



## Tutorial

The tutorial is aimed at first time users of Evaluator. Experience with processing noise data is assumed, as well as a working knowledge of Windows applications.

The tutorial cannot cover every aspect of Evaluator. However, if you work through the tutorial sequentially, you will cover the most salient points.

This screen version of the Evaluator tutorial is quite lengthy. For increased convenience and to give more screen space to Evaluator, you should print the tutorial onto paper. To do so:

1. Check that your printer is ready.
2. Select the **Print Topic** command from the **File** menu at the top of the Help window.

To view a specific subject, select the section from the list below. The section will be displayed at the top of the screen. You can, however, scroll throughout the entire tutorial.

**Note:** [Demonstration data](#) can be found on the CD-ROM BZ 5298 provided with the Evaluator software.

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## 1. General Comments

Evaluator uses the Windows graphical interface to the full. This means that to get the best out of Evaluator and to improve the efficiency with which you use it, you should be familiar with operation of Windows programs. In particular, Evaluator can display many windows with many different parameters on them. You should be proficient with opening, closing and resizing windows.

You should also be aware that most items displayed in Evaluator have »hotspots« associated with them, meaning that while the mouse cursor is over the item either a small »tooltip« is displayed or double-clicking with the left or clicking with the right mouse buttons might bring up new and related dialogs and menus. You should feel free to click on items using both mouse buttons to see what happens.

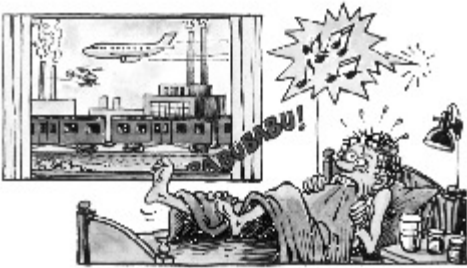
This tutorial cannot cover every part of Evaluator. If at any time you are unsure of the function of a particular part of Evaluator, use the context sensitive help button to get help (or press <F1>). You will also notice that many of the dialogs have help buttons on them. Again, use this feature when you are in doubt. The Status Bar at the bottom of the Evaluator application window often gives you guidance about what will happen next or what you should do.

Lastly, Evaluator, in common with most Windows applications, often has several ways to achieve the same command. There can be a menu item in the main menu bar, a short-cut icon in the toolbar, a keyboard short-cut (combinations of the Ctrl, Alt and letter keys), or a direct link from a floating dialog. The tutorial introduces you to

all of these methods, but be on the look out for short-cuts, etc. as you move within Evaluator.

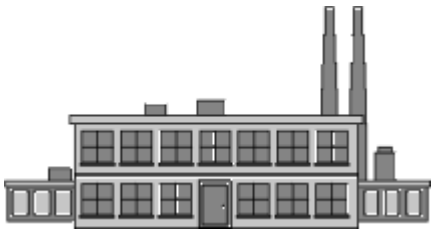
## 2. Rating Level

The Rating Level,  $L_r$ , is defined in the ISO1996-2 standard. It is basically a measure of the environmental noise exposure corrected for factors known to increase annoyance. It is used to compare measured levels with noise limits that usually vary depending on the use of the property under investigation. The basic parameter is the A-weighted equivalent continuous sound pressure level  $L_{Aeq}$ .



*This man is subject to annoyance*

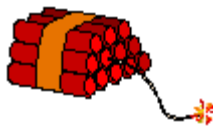
Annoyance from a specific source depends on:



*The specific source*



*Other sources*



*Impulsiveness*



*Tones*



*Your activities (time of day)*



*Social factors*

### 2.1. Rating level formula

The **formula** for Rating Level is (in general terms):

$$L_{Ar} = L_{AeqT} + KI + KT + KR + KS$$

where

$L_{Ar}$  is the Rating Level in the period T

$L_{AeqT}$  is the average A-weighted sound pressure level (corrected for residual noise) in the period T

T is the reference time interval

KI is a penalty for impulsiveness

KT is a penalty for tonal components

KR is a penalty depending on the time of day

KS is a penalty (positive or negative) for certain sources, situations or meteorological factors

## 2.2. Procedure for measuring and calculating the rating level

The way to measure and evaluate the penalties is different from country to country, but the basic principles are the same.

