position the mouse cursor over the icon in the Calculations folder.

2   Click the right-hand mouse button to call up a menu.

3   Click on **Properties**.

4   Select the Standard tab page of the Job Properties dialog box.

Alternatively:

1   Position the mouse cursor over the icon in the Calculations folder.

2   Press **<Shift + F10>** to call up a menu.

3   Highlight **Properties** using the up and down arrow keys and press **<Enter>**.

4   Select the Standard tab page of the Job Properties dialog box.

The Standard tab page is described in section 2.1.3.

Chapter 6 contains a description of the building acoustics parameters and standards implemented in Qualifier.

4.2.3 Setting Calculation Parameters

In order to calculate building acoustics parameters correctly, the software needs to know the volume of the room in which measurements were made, the surface area of the partition (wall, floor, etc.) in question and the reference value to be used for reverberation time. The Partition Properties dialog box allows you to enter these values.

To open the Partition Properties dialog box:

1   Position the mouse cursor over a Partition icon in the Calculations folder.

2   Click the right-hand mouse button to call up a menu.

3   Click on **Properties**.

Alternatively:

1   Position the mouse cursor over a Partition icon in the Calculations folder.

2   Press **<Shift + F10>** to call up a menu.

3   Highlight **Properties** and press **<Enter>**.

Then:

4   Enter the room volume, surface area and reference reverberation time.
5   Click on **OK** to accept the changes.

Notes:

- T0, the reference reverberation time, is normally 0.5 seconds but may vary with standards. See the relevant sections in Chapter 6 for details.
- You can use the Notes tab page to add any notes or reminders about the partition. These are saved along with the project.

4.2.4 Calculation Results

To view the results of a calculation, double-click on a partition icon. This opens a graph window with a Results tab.

The graph displayed (and graphs available for display) depends on the standard you have chosen for your calculations (see section 4.2.2).

At the top of the graph is a text box with a drop-down list. Use this to select the spectrum you wish to display. For example, if you have selected calculation according to ISO 140, you can choose to display D, DnT, or R´.

Immediately above the graph is a text line showing a single-valued function such as Dw. To view different single-valued functions, move the mouse cursor to the text line so that it changes to an arrow ➡. Clicking the mouse then cycles through the available functions.

Qualifier lets you make a report of your results. A full description of the report generation facilities incorporated into the software is given in Chapter 5.

4.2.5 Editing Data

Data in the Calculations folder can be edited by displaying a graph or sheet and doing the editing there. The only graphs which cannot be edited are multispectra. Whenever you edit data, the color of the data point, background color in a sheet or end points on a decay line changes. Data which are affected by edited data, for example the average L1 when you edit the data at one measurement point, are shown in another color. See Chapter 3: Colors.

Data in a Sheet
To edit data in a sheet, select the cell you want to edit and enter a new value. If the sheet is displaying data dependent on the edited data, these are marked as "Affected by manual input". See Chapter 2: Status Codes.

Points in a Spectrum
To edit data represented as a series of points in a spectrum (reverberation time or noise level), move the graph cursor to the point you want to edit and then use the **up and down arrow keys** to shift the point. If you hold down the **<Ctrl>** key while using the up and down arrow keys, you can shift the point at **ten times the speed**.

Reverberation Decay Lines
To edit the reverberation time from the averaged decay curve, select the frequency you want to edit then use the mouse to **click and drag** the upper or lower point to the required position.

Undoing Changes

There are two **Reset** buttons in a toolbar at the top of each window in which data can be edited.

🔄 **Reset All:** Resets all changes made *in the current view* to their original measured values (for averaged decay curves, this means the calculated reverberation time at all frequencies, even if they are not visible)

🔄 **Reset Selected:** Resets the current point or decay line to its original measured value

4.2.6 Reusing Data

You can reuse (copy) measurements from one partition to another, and between jobs. This is useful e.g. when measuring two partitions of one receiving room - then you need to measure T2 only once and then reuse (copy/paste) it from one partition to the other.

Functions (L1, L2, B2 and T2) can be reused.

This is done using drag and drop, or copy/paste in the in the project tree (right-click or use the Edit menu). Drag from (or copy) e.g. L1-average, and drop (or paste) it on the "Partition" where it is to be reused. All positions for L1 are then reused.

A function can also be deleted. Single positions cannot be deleted.

Reuse is not allowed if setups are not consistent between source and destination jobs, i.e. if bandwidth, start-frequency and stop-frequency are not identical.

Further the following is not allowed since it would not make sense:

- To copy L1 and L2 to or from dual-channel measurements, e.g. in Façade measurements, where L1 and L2 belong together.

- To copy L1 to an Impact-measurement
- To copy L1, L2, B2 or T2 to a Reverb-Job.

Chapter 5: Report Generation

5.1 Creating Reports

The actual *creation* of a report is a simple process. There are three ways to do it. A simple way is to use drag and drop:

1   Position the mouse cursor over the ☐ job icon in the Calculations folder.
2   Click and hold the left-hand mouse button.
3   Drag the cursor to the Reports folder.
4   Release the mouse button.

Secondly, you can:

1   Position the mouse cursor over the ☐ job icon in the Calculations folder.
2   Click the right-hand mouse button to call up the mouse menu.
3   Select **Add to Reports**.

Finally, you can use copy and paste:

1   Highlight the ☐ job icon in the Calculations folder.
2   Select **Edit, Copy**

   or

   click on ☐ in the toolbar

   or

   press **<Ctrl + C>**.

3   Highlight the Reports folder.
4   Select **Edit, Paste**

   or

   click on ☐ in the toolbar

   or

   press **<Ctrl + V>**.

Any of these procedures creates a ☐ report icon in the Reports folder. If you then use the mouse menu to open the report properties dialog box, you can specify what to include in the report. See section 5.2.

5.2 Report Templates and Properties

The Report Properties dialog box comprises two to four tab pages that allow you to fully specify the appearance and contents of your reports.

For **ISO, SS, DIN** and **ÖNORM** calculation standards you can make your report

- as form pages or formblätter in accordance with the used standard - or
- user defined.

For all other calculation standards you can make your report

- user defined.

The **user defined** report is defined using three template pages:

- Template - Airborne/Impact/Façade/Reverberation

- Data Entry

- Template - Page

Note: You can make reports based on the same measurement data but for different calculation standards. Example: You want to report your measurement according to ISO and DIN standards:

1. Make your calculation based on ISO (select your standard on the Job Properties page for the job in the calculations folder (see section 4.2.2).
2. Add your calculated job into the Reports folder (see section 5.1).
3. Define and print your first report (see section 5.2.1-3 and section 5.3).
4. Select the DIN standard (see section 4.2.2) - all results are automatically recalculated to reflect the new standard.
5. Define and print your second report (see section 5.2.1-3 and section 5.3).

5.2.1 Template - Airborne/Impact/Facade/Reverberation

Here you can select from a wide variety of items to include in your report, edit titles and specify their appearance and set up a default report template. The template that appears here is dependent on the type of job for which you are making a report. Fig.5.1 shows the Airborne template. The Impact, Facade and Reverberation templates are similar, but have different lists of items to display.