- One or more representative A-weighted  $L_{eq}$  of the noise from the source under investigation (specific noise) is measured, often over a period of time defined by legislation.
- The measured levels are corrected for the presence of noise from other sources (called Residual Noise - e.g., the drone of a distant motorway).
- The level can be corrected for the presence of impulses (bangs and clatters) using objective techniques (e.g., identification of source using sound recording).
- The level may be corrected for the presence of tones (whistles and whines) using 1/3-octave or FFT analysis.
- The level can be corrected according to when it occurs during the day. Penalties are defined in the legislation.
- The level can be corrected for meteorological factors (wind directions) as defined in the legislation.
- The resulting Rating Level,  $L_r$ , is compared to the noise limit for that noise source for that period (weekday, weekend, etc.). If the limit is exceeded, action must be taken.

Country or local authority regulates the limits individually. Differences in lifestyle, climate (outdoor activities, open or closed windows) and building design make international harmonisation of noise limits impossible.

## 3. Evaluator used for Rating Level calculation

With Evaluator you are able to make rating level calculations based on measurements made with a Brüel & Kjær sound level meter and in accordance with your local regulations.

The following steps for calculating rating level are used in Evaluator and these are detailed later in this tutorial:

1. Format the default marker set-up - the markers will then be available for all the data inserted afterwards.
2. Set the reference period for your rating level calculation, set Penalty periods (if any), specify whether the calculation should be based on a loudest period (e.g. 1 hour) or not, etc. Note: You only need to do this once.
3. Insert measurement data from your sound level meter. The measurement data will be placed in the Measurements section and cannot be changed or manipulated by Evaluator.
4. Move the (relevant part of the) measurement data into the Calculations part of Evaluator. In this part you use the markers to point out representative parts of the measurement e.g. specific noise, noise with correction terms, residual noise, etc.  
You can adjust markers, insert new markers, use the automatic marker tools (e.g. for pure tone detection), attach pictures, video clips, maps, drawings or other documentation to relevant markers.  
Finally you concatenate (join) your measurements (except FFT data) into one profile representing the whole measurement. This profile forms the base input data for the calculation.
5. Move the profile with the base input data made in the previous step into the Results part of Evaluator. Select

the relevant reference period for your measurement and Evaluator will calculate LAeq for each marked part of your measurement, calculate correction terms, calculate penalties, subtract Residual Noise, etc. The calculations are presented in a sheet.

You finally adjust the duration of the representative parts of the noise to the duration typical for the reference period. The Rating Level is then calculated.

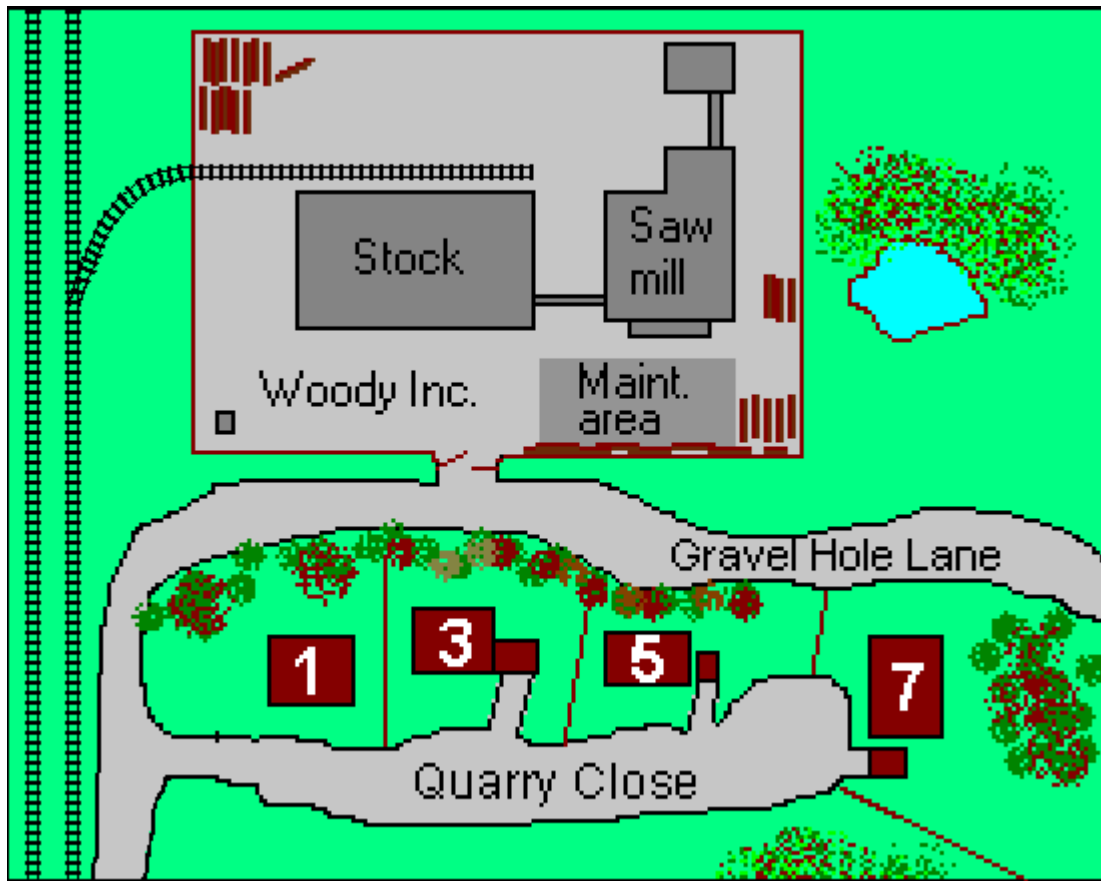
The steps above are detailed in this tutorial.