Note: Throughout the rest of this chapter we will refer only to the Template - Airborne tab page. The information also applies to the Impact, Facade and Reverberation pages.
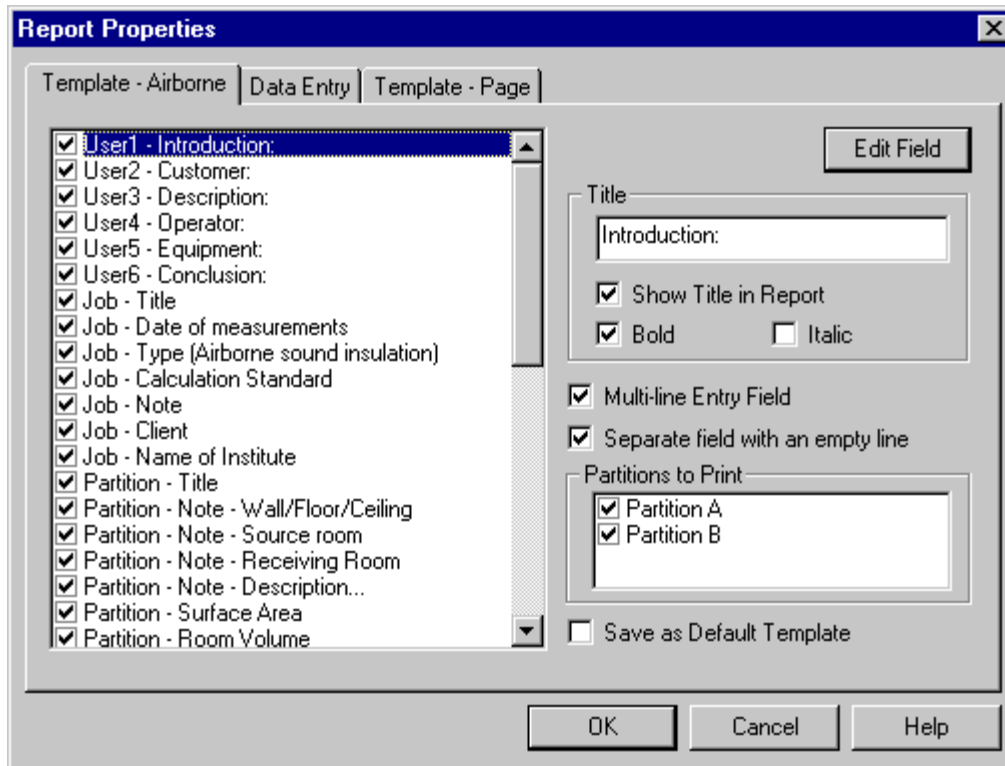
Fig.5.1 The Template - Airborne page of the Report Properties dialog box

List

The list on the left of the dialog box shows all the items you can select for display. Items are selected when there is a tick in the check box to their left.

The first six items are for user specified data entry, and if you select them you can use the Data Entry tab page to enter the text you require. See section 5.2.2.

A number of items (preceded by the text "Partition") are displayed for a single partition. Use the Partition drop down list to select which partition to display.

To select/deselect items, use the left-hand mouse button and the **<Ctrl>** and **<Shift>** keys to select single items, blocks of items or a number of items from the list. If a number of items are highlighted and you then click on the check box to the left of one of the highlighted items, all the selected items will be given the same status as the one on which you have clicked.

Note: The graph displayed if you select T2 positions/multispectrum depends on whether you have selected T20/T30 or ensemble averaging in the calculation Job Properties dialog box. See section 2.1.3, Job Icon.

Edit Field

When you have highlighted a single item in the list, you can click on **Edit Field** to specify how that item will appear in your report:

▪ **Title:** Type in the text that you want to appear in the list and on the Data Entry tab page (first six items only) and optionally in your report. The change is applied when you select another item, or when you click on **OK**.

▪ **Show Title in Report:** Select this check box if you also want the title to be visible in your report

- **Bold:** Select this check box if you want the title to be bolded when included in a report
- **Italic:** Select this text box if you want the title to be italic when included in a report

If you have highlighted one of the first six items in the list on the left (User 1 to User 6), you can check **Multi-line Entry Field** to allow several lines of text entry. Otherwise you can only enter one line of text. You enter text on the Data Entry tab page. See section 2.1.3, Job Icon.

Separate Field with an Empty Line
If you select this check box for a field, there will be an empty line after the field when it is included in your report. This allows you to add extra white space to a report to avoid cramped text.

Partitions to Print
Select the partitions to print from the list. Items are selected when there is a tick in the check box to their left.

Save as Default Template
If you select this check box and click on **OK**, the current settings on the Template - Airborne tab page as well as the Data Entry and Template - Page are saved as the default template for all Qualifier projects. Otherwise the settings are only used by the current report.

5.2.2 Data Entry

This page shows a series of text boxes, one for each User item selected for display in the Template - Airborne tab page (i.e., the first six items in the list shown in Fig.5.1). You can enter a single line of text, or a more extensive description, depending on the setting you have chosen for **Multi-line Entry Field** also on the Template - Airborne tab page.

If you enter a single line of text, and have also chosen to show the title in the report, the two are shown on the same line.

If you enter multiple lines of text, any title is shown on the line above the text as a heading.

5.2.3 Template - Page

This tab page allows you to specify how your report pages will appear.

Company Name on first page
If you want to include your company name on the first page:

1   Type the name into the text box.
2   Select the Alignment (left, right or centered).

Page Header for Print
Type in any text that you want to use as the page header. If you want to include the job title specified on the Template - Airborne tab page, select the text box.

Page Footer for Print
Type in any text that you want to use as the page footer. If you want to include the page number, date or time, select the appropriate check box.

Font
This opens a standard Windows Font dialog box where you can specify the font to be used for your report. Note that you can only specify the font and point size; the font style (bold, italics, etc.) is not active.

5.3 Outputting Reports

5.3.1 Printing

As well as exporting reports via the clipboard (section 5.3.2), you can print them directly:

1   Ensure that the window containing the report is the active window.

2   Click on [printer icon]

or

Select **File, Print** from the menu bar

or

Select **Print** from the mouse menu on the report

or

Press **<Ctrl + P>**.

Print preview is available in the usual way.

5.3.2 Copy to Clipboard

You can copy any report to the clipboard for pasting into word-processors where you can edit the text, etc.

To copy a report:

1   Ensure that the window you want to copy is the active window.

2   Click on [copy icon]

or

Select **Edit, Copy** from the menu bar

or

Select **Copy** from the mouse menu on a report

or

Press **<Ctrl + C>**.

5.4 Saving Reports

5.4.1 As Part of Project

Whenever you save a project, you automatically save any report associated with it, so that the next time you open the project, the report is included.

5.4.2 As External File

As well as saving a report as part of the project, you can save it as a separate .RTF file, which you can later open using, for example, MS Word.

To save the report:

1   Select **File, Save Report As**

or

With the mouse cursor in an open report window, click the right-hand mouse button and select **Save Report As** from the popup menu.

This opens the Save Report As dialog.

2   Select the drive, path and file (with extension .rtf) where you want to save the report.

3   Click **OK**.

Chapter 6: Building Acoustics Parameters and Standards

Note: Before printing this chapter, go into the print setup and select landscape page orientation to allow room for the tables.