### 3.1. Demonstration data

In normal use, you would begin by making measurements at the site under investigation.

However, to enable you to begin to learn using Evaluator immediately, a set of dummy data is included with the software package. The dummy data is based on a set of real measurements made at the boundary of an industrial site - a sawmill.

To make the real site anonymous, a fictitious factory environment, a sawmill owned by Woody Inc. has been created.



Woody Inc. is a medium sized sawmill founded years ago before the nearby city started to grow.

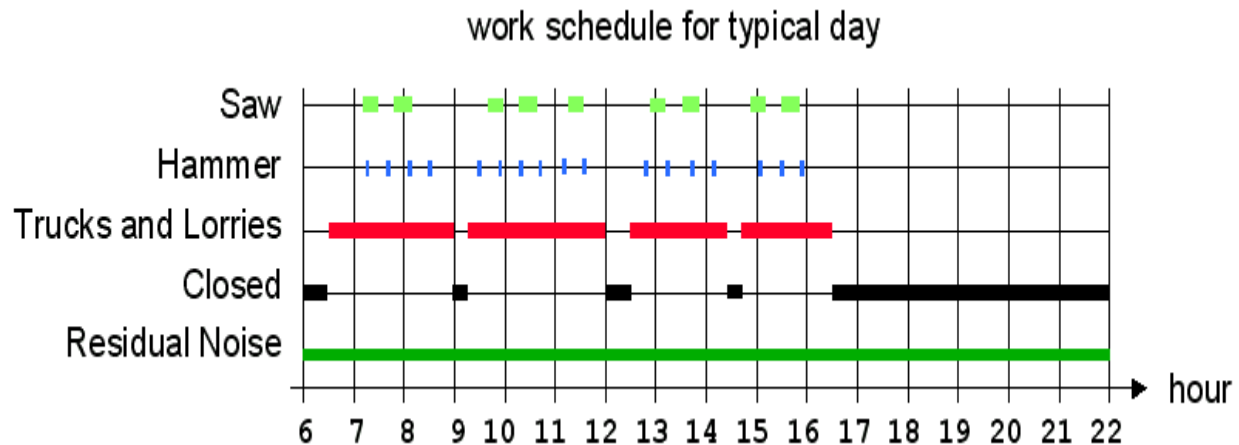
**The citizens living close to the sawmill are now complaining about the working noise during the daytime and noise from compressors starting and stopping during the nighttime.**

The daily work and internal traffic of trucks and lorries on the site is concentrated at the far end of the site - there is a fairly good noise barrier afforded by a large stock building. However, between this building and the city a part of the site holds a place for minor sawing and maintenance tasks. This part is unshielded and emits probably the most annoying part of the noise.

The work and internal traffic noise starts at 6:30 am and ends at 4:30 pm, including two 15 minutes breaks and a half hour break between 12 and 12:30.

The noise from the maintenance area consists of noise from chain saws (approximately 2 hours and 10 minutes average each day between 9 am and 4 pm) and hammering (approximately 25 minutes average each day between 9 am and 4 pm).

When the sawmill is closed, and in the breaks, you only hear noise from some compressors and fans.



**The day measurements** have been made as **attended** measurements using 2260 Investigator running the BZ 7206 Enhanced Sound Analysis software. The measurements have been divided into three separate sub-measurements of:

- 0001.S3D - Noise from the site - measured just outside the site at Gravel Hole Lane - including the noise from all the present noise sources (internal traffic, sawing and hammering). The measurement is a 20 minutes profile of LAeq with 1 s resolution. The contribution from the different noise sources has been marked during the measurement using the on-line marking facilities in BZ 7206. The marked noise was also recorded as sound (wav) files on a laptop computer during the measurement controlled from 2260.
- 0002.S3A - Noise from the site when no activity is taken place (the minimum noise from the site regardless of the time of day or night). The measurement consists of a 10-minute sample made just after the sawmill closed.
- 0003.S3A - Residual Noise - the noise from other sources. The measurement is a 5-minute sample when the sawmill was closed, made in the same area a few streets away where no noise is heard from the sawmill.

**The night measurement** has been made as an **unattended** measurement using 2260 Investigator running the BZ 7206 Enhanced Sound Analysis software connected to a laptop Computer running Evaluator for sound recording. The measurement consists of:

- 0004.S3D - Noise from the site - measured just outside the site at Gravel Hole Lane. The measurement consists of approx. 11 hour's noise from the site, disturbed by trains passing by in the late evening and early morning and of flight and road traffic and birdsong.

In addition to this an **attended** FFT measurement has been made using 2260 Investigator running the BZ 7208 FFT software:

- WOODY01.FFT and WOODY02.FFT - Noise from the site - measured at the same point as the unattended measurement, but done while the compressor worked. The tones from the compressor is varying slightly in frequency. To get detailed information of the tonal variation, the measurements are two 2 minute logging of FFT spectra with 1s resolution - instead of just total measurements with possibly smeared tones. WOODY01.FFT covers the frequency range 1800 Hz to 6800 Hz; WOODY02.FFT covers the frequency range 300 Hz to 1550 Hz.

Normally you would have used the **Backup 2260 data** tool to copy the data from the Investigator/Observer to the PC but for this tutorial they are stored on the CD-ROM BZ 5298 provided with the Evaluator software. If you have a software key, you are now ready to load the data **0001.S3D**, **0002.S3A**, **0003.S3A** (day measurements) and

**0004.S3D, WOODY01.FFT, WOODY02.FFT** (night measurements) into Evaluator.

Alternatively, if you do not have a software key for Evaluator, then you can open the project **TutorDay.RLP** containing the day measurement or the project **TutorNight.RLP** containing the night measurement.

Completed rating level calculations of the sawmill are also available as **DemoDataDay.RLP** and **DemoDataNight.RLP**.

The files can be installed from the **ENV Software CD-ROM BZ 5298**.

**Note:**

**The tutorial shows you most of the features in Evaluator. The demonstration data will be processed in accordance with the German TA-Lärm - 1998, the Italian law no. 447 - 1995 and the British Standard BS 4142 : 1997.**

**Please read and try out the whole tutorial regardless of which local standard and legislation you need to fulfil. You will find new and useful features in each section of the tutorial.**

## **4. Preparing Set-ups**

Evaluator can calculate the Rating Level based on many different national and international standards. Before you proceed with inserting data and the rating level calculation, it is wise to specify the calculation parameters to the required standard and to set the various markers up to your preferences. By setting it up at the start of a session, you effectively set the default for all contributions.

**This part of the tutorial (sections 4 - 7) will set-up Evaluator in accordance with the German TA-Lärm - 1998.**

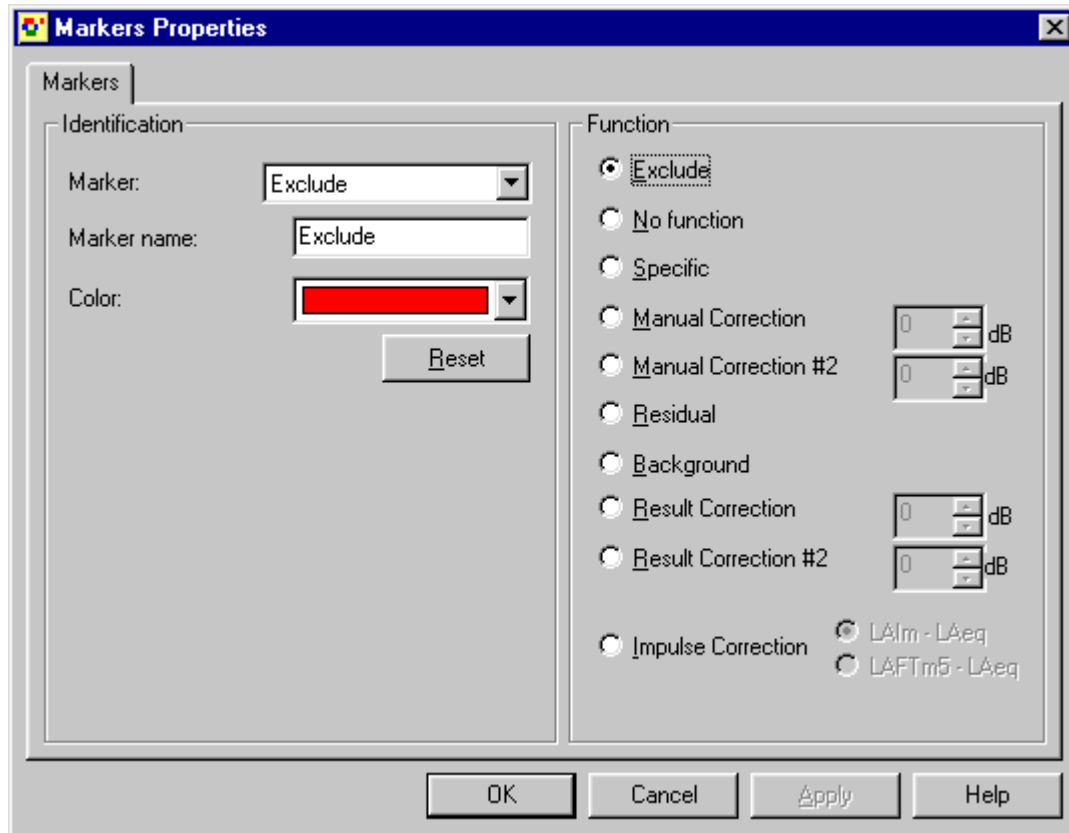
### **4.1. To set the Default Marker set-up**