6.1 Implementation of Standards

The table below shows the standards which are implemented in Qualifier. To select the standard, click the right-hand mouse button on the Calculations job icon , select **Properties** and use the drop-down Standard list on the **Standard** page (see section 4.2.2).

7830 Setup:	**ISO**	**SS**	**DIN**	**ÖNORM**	**BS**	**BREW**	**Sia**	**UNI**	**NF**	**NBE**	**CTE**	**ASTM**	**NEN**	**NEN'06**	**N**
Country:		**Sweden**	**Germany**	**Austria**	**UK**	**England Wales**	**Switzerland**	**Italy**	**France**	**Spain**	**Spain**	**USA**	**Holland**	**Holland**	
Basic standards:	ISO 140 ISO 717	ISO 140 ISO 717	ISO 140 ISO 717	ISO 140 ISO 717	ISO 140 ISO 717	ISO 140 ISO 717	ISO 140 ISO 717	ISO 140 ISO 717	NF S31-05x	ISO 140	ISO 140	ASTM E336, 1007, 1332	NEN 5077	NEN 5077-2006	IS
Airborne: **Calculated parameters**	D Dw Dn Dnw DnT DnTw R´ R´w R Rw DnTw or R´w or *Rw* + C Ctr C50-3150 C50-5000 C100-5000 Ctr50-3150 Ctr50-5000 Ctr100-5000	ISO plus R´w8 *Rw8* Dw8 DnTw8	See ISO	See ISO	See ISO	DnT DnTw+C DnTw+Ctr	ISO plus: DnTw+C-Cv	See ISO	D DnT DnATrose DnATroute R Rrose Rroute	ISO* plus: DA Dw+C Dw+Ctr DnAT Dnw+C Dnw+Ctr RA R'A * not C and Ctr corrections for extended frequency	ISO* plus: DA DnA DnT,A RA R'A	NR NNR ATL NIC NNIC ASTC	DnT Ilu Ilu;k	DnT DnT,A DnT,A,k	D Dr Dr R´ R

Façade:	Dls,2m	See ISO	See ISO	See ISO	See ISO		ISO plus:	See ISO		ISO	ISO	OILR	Gi	Gi	R'₂
	Dls,2m,w									plus:	plus:	OITL	GA	GA	R'ₜ
Calculated	Dls,2m,nT						D45nT					OITC	GA;k		Dl
parameters	Dls,2m,nT,w							DnT45						GA;k	Dl
	Dls,2m,nT,w +						Dls,2m,nT,w+Ctr-Cv	DnATroute45							Dt
	C						Dtr,2m,nT,w+Ctr-Cv	DnTtr							Dt
	Ctr						D45nT,w+Ctr-Cv	DnATroute							
	Dls,2m,n								Dls,2m,A						
	Dls,2m,n,w								Dls,2m,nAT						
	Dtr,2m								Dtr,2m,A						
	Dtr,2m,w								Dtr,2m,nAT						
	Dtr,2m,nT								R'A45						
	Dtr,2m,nT,w +								Dls,2m,n,w+C						
	C								Dls,2m,n,w+Ctr						
	Ctr														
	Dtr2m,n								R'45A						
	Dtr,2m,n,w								R'45Atr						
	R'45 R'tr,s								R'A R'Atr						
	R'45w or								D2m,A						
	R'tr,s,w +								D2m,Atr						
	C								D2m,n,A						
	Ctr								D2m,n,Atr						
	C50-3150								D2m,nT,A						
	C50-5000								D2m,nT,Atr						
									Dls,2m,n,w+C						
	C100-5000								Dls,2m,n,w+Ctr						
	Ctr50-3150														
	Ctr50-5000														
	Ctr100-5000														
Impact:	L´nT L´nTw	ISO plus	See ISO	See ISO	See ISO		See ISO	See ISO	LnT	ISO plus:	See ISO	Ln	LnT	LnT,A	L´

Calculated parameters	L´n L´nw L´nw8	Ln	LnAT	IIC	Ico	L´
	Ln Lnw Lnw8	LnAT	LnA			*Ln*
	L´nw, *Lnw* or L´nTw8	LnA				
	L´nTw +					
	Ci					
	Ci50-2500					

Note: The unprimed parameters shown in italics are laboratory parameters.

6.2 Overview of National and International Standards

Sweden	As ISO, but retains the 8 dB rule. C-corrections will be used with no 8 dB-rule.
Germany	As ISO.
Austria	As ISO.
UK:	As ISO.
England, Wales:	Airborne task according to BREW using two source locations
Switzerland:	As ISO, but has a choice of To.
Italy:	As ISO
France	ISO 717 has calculations similar to those of the French standards, but they are not identical.
Spain:	As ISO, but also uses calculations similar to the French standards.
Holland	Special standard; uses octaves and special calculation procedures.
USA	Frequency range and designations differ from ISO. Weighted index for impact has an offset.

Standards - Overview

Measurement			Sweden	Germany	Austria	UK	England Wales	Switzerland	Italy	France	Spain	Spain	Holland	Holland	USA
		ISO	SS	DIN	ÖNORM	BS	BREW	Sia	UNI	NF-S31-NBE	CTE	NEN	NEN'06	ASTM
Typical Parameters		R´ L´n	R´ L´n	R´ L´n	DnT L´nT	DnT L´nT	DnT	DnT L´nT	Dn Ln	DnAT LnAT	DnAT LnAT	DnT,A L'nT	Ilu Ico	DnT,A LnT,A	ATL Ln
Airborne	Laboratory	140-3	EN20 140-3	EN 20140-3	S5101	EN20140-3				8270-1	051	74-040-84/3	CTE2008			
	Field	140-4	EN20 140-4	52210-1	S5100-1	2750-4	BREW	181		8270-4	054, 057	74-040-84/4	CTE2008	5077	5077	E336-90
	Facade	140-5	EN20 140-5	52210-5	S5100-3	2750-5		181		8270-5	055, 057	74-040-84/5	CTE2008	5077	5077	E966-90
Impact	Laboratory	140-6	EN20	52210-1	S5101	2750-6				8270-6	052	74-040-	CTE2008			

Field	140-7	140-6 EN20 140-7	52210-1	S5100-2	2750-7		181	8270-4	056, 057	84/6 74-040- 84/7	CTE2008	5077	5077	E1007-90
RT	3382 354		52212										5077	5077
Rating	**Air**	717-1	SS-ISO717-1	52210-4	S5100-1	5821-1, -3	BS EN 717-1	181	8270-7	057	NBECA- 88	CTE2008	5077	NPR5079 E413-73 E1332-90
	Impact	717-2	SS-ISO717-2	52210-4	S5100-2	5821-2		181	8270-7	057	NBECA- 88	CTE2008	5077	NPR5079 E989

6.3 Definitions

Note: For each standard, definitions identical to those of ISO are not shown.

6.3.1 General Definitions

L1   Spectrum of level in transmitting room.

L2   Spectrum of level in receiving room.

B2   Spectrum of background noise level in receiving room.

Averaging: Levels (L1, L2 and B2) are averaged for a number (n) of positions using $L = 10\log\dfrac{1}{n}\sum\limits_{i=1}^{n}10^{Li/10}$

T2   Spectrum of reverberation time in receiving room. Alternatively, T may be used as a symbol.

Averaging: Reverberation times for a number of positions may be averaged using arithmetical averaging.