**You should set the markers to suit your needs before inserting any data.**

The default marker set-up determines the marker settings for measurement data inserted in Evaluator.

If markers have been defined and used in the BZ 7201/02/03/06/10/19 applications for 2260, then the names of the markers will be copied from the 2260 to the marker properties for the inserted data (marker 1 to 6). The default marker set-up will determine the functions of the markers.

From the **Format** menu, select **Default Marker setup...** to enter the properties of the markers.



Click on the  button adjacent to Exclude to reveal the list of markers.

The markers 1 to 4 set with 2260 on the day measurements in this tutorial are EXCLUDE, SAW, HAMMER and SAWMILL - defined in 2260. The functions for the first four markers should then be set in accordance with these markers:

- Set function for Marker 1 to Exclude (default for this marker - probably already set).
- Rename Marker 2 to SAW. Set the function of SAW to Manual Correction 3 dB. When inserting new data then all SAW markers will get this function.
- Rename Marker 3 to HAMMER. Set the function of HAMMER to Impulse Correction, LAFTeq-LAeq. When inserting new data then all HAMMER markers will get this function.
- Rename Marker 4 to SAWMILL. Set the function of SAWMILL to Specific (default for this marker - probably already set).
- Set function for Marker 6 to No function (default for this marker - probably already set).
- Set the function for other markers as you need when inserting new data.
- Click on OK to leave the Markers Properties window.

However, the settings of the default marker set-up will not have any effect in the TutorDay.RLP and TutorNight.RLP projects because the data have already been inserted. You then have to change the function of the markers already on the data - this is done in [section 6.3 Checking the function of all the markers](#) of this tutorial.

## 4.2. To set the Reference Period

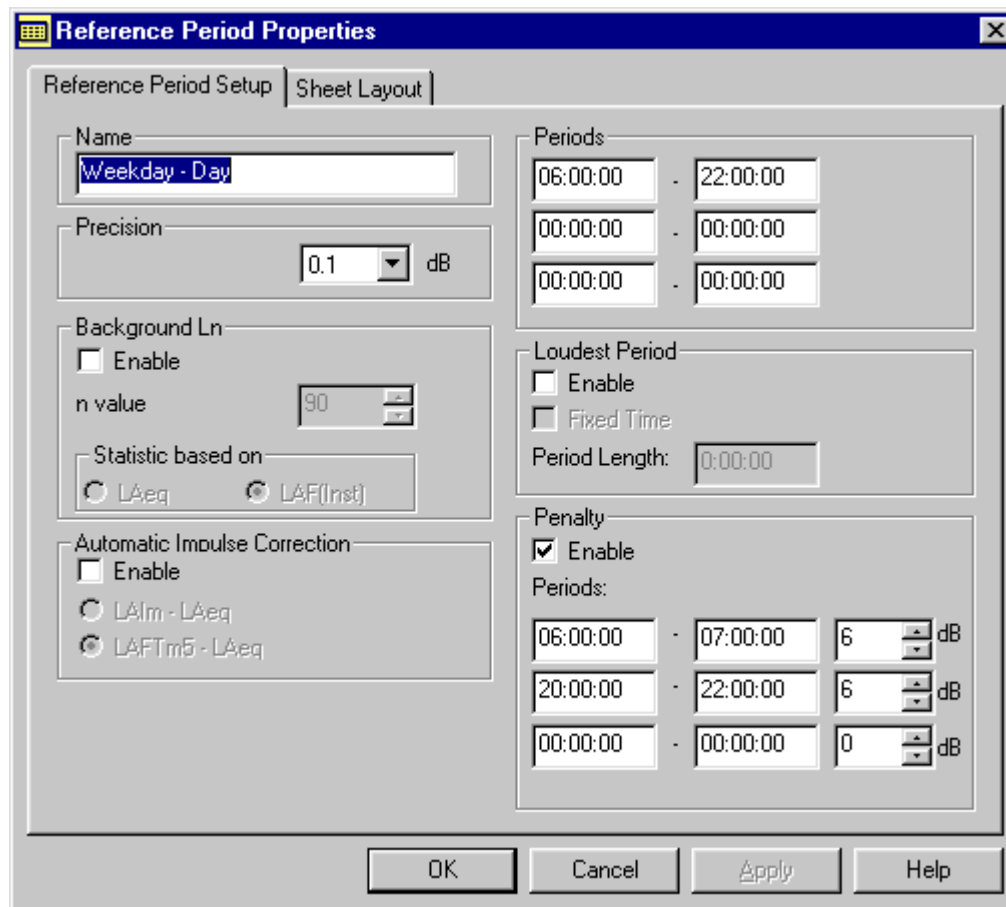
The Reference Period section of Evaluator controls setting a standard.