Alternatively, decay curves may be averaged for a number of positions (ensemble averaging).

To   Reference reverberation time. For dwellings, normally 0.5s. Several standards have equations to calculate To as a function of V.

Ao   Reference equivalent absorption area; Ao is set to 10 square metres in all equations, since this is the value used in all standards.

V   Volume in cubic metres of receiving room.

S   Surface area in square metres of partition between transmitting and receiving room.

6.3.2 ISO

D   Level difference   D = L1-L2

Dw	Weighted level difference	
Dn	Normalized Level Difference	$Dn = L1-L2+10\log 10T2/0.16V$
DnT	Standardized level difference	$DnT = L1-l2+10\log T2/To$
DnTw	Weighted standardized level difference	
R´	Apparent sound reduction index	$R´ = L1-L2+10\log ST2/0.16V$
R´w	Weighted apparent sound reduction index	
R	Sound reduction index	$R = L1-L2+10\log ST2/0.16V$
Rw	Weighted sound reduction index	
L´nT	Standardized impact sound pressure level	$L´nT = L2-10\log T2/To$
L´n	Normalized impact sound pressure level	$L´n = L2+10\log 0.016V/T2$
C	Spectrum adaptation term (pink spectrum)	
Ctr	Spectrum adaptation term (traffic spectrum)	

6.3.3 SS - Sweden

R´w8   Result of weighting calculation using 8dB-rule (see SS EN 20140). Dw8, DnTw8, L´nTw8 and
L´nTw8 are similarly calculated

6.3.4 DIN - Germany

Dnw   Bewertete Norm-Schallpegeldifferenz

6.3.5 NF - France

DnAT   = DnATrose, DnATroute. Isolement au bruit aérien normalisé exprimé en dB(A)

Rrose   Indice d'affaiblissement acoustique exprimé en dB(A), pour un bruit rose

Rroute   Indice d'affaiblissement acoustique exprimé en dB(A), pour un bruit de trafic routier

LnAT   Niveau de bruit de choc normalisé exprimé en dB(A)

LnA   Niveau de bruit de choc normalisé exprimé en dB(A)

6.3.6 NEN - Holland

Ilu   Isolatie-index voor luchtgeluid

Ilu;k   Karakteristieke isolatie-index voor luchtgeluid

Sz;vg   Oppervlakte van het gemeenschappelijke deel van de inwendige scheidingsconstructie tussen de zendruimte en het verblijfsgebied, in m2.

Gi   Partiële geluidwering van een scheidingsconstructie voor octaafband

GA   Geluidwering van een scheidingsconstructie

GA;k   Karakteristieke geluidwering van een scheidingsconstructie

Ico   Isolatie-index voor contactgeluid

6.3.7 NEN'06 - Holland

DnT,A   A-gewogen genormeerd lucht-geluidniveauverschil

DnT,A,k A-gewogen genormeerd karakteristieke lucht-geluidniveauverschil

Gi   Partiële geluidwering van een scheidingsconstructie voor octaafband

GA   Geluidwering van een scheidingsconstructie

GA;k   Karakteristieke geluidwering van een scheidingsconstructie

LnT,A   A-gewogen genormeerd contact-geluidniveau

6.3.8 NBE - Spain

RA   Similar to NF Rrose

LnA   Similar to NF LnA

LnAT   Similar to NF LnAT

DnAT   Similar to NF DnATrose

6.3.9 ASTM - USA

NR   Noise Reduction

NIC   Noise Insulation Class

NNR   Normalised Noise Reduction

NNIC   Normalised Noise Insulation Class

ATL   Apparent Transmission Loss

ASTC   Apparent Sound Transmission Class

OILR   Outdoor-Indoor Level Reduction

OITL   Outdoor-Indoor Transmission Loss

OITC   Outdoor-Indoor Transmission Class

IIC   Impact Insulation Class

6.3.10 BREW - England Wales

DnT   Standardized level difference, from two source locations (1) and (2)   (Level Difference (1) + Level Difference (2))/2
= ((L1(1) - L2(1)) + (L1(2) - L2(2)))/2 = (D(1) + D(2))/2
DnT = (D(1) + D(2))/2+10log T2/To

DnTw   Weighted standardized level difference

6.4 Airborne - ISO 140-4

Standard	Measure	Bandwidth Hz	Calculate	Equation	Weighted	Weighting calculation
ISO 140-4	L1 L2 T2 B2	1/3 octave: Min. 100-3150	D	D=L1-L2	Dw	Shift the reference curve (table 6.4.1) towards the measured curve, in 1dB steps, until the average unfavourable deviation is as large as possible but not more than 2.0dB.
Weighting: ISO 717-1		Option 50-5000 1/1 octave: Min. 125-2000 Option 63-4000				An unfavourable deviation occurs when the result of measurement is less than the reference value. Dw is the value of the shifted reference curve at 500Hz
			Dn	Dn=L1-L2+10log 10T2/0.16V	Dnw	As above (see DIN 52210 - Dnw is not defined in ISO 717)
			DnT	DnT=L1-L2+10log T2/To	DnTw	As above
			R´	R´=L1-L2+10log ST2/0.16V	R´w	As above
					DnTw + C	$C = X_A - DnTw$ where $X_A = -10\log\sum 10^{(Li-DnTi)/10}$ i: centre frequency index Li: values in table 6.4.2 DnTi: DnT at centre frequency
					R´w + C	As DnTw+C, except replace DnT by R´
					DnTw + Ctr	As DnTw+C, except use table 6.4.3
					R´w + Ctr	As DnTw+C, except replace DnT by R´ and use table 6.4.3

Note: DnTw+C is similar to DnAT used in the French standard NF S31-057.

Table 6.4.1: ISO 717-1, Reference curves for airborne sound

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1/3 octave value dB	33	36	39	42	45	48	51	52	53	54	55	56	56	56	56	56
1/1 octave value dB		36			45			52			55			56		

Table 6.4.2: ISO 717-1, Sound level spectra to calculate C, A-weighted and normalized to 0dB

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1/3 octave value dB	-29	-26	-23	-21	-19	-17	-15	-13	-12	-11	-10	-9	-9	-9	-9	-9
1/1 octave value dB		-21			-14			-8			-5			-4		

Table 6.4.3: ISO 717-1, Sound level spectra to calculate Ctr, A-weighted and normalized to 0dB

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1/3 octave value dB	-20	-20	-18	-16	-15	-14	-13	-12	-11	-9	-8	-9	-10	-11	-13	-15
1/1 octave value dB		-14			-10			-7			-4			-6		

6.5 Airborne - ISO 140-4 Enlarged Frequency Range

Standard	Calculate	Equation	Weighted	Weighting calculation
ISO 140-4	R´	As in table above	R´w+C50-3150	As for R´w+Ctr, except use table 6.5.2
Weighting: **ISO 717-1**			R´w+C50-5000	As above, except use table 6.5.2 in the range 50 - 5000Hz
			R´w+C100-5000	As above, except use table 6.5.2 in the range 100 - 5000Hz
			R´w+Ctr50-3150	As above, except use table 6.5.3
			R´w+Ctr50-5000	As above, except use table 6.5.3
			R´w+Ctr100-5000	As above, except use table 6.5.3

Note: The names of parameters follow the relevant centre frequencies (e.g., C63-4000 for octave calculation)