Let's assume you have to work in accordance with the German Standard, TA-Lärm - 1998. You then have to create a reference period in accordance with this standard:



- From the **Tools** menu, select **Reference Period...**
- Select **New**
- Select **Germany**.
- Since our complaint is about weekday noise, select **Weekday-Day**
- Select **Next**

Now you will see the main reference period set-up dialog. In it the default values for TA-Lärm during a weekday day are set. You can see that two penalty periods are specified in the early morning and late evening, each with 6dB penalty, and that the main period of concern is from 06:00 until 22:00.



The image shows the 'Reference Period Properties' dialog box with two tabs: 'Reference Period Setup' and 'Sheet Layout'. The 'Reference Period Setup' tab is active.

**Name:** Weekday - Day

**Precision:** 0.1 dB

**Background Ln:**  
☐ Enable  
 n value: 90  
 Statistic based on: ☐ LAeq ☒ LAF(Inst)

**Automatic Impulse Correction:**  
☐ Enable  
☐ LAIm - LAeq  
☒ LAFTm5 - LAeq

**Periods:**

06:00:00	-	22:00:00
00:00:00	-	00:00:00
00:00:00	-	00:00:00

**Loudest Period:**  
☐ Enable  
☐ Fixed Time  
 Period Length: 0:00:00

**Penalty:**  
☒ Enable

**Periods:**

06:00:00	-	07:00:00	6	dB
20:00:00	-	22:00:00	6	dB
00:00:00	-	00:00:00	0	dB

Buttons: OK, Cancel, Apply, Help

When you are satisfied with the values (or just want to accept the default values):

- Select **Next**

This brings you to the Sheet Layout dialog.

This dialog allows you to select which headings appear in your final rating level sheet. A default set has been chosen, but moving the headings between the Available columns and Selected columns areas can easily change these. You can also re-arrange the column order by moving headings up and down, or you can rename them.

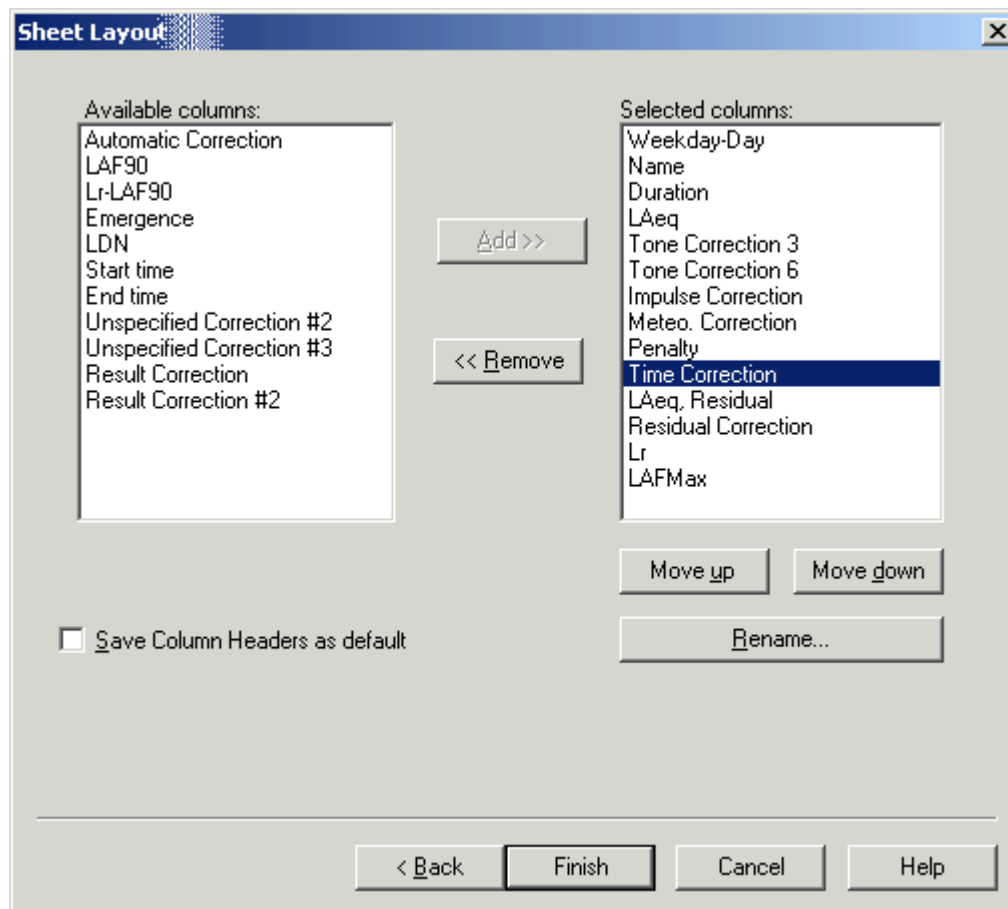
You might want to rename some of the column headers:

Select the column header in "Selected Columns", press Rename and you can enter a new name for the column header. The original header is displayed in the grey box.

- Rename **Manual Correction** to "Tone Correction 3" (or "Zuschlag für Ton 3" or "KT3" - later on you will use the "Tone Correction 3" marker for tonal correction of 3 dB).

- Rename **Manual Correction #2** to "Tone Correction 6" (or "Zuschlag für Ton 6" or "KT6" - you can then use the "Tone Correction 6" marker for tonal correction of 6 dB).
- Rename **Impulse Correction** to "Impulse Correction" (or "Zuschlag für Impuls" or "KI").
- Rename **Unspecified Correction** to "Meteo. Correction" (or "Cmet").
- Rename **Penalty** to "Penalty" (or "Zuschlag für Ruhezeiten" or "KR").
- Rename **Time Correction** to "Time Correction" (or "Korrektur für Einwirkdauer" or "KE").

Your sheet layout should now look like:



Select Finish, and the Reference Period set-up dialog closes.


## 5. Opening a Project / Inserting Data

When Evaluator is first started, a default project is shown. The Project is called **Untitled**. This is the root of a Project tree and is shown as a book. Within this book are folders called **Measurements**, **Calculations** and **Results**. There is no data in the Project at present. The title bar of Evaluator tells you that the current Project database is called **RL1**.

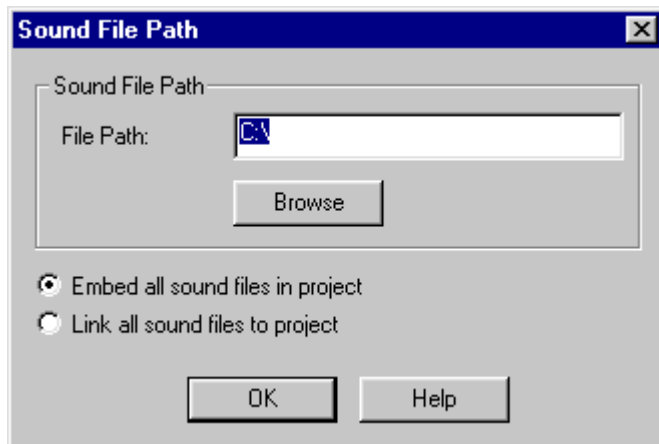
**Note:** Evaluator has a software key that prevents the program inserting data from an instrument unless the key is present. All other Evaluator functions are enabled. Because this tutorial is designed to be used even when a software key is not present, a dummy project has been created with pre-inserted data.

If you have a software key you can insert the data files, otherwise you can open the tutorial project.

## 5.1. Inserting data files

To insert data from files on your hard disk or other disks, click on the  icon. This displays a standard file-open dialog. Locate the files **0001.S3D**, **0002.S3A** and **0003.S3A** from the DemoData and press **Open**. Note: Be sure the **Files of type** field is set to All Files when browsing for the files.