Table 6.5.1: ISO 717-1, Sound level spectra to calculate C50-3150, A-weighted and normalized to 0dB

Centre frequency	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1/3 octave value dB	-40	-36	-33	-29	-26	-23	-21	-19	-17	-15	-13	-12	-11	-10	-9	-9	-9	-9	-9
1/1 octave value dB		-31			-21			-14			-8			-5			-4		

Table 6.5.2: ISO 717-1, Sound level spectra to calculate C50-5000 and C100-5000, A-weighted and normalized to 0dB

Centre frequency	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
1/3 octave value dB	-41	-37	-34	-30	-27	-24	-22	-20	-18	-16	-14	-13	-12	-11	-10	-10	-10	-10	-10	-10	-10
1/1 octave value dB		-32			-22			-15			-9			-6			-5			-5	

Table 6.5.3: ISO 717-1, Sound level spectra to calculate Ctr for any frequency range, A-weighted and normalized to 0dB

Centre frequency	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
1/3 octave value dB	-25	-23	-21	-20	-20	-18	-16	-15	-14	-13	-12	-11	-9	-8	-9	-10	-11	-13	-15	-16	-18
1/1 octave value dB		-18			-14			-10			-7			-4			-6			-11	

6.6 Impact - ISO 140-7

Standard	Measure	Bandwidth Hz	Calculate	Equation	Weighted	Weighting calculation
ISO 140-7 Weighting: ISO 717-2	L2 T2 B2	1/3 octave: Min. 100 - 3150 Option 50 - 5000 1/1 octave: Min. 125 - 2000 Option 63 - 4000	L´nT	$L´nT = L2 - 10\log T2/To$	L´nTw	Shift the reference curve (table 6.6.1) towards the measured curve, in 1dB steps, until the average unfavourable deviation is as large as possible but not more than 2.0dB. An unfavourable deviation occurs when the result of measurement exceeds the reference value. **1/3 octaves:** L´nTw is the value of the shifted reference curve at 500Hz **1/1 octaves:** L´nTw is the value of the shifted reference curve at 500Hz less 5dB
			L´n	$L´n = L2 + 10\log 0.016V/T2$	L´nw	As above
					L´nw+Ci	$Ci = \left(10\log \sum 10^{Li/10}\right) - 15 - L'nw$ i: Centre frequency index for 100 - 2500Hz Li: Value of L´n at frequency i

L´nw+Ci50-2500	As above, except use frequencies 50 - 2500Hz
L´nTw+Ci	As above, except replace L´n by L´nT and L´nw by L´nTw

Table 6.6.1: ISO 717-2, Reference curves for impact sound

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1/3 octave value dB	62	62	62	62	62	62	61	60	59	58	57	54	51	48	45	42
1/1 octave value dB		67			67			65			62			49		

6.7 Airborne and Impact

6.7.1 Sweden - SS EN 20140

Similar to ISO
SS EN 20140 follows ISO, except for the 8dB-rule (see below).

Measurements
Measurements follow ISO-140.

Weighting Calculation
Rating is performed as in ISO 717-1 and ISO 717-2, but using the so-called 8dB-rule (see below).

The result of the weighting calculation is R´w8 , Dw8 ,DnTw8 for airborne, and L´nw8 , L´nTw8 for impact, where 8 denotes the 8dB-rule.

C-corrections
The 8dB-rule is not used for C-corrections.

The 8dB-rule
The 8dB-rule is used when rating 1/3-octave (or 1/1 octave spectra).

It states that besides the 2dB limit for the average of unfavourable deviations, there is an additional limit to the maximum unfavourable deviation at any one frequency in the calculation range; this limit is 8 dB for 1/3 octaves (5 dB for octaves). Both limits may be reached at the same time.

6.7.2 Germany - DIN 52210

Similar to ISO.

6.7.3 Austria - ÖNORM S5100

Similar to ISO.

6.7.4 UK - BS 2750 & 5821

Similar to ISO.

6.7.5 Switzerland - Sia 181

Similar to ISO
ISO 140 is followed except for To which depends on room volume measured in cubic metres (see below).

Reference Reverberation Time To
For room volumes $V \leq 100$ the reference reverberation time To = 0.5s

For room volumes $100 < V < 2500$ the reference reverberation time

$$To = to \cdot \sqrt{V / Vo}$$

where to = 1s, Vo = 400 m3

For room volumes $V \geq 2500$ m3 the reference reverberation time To = 2.5s

6.7.6 Italy - UNI 8270

Similar to ISO

6.7.7 France - NF S31-054 & NF S31-056

Airborne - NF S31-054

Standard	Measure	Bandwidth (Hz)	Calculate	Equation	Weighted	Weighting Calculation
NF S31-054	L1 L2 T2 B2	1/3 octave:	D	D = L1-L2		

| Weighting: NF S31-057 | Min. 100 - 5000 1/1 octave: Min. 125 - 4000 | DnT | DnT = DnT = L1-L2+10log T2/To

To is specified depending on the use of the room. In the absence of such specification (V in cubic metres),
To = 0.5s   if V < 50
To = V/100   if V > 50 | DnATrose | $DnATrose = 10\log \sum 10^{(Sj+Cj)/10} - 10\log \sum 10^{(Sj+Cj-DnTj)/10}$
Sj: assumed pink noise level L1 (say Sj = 100dB in all bands)
Cj: value in table 6.7.1
DnTj: DnT at centre frequency j
j: centre frequency index |
| | | R | R=L1-L2+10log ST2/0.16V | DnATroute
Rrose
Rroute | As above, except Sj is taken from table 6.7.2
As above, except replace DnAT and DnTj by R and Rj
As above, except use table 6.7.2 |

Table 6.7.1: NF S31-057, A-weighting spectrum

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
1/3 octave value dB	-19.1	-16.1	-13.4	-10.9	-8.6	-6.6	-4.8	-3.2	-1.9	-0.8	0	0.6	1.0	1.2	1.3	1.2	1.0	0.5
1/1 octave value dB		-16			-8.5			-3			0			1			1	

Note: The spectrum is not normalized to any particular A-weighted level. Only the shape matters.

Table 6.7.2: NF S31-057, Rroute reference spectrum

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
1/3 octave value dB	66	66	66	65	65	63	62	61	61	61	60	59	59	58	56	54	52	50
1/1 octave value dB		71			70			66			65			63			57	

Note: The spectrum is normalized at an A-weighted level around 70dB(A). Only the shape matters.

NF S31-057: Reference Reverberation Time To

For dwellings, To = 0.5s. Otherwise:

For room volumes (in cubic metres) V ≤ 50, the reference reverberation time To = 0.5s

For room volumes (in cubic metres) V > 50, the reference reverberation time To = to V/Vo, where to = 1s, Vo = 100.

Impact - NF S31-056

Standard	Measure	Bandwidth Hz	Calculate	Equation	Weighted	Weighting Calculation

NF S31-056	L2 T2 B2	1/3 octave: Min. 100 - 5000	LnT	$LnT = L2 - 10\log T2/To$	LnAT	$LnAT = 10\log\sum 10^{(LnTj+Cj)/10}$ Cj: value in table 6.7.1
NF S31-057	Weighting:	1/1 octave: Min. 125 - 4000				LnTj: LnTj at centre frequency j j: centre frequency index
			Ln	$Ln = L2 + 10\log 0.016V/T2$	LnA	As LnAT, except replace LnTj by Lnj

6.7.8 Spain - NBE 74-040

Use ISO plus French calculations.

French Calculations

The parameters RA, LnA, LnAT and DnAT are calculated as for the corresponding French parameters.

Parameter	See French calculation for	Frequency range
RA	Rrose	100 - 5000 Hz in 1/3 octaves or
R'A	Rrose	125 - 4000 Hz in 1/1 octaves
LnA	LnA	
LnAT	LnAT	
DA	DnATrose	
DnAT	DnATrose	
Dls2mA	DnATrose	
Dls2mnAT	DnATrose	
Dtr2mA	DnATrose	
Dtr2mnAT	DnATrose	
R'A45	Rrose	

Notes:

- The measurement standards NBE 74-040 are like ISO 140.

- The rating standard is NBE CA-88, which assumes procedures for R and Ln similar to those in the French standards. This is valid for airborne as well as impact sound insulation.

- No specific name is given in NBE CA-88 for the A-weighted R and Ln, so we use RA and LnA.

- DnT and L´nT are included in the measurement standards, but not in NBE CA-88. We calculate DnTA and LnAT anyway.

- Besides the rating in NBE CA-88, the ISO 717 rating is also used.

- We provide all of ISO plus rating according to NBE CA-88.

6.7.9 Spain - CTE

Use ISO calculations.

Airborne - CTE-2008

Standard	Measure	Bandwidth (Hz)	Spectrum	Equation	A-Weighted	Weighting calculation
CTE-2008	L1, L2, B2, T2	1/3 octave: 100-5000 Hz	R R' D Dn DnT	Like ISO	RA R'A DA DnA DnT,A	

$$"Spectrum"\,A = -10\log\frac{1}{n}\sum_{i=1}^{n}10^{(K_i - Spectrum_i)/10}$$

"i" is 1/3 oct. band.

K are **LAr** from table 6.7.3.

$"Spectrum"$ is rounded to the nearest multiple of 0.1 dB

$"Spectrum"\,A$ is rounded to nearest whole number.

Façade - CTE-2008

Standard	Measure	Bandwidth (Hz)	Spectrum	Equation	A-Weighted	Weighting calculation
CTE-2008	L1 and L2 using a loudspeaker. B2, T2	1/3 octave: 100-5000	R'45° Dls,2m Dls,2m,n Dls,2m,nT	Like ISO	R'45°A D,2m,A D,2m,n,A D,2m,nT,A	

$$"Spectrum"\,A = -10\log\frac{1}{n}\sum_{i=1}^{n}10^{(K_i - Spectrum_i)/10}$$

"i" is 1/3 oct. band. K are **LrA** from table 6.7.3.

Standard	Measure	Bandwidth (Hz)	Spectrum	Equation	A-Weighted	Weighting calculation
CTE-2008	L1 and L2 using traffic noise as source. B2, T2	1/3 octave: 100-5000	R'tr,s Dtr,2m Dtr,2m,n Dtr,2m,nT	Like ISO	R'Atr D,2m,Atr D,2m,n,Atr D,2m,nT,Atr	

$$"Spectrum"\,A = -10\log\frac{1}{n}\sum_{i=1}^{n}10^{(K_i - Spectrum_i)/10}$$

"i" is 1/3 oct. band. K are **LAtr** from table 6.7.3

$"Spectrum"$ is rounded to the nearest multiple of 0.1 dB

$"Spectrum"\,A$ is rounded to nearest whole number.

Note: The "tr" indicating the source type is not included in the

Table 6.7.3: Table A.3 and A.5 from CTE-2008

Centre frequency	LAr	LAtr	Centre frequency	LAr	LAtr
in Hz	dBA	dBA	in Hz	dBA	dBA
100	-30,1	-20	800	-11,8	-9
125	-27,1	-20	1000	-11,0	-8
160	-24,4	-18	1250	-10,4	-9
200	-21,9	-16	1600	-10,0	-10
250	-19,6	-15	2000	-9,8	-11
315	-17,6	-14	2500	-9,7	-13
400	-15,8	-13	3150	-9,8	-15
500	-14,2	-12	4000	-10	-16
630	-12,9	-11	5000	-10,5	-18

6.7.9 Holland - NEN 5077

Airborne

Standard	Measure	Bandwidth	Calculate	Equation	Weighted	Weighting Calculation
NEN 5077	L1 L2 T2 B2	1/1 oct	Lz - Lo	Lz - Lo = L1 - L2		**Notes:** One source room is assumed
		125 - 2000Hz	(Lz - Lo)m	$(Lz - Lo)m =$ $-10\log\frac{1}{n}\sum_{1}^{n}10^{-(Lz-Lo)/10}$		One or several source locations may be used Lz-Lo is calculated for each source location (Lz-Lo)m is the average for source locations 1..j Lz-Lo and (Lz-Lo)m are intermediate results and should not be displayed
Weighting NEN 5077						
			DnT	DnT = (Lz - Lo)m + 10log T2/To To: For dwellings 0.5s, otherwise 0.8s	Ilu	Subtract reference spectrum table 6.7.4 from DnT a) average the five differences b) average the two lowest differences and add 2 c) take lowest difference and add 4 Ilu is the lowest of a), b) and c)

| Ilu;k | Ilu;k is calculated for each partition (room to room) and for a number of partitions (one room to staying area). |

$$I_{lu;k} = -10\log \sum_{j=1}^{m} \left[\frac{V_j}{6 \times T_o \times s} \times 10^{-I_{lu;j}/10} \right] - 1$$

m: Number of receiving rooms
j: Index number for each room
Ilu;j: Ilu for room j
Vj: Volume in cubic metres of room j
S: For room-to-room, m = 1, s = S (partition area for one room). If there is no common partition area, set S to 10 square metres
If S<V/(15To) then S=V/(15To)
Sz;vg For room-to-staying area (m > 1), s = Sz;vg (partition area for total staying area, rooms 1..m)
If there is no common partition area, set Sz;vg to 10 square metres
Vtot: Sum of Vjs
If Vtot/(3Sz;vg) > 2.5 then set Sz;vg = Vtot/7.5
Cvg Correction term used only for room to staying area. Entered by the user, range 0.0 .. 2.0 dB, default 0.0 dB

Table 6.7.4: NEN 5077

Centre frequency	125	250	500	1000	2000
Value dB	34	43	50	53	54

Impact - NEN 5077

Standard	Measure	Bandwidth	Calculate	Equation	Weighted	Weighting calculation
NEN 5077	L2 T2 B2	1/1 oct 125 - 2000Hz	LnT	LnT = L2-10log T2/To To is 0.5 for dwellings, 0.8s elsewhere	Ico	Subtract LnT from the reference spectrum in table 6.7.5 a) average the five differences b) average the two lowest differences and add 2 c) take lowest difference and add 4 Ico is the lowest of a), b) and c)

Table 6.7.5: NEN 5077

Centre frequency	125	250	500	1000	2000
Value dB	70	66	66	66	70

Impact Correction for Rubber Hammers - NEN 5077

When rubber hammers are used (to avoid damage to the floor), correct the measured L2 levels (corrected for background noise) by adding the dB levels in table 6.7.6.