During the measurement of 0001.S3D markers have controlled sound recording on a PC. Evaluator automatically detects this when inserting 0001.S3D and searches for the recorded wave files at the directory used for sound recording. Obviously the files can not be found in this case and the following dialogue pops up:



Press **Browse** to locate the directory **DemoData\tutorday.emb** with the sound records. Then select whether you want to **embed all the sound files in the project** (they will be stored together with the project) or you want to **link all the sound files to the project** (then you must insert the CD-ROM each time you want to hear the records).




If you don't have a software key, then you can open the TutorDay project:



## 5.2. Opening an existing Evaluator project

Click on the  icon on the toolbar. This displays a file-open dialog box. The same operation can be done using **File/Open Project...** Select the file called **TutorDay.RLP** from the DemoData and click on the **Open** button.


You have just opened the tutorial project containing pre-inserted measurement files. Notice that the title bar now shows the name TutorDay.RLP.

In the **Measurements branch** you see three 2260 icons for the three measurements made at Woody Inc.

- The first contains the noise from the site including the noise from all the present noise sources (internal traffic, sawing and hammering). This measurement is treated and displayed as three separate sets of data: logged 1s data () 0001.S3D), logged 100 ms LAF data () 0001.S3D - Fast Logged), and data representing the total measurement period () 0001.S3D).
- The second set contains noise from the site when no activity is taken place. The measurement is displayed as


- one set of data ( 0002.S3A).
- The third contains residual noise - the noise from other sources. The measurement is displayed as one set of data ( 0003.S3A).

### 5.3. Adding comments to an Evaluator project

The Project folder () has information about the project attached to it. To see this information, right-click on the book icon. A pop-up called **Properties** appears. Click on this. The document statistics and summary pages are shown.

The information shown is not used in calculations, but is useful for you or your colleagues to see what the project is about.

When you have finished entering the details, click on OK.

Click on  (the **Save** icon) to save your changes. This saves all the data in your Project to the Project file. It is always wise to save your work regularly to avoid data loss.


### 5.4. Viewing set-up information

To view an instrument's setup information, right click on its icon in the measurements branch of the project tree. Select **Properties**. A new set of dialogs appears.

Click between the different tabs to see the information about the instrument, its setup and time of measurement, etc. You can add your own comments in the **Location**, **Operator**, **Site Name** and **Keywords** fields if you wish. The remaining fields are read only information and cannot be altered.

## 6. Preparing Data for Rating Level Calculation

### 6.1. Viewing Data in the Measurements Branch

In the Measurements branch, locate the Logged Profile **0001.S3D** measurement () that is attached to the first 2260 instrument icon and double click on the icon. You will see a new window appear - a graph and a set of results. Maximize them in the normal Windows way.

Turn your attention to the **profile view** (the graph at the top of the set of the windows). You will see a number of curves (LAeq, LAFmax and LCPeak and LAFmin. Each curve represents results for one measured parameter. The x-axis represents time, the y-axis is level.

You can see that the curves are noise profiles. The noise profiles represent the noise measured outside Woody Inc.'s sawmill.

Above the profile you can see coloured horizontal bars. These represent **markers** made with the 2260 during the measurement, e.g., the SAW bars indicate when the saw was active. Right click with the mouse cursor on a Sound bar below the SAW bar and select Play Sound from the menu to hear the noise of the saw.

The middle window is a **text view** displaying more details for each cursor position in the profile.



At the bottom you see the **spectrum view** and the **statistics view**. Both views display details from the measurement controlled by the cursor position in the profile.

## 6.2. Using Markers to point out representative parts of the measurement

Before calculating the Rating Level you have to identify the relevant parts of the noise contributing to the Rating Level. This is done by use of the markers.

The data in the Measurement part cannot be changed - you have to drag the data into the Calculations part and manipulate the markers there.

First drag the 0001.S3D profile into the Calculations part. This can be done in several ways (the first two ways are for copying the total profile into Calculations, the last two can also be used if only a part of the profile needs to be copied):

- 1) Click and drag the  icon with the left mouse button to the Calculations folder and drop it there.  
or
- 2) Right click on the  icon and then select **Insert into** and then **Calculations**.  
or
- 3) Click with the left mouse button inside the profile and drag it horizontally to select part of the profile. When you release the button select **Adjust Selection...** from the menu and check **All** and **OK** and then select **Insert into Calculations**.  
or
- 4) Right click inside the profile, choose **Selection...** and check **All** and **OK** and then select **Insert into Calculations**.

Use the first method now so that the total 0001.S3D profile is copied into the Calculations section.

Double click the "=0001.S3D" icon (or right click and select Open) to inspect the markers on the profile.

The names of the markers set are:

- **EXCLUDE** at the noise parts irrelevant