Table 6.7.6: NEN 5077

Centre frequency	125	250	500	1000	2000
Stone floor	0	1	3	10	26
Wooden floor	0	1	3	5	10

6.7.10 USA - ASTM

Airborne - ASTM E 336-90

Standard	Measure	Bandwidth Hz	Calculate	Equation	Weighted	Weighting calculation
E 336-90	L1 L2 T2 B2	1/3 octave: Min. 125-4000	NR	NR=L1-L2	NIC	Round the NR spectrum to 1 dB precision. Shift the reference curve (table 6.7.7) towards the
Weighting: **E 413-73**		Option 100-5000				measured curve, in 1dB steps, until the average unfavourable deviation is as large as possible but not more than 2,0dB. Also, the maximum unfavourable deviation must not exceed 8dB. An unfavourable deviation occurs when the result of measurement is less than the reference value. NIC is the value of the shifted reference curve at 500 Hz
			NNR	NNR=L1-L2+10log T2/To	NNIC	As above
			ATL	ATL=L1-L2+10log ST/0,16V	ASTC	As above

Note:	NR	corresponds to D in ISO 140			NIC	corresponds to Dw in ISO 140
	NNR	corresponds to DnT in ISO 140			NNIC	corresponds to DnTw in ISO 140
	ATL	corresponds to R' in ISO 140			ASTC	corresponds to R'w in ISO 140

Table 6.7.7: ASTM E 413-73 Reference curves for airborne sound

Centre frequency	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000
1/3 octave value dB	36	39	42	45	48	51	52	53	54	55	56	56	56	56	56	56

Impact - ASTM E 1007-90

Standard	Measure	Bandwidth Hz	Calculate	Equation	Weighted	Weighting calculation
E 1007-90	L2 T2 B2	1/3 octave: min. 100-3150	Ln	$Ln=L2+10\log 0,016V/T$	IIC	Round the IIC spectrum to 1 dB precision.
Weighting: E 989						Shift the reference curve (table 6.7.8) towards the measured curve, in 1dB steps, until the average unfavourable deviations is as large as possible but not more than 2,0dB.

Also, the maximum unfavourable deviation must not exceed 8,0dB.

An unfavourable deviation occurs when the result of measurement exceeds the reference value.

IIC is 110dB minus the value of the shifted reference curve at 500 Hz

Table 6.7.8 Reference curve for impact sound

Centre frequency	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150
1/3 octave value dB	62	62	62	62	62	62	61	60	59	58	57	54	51	48	45	42

6.7.11 England Wales - BREW

Airborne - BREW   UK Building Regulations (2003)

Standard	Measure	Bandwidth Hz	Calculate	Equation	Weighted	Weighting calculation
BREW	L1(1) L1(2)	1/3 octave:		D1 = L1(1)-L2(1)		
	L2(1) L2(2)	Min. 100-3150 Option 50-5000		D2 = L1(2)-L2(2)		
Weighting: BS EN 717-1	B2(1) B2(2)			Dm = (D1+D2)/2 arithmetic average		
	T2					

| | | | DnT | | DnT=Dm+10log T2/To | | DnTw | As above for ISO |

(1) and (2) indicate levels from loudspeaker position 1 and loudspeaker position 2

6.8 Facade Insulation (loudspeaker and road) other than NEN

Standard	Method	Application	Source	Microphones	Equation	Weighted		2260 names
ISO 140-5	Element loudspeaker	Preferred for elements	LS at 45°	L1 surface average L2 room average	$R'45° = L1,s - L2 + 10logST/0.16V - 1.5$	**R'45°,w**	R'45	R'45w
Weighting: ISO 717-1	Element road traffic	Road traffic noise available	Road	L1 surface, L2 room Simultaneously	$D = -10log(1/n10-(L1i-L2i)/10)$ $R'tr,s = D + 10logST/0.16V - 3$	**R'tr,s,w**	R'tr,s	R'tr,s,w
	Global loudspeaker	Alternative to the following	LS at 45°	L1 at 2m L2 room average	$Dls,2m = L1,2m - L2$ $Dls,2m,nT = Dls,2m + 10logT/To$ $Dls,2m,n = Dls,2m + 10log10T/0.16V$	Dls,2m,w Dls,2m,nT,w Dls,2m,n,w	Dls,2m Dls,2m,nT Dls,2m,n	Dls,2m,w Dls,2m,nT,w Dls,2m,n,w
	Global road traffic	Preferred for global (road)	Road	L1 at 2m L2 in room Simultaneously	$Dtr,2m = -10log(1/n10-(L1i-L2i)/10)$ $Dtr,2m,nT = Dtr,2m + 10logT/To$ $Dtr,2m,n = Dtr,2m + 10log10T/0.16V$	Dtr,2m,w **Dtr,2m,nT,w** Dtr,2m,n,w	Dtr,2m Dtr,2m,nT Dtr,2m,n	Dtr,2m,w Dtr,2m,nT,w Dtr,2m,n,w
NFS 31-057			LS at 45°	L1 at 2m L2 in room	$DnT,45° = L1 - L2 + 10logT/To$	DnATroute,45°	DnT45	DnATroute45
Weighting: NFS 31-057			Road	L1 at 2m L2 in room	$DnT,tr = L1 - L2 + 10logT/To$	DnAT,route	DnTtr	DnATroute
ASTM E966-92	Weighting: ASTM E1332	Elements or global		Remote, 2m or surface	$OILR = L1 - L2 + X$ $OITL = L1 - L2 + 10logST/0.16V + Y$ (X,Y set by user X,Y = -10 .. +10) Frequency range is 80-4000 Hz	OITC See table below	OILR OITL	OILR OITL OITC
NBE	**See note below**	See note below	See note below	See note below	ISO plus Dls2mA, Dls2mnAT, Dtr2mA, Dtr2mnAT og R'A45	See note below	See note below	See note below

Notes:

LS is Loudspeaker

R' is Apparent sound reduction index

D is Level difference

DnT is Standardised level difference

Dn is Normalised level difference

A = 0.16V/T

S/A = ST/0.16V

ls means loudspeaker

s means surface

S is element surface area

OILR means Outdoor-Indoor Level Reduction

OITL means Outdoor-Indoor Transmission Loss

OITC means Outdoor-Indoor Transmission Class

Correction for background noise: as usual (but only with loudspeaker noise)

Weighted parameters in **bold** are found in ISO 717-1

Weighted results might also be calculated using spectral adaption terms and extended frequency range

DnATroute45 and DnATroute are calculated as described in section 6.7.7 for Airborne

Averaging of differences ($D = -10log(1/n10-(L1i-L2i)/10)$) is done when Facade, 2channels and Generator Off are

chosen

n means normalised

2m means 2 metres

The X adjustment accounts for the standard's various OILR's depending on microphone place and sound incidence

The Y adjustment accounts for the standard's various OITL's depending on microphone place and sound incidence

ASTM E1332-90 OITC Calculation

Band Centre Frequency Hz	Reference Sound Spectrum Lf dB	A-weighting Correction Af dB	Reference + A-weighting Correction dB	Example: Measured TL TLf dB	Reference +A-weighting - measured TL dB	OITC dB
80	103	-22,5	80,5	26	54,5	A-weight the previous column
100	102	-19,1	82,9	26	56,9	and subtract from
125	101	-16,1	84,9	29	55,9	A-weighted reference spectrum
160	98	-13,4	84,6	29	55,6	(see Equation below)
200	97	-10,9	88,1	31	55,1	
250	95	-8,6	86,4	32	54,4	
315	94	-6,6	87,4	32	55,4	
400	93	-4,8	88,2	30	58,2	
500	93	-3,2	89,8	32	57,8	
630	91	-1,9	89,1	36	53,1	
800	90	-0,8	89,2	40	49,2	
1k	89	0	89,0	44	45,0	
1,25k	89	0,6	89,6	46	43,6	
1,6k	88	1,0	89,0	48	41,0	
2k	88	1,2	89,2	49	40,2	
2,5k	87	1,3	88,3	47	41,3	
3,15k	85	1,2	86,2	46	40,2	
4k	84	1,0	85,0	50	35,0	

Equation:

$$OITC = 100,13 - 10*\log \sum_f 10^{((Lf-TLf+Af)/10)}\, dB$$

Facade Insulation - NEN 5077

Note: The calculation of facade insulation in NEN 5077 is special and is included as an exception - generally facade insulation is not covered in this version.

Standard	Measure	Bandwidth	Calculate	Equation	Weighted	Weighting Calculation
NEN 5077	L1 L2 T2 B2	1/1 oct 125 - 2000Hz	Lbu - Lbi	Lbu-Lbi = L1-L2		**Notes:** One or several source locations may be used. Lbu - Lbi is calculated for each source location. (Lbu - Lbi)m is the average for source locations 1 - j. Lbu - Lbi and (Lbu - Lbi)m are intermediate results and should not be displayed
			(Lbu - Lbi)m	$(Lbu - Lbi)m =$ $-10\log\frac{1}{n}\sum_{1}^{n}10^{-(Lbu-Lbi)_j/10}$		
			Gi	Gi = (Lbu - Lbi)m + (10log T2/To) - Cr To: For dwellings 0.5s, or 0.8s Cr: Geometry factor -10, ..., 10	GA	$G_A = -10\log(\sum_{1}^{5}10^{-(Gi-Ci)/10})$ i: Centre frequency index Ci: Given in table 6.8.1 for different types of traffic
					GA;k	GA;k is calculated for each partition (outside-to-room) and for a number of rooms (outside-to-staying area). $G_{A;k} = -10\log\sum_{j=1}^{m}\left[\frac{V_j}{6\times T_o\times s}\times 10^{-G_{A;j}/10}\right]$ m: Number of receiving rooms j: Index number for each room GA;j: GA for room j Vj: Volume in cubic metres of room j s: For outside-to-room, m = 1, s = S (partition area) For outside-to-staying area, m > 1, s = Stot Stot: Total partition area in square metres. Stot is sum of S's

Table 6.8.1: NEN 5077, Ci - Sound level spectra for different types of traffic

Centre frequency	Hz	125	250	500	1000	2000
Road	dB	-14	-10	-6	-5	-7
Rail	dB	-27	-17	-9	-4	-4
Air	dB	-21	-11	-7	-4.5	-6
Other	dB	-14	-10	-6	-5	-7

6.9 Background Noise in Level Measurements

Standard	No correction at L2 - B2 above	Correction at L2 - B2 between:	At L2 - B2 below	Comments **L2 avg. is corrected using B2 avg.**
ISO 140-3 **ISO 140-6**	$\geq$ 15dB	14.9, ..., 6.1dB: $L2c = 10\log(10^{L2/10} - 10^{B2/10})$	< 6dB: $L2c = L2 - 1,3$dB	No lower limit for correction Case < 6 dB must be indicated with result
ISO 140-4 **ISO 140-5** **ISO 140-7**	$\geq$ 10dB	9.9, ..., 6.1dB: $L2c = 10\log(10^{L2/10} - 10^{B2/10})$	< 6dB: $L2c = L2 - 1,3$dB	No lower limit for correction Case < 6 dB must be indicated with result
NEN 5077	$\geq$ 10dB	9.9, ..., 3.1dB: $L2c = 10\log(10^{L2/10} - 10^{B2/10})$	< 3dB: Do not use L2	The case 9.9..., 3.1dB is indicated by code b The case $\leq$3dB is indicated by code B, correction 3dB
NF S5X	$\geq$ 15dB	14.9, .., 3.1dB: $L2c = 10\log(10^{L2/10} - 10^{B2/10})$	< 3dB: Do not use L2	The case 14.9..., 3.1dB is indicated by code b The case $\leq$3dB is indicated by code B, correction 3dB
ASTM E 336	$\geq$ 10dB	9.9, .., 5dB: $L2c = 10\log(10^{L2/10} - 10^{B2/10})$	< 5dB $L2c = L2 - 2$dB	No lower limit for correction! Case < 5dB must be indicated with result
DIN 52210-1	$\geq$ 10dB	9.9, .., 3dB: $L2c = 10\log(10^{L2/10} - 10^{B2/10})$	< 3dB No precise L2	Case < 3dB: L2 is corrected by 3dB, indicated by code B

Note: L2c indicates an L2 corrected for background noise.

6.10 Background Noise in Reverberation Measurements

Standard	Evaluation range dB (starts at -5dB)	Max. background noise re steady-state level		Comments
		for T20	for T30	
ISO 354, 140-13	30 (if not possible: 20)	-35dB	-45dB	T20 must be labelled as such
NEN 5077 9.5.3.3	20	-30dB		

6.11 Rounding

Standard	Intermediate results	Weighted end results	Comments to Weighted end results
ISO 140-3	0.1 dB	1 dB	
ISO 717-1 **ISO 717-2**	0.1dB	1dB	Ci is calculated to 0,1dB and rounded to nearest integer. +xy.5 is rounded to xy+1 and -xy.5 is rounded to -xy.
NEN 5077	0.1 dB or less	1 dB	Do not round if result is used in further calculation. Otherwise round to nearest whole number; if result ends in .5 round to nearest even number
NF S31-057		1 dB	Round to nearest integer; if result ends in .5 round to most favourable integer, i.e., round up for airborne, down for impact.
ISO 354	0.01 s		Reverberation time is given in two decimal places.

Note: All level data measured at individual positions using Types 2250, 2260 and 2270 are imported and saved with 0.01 dB resolution (for BREW: data are rounded to 0.1 dB precision before used in averages).
All reverberation time data are calculated to 0.01 s precision.
Averaged data (like L1A, (1)L1A, (2)L1A, L2A, B2A, etc.) are saved internally with full resolution (12 decimal places) and used un-rounded in the calculations (e.g. when correcting L2 for background noise or calculating Dn, etc.).
The intermediate results (e.g. Dn, R', etc.) are rounded as described above.
The weighed end results are rounded to 1 dB.

Note: In order to verify the calculations done by Qualifier using e.g. MS Excel, you can export the position data by selecting all the cells from the individual positions in the Sum sheets, copy the content and paste it into Excel. All calculations (like rounding to 0.1 dB before usage for BREW, averaging, correction for background noise, etc.) are then to be taken care of by Excel. Do not copy/paste the content of the averages - you will not get the full resolution of these values as only one or two decimals are displayed in the cells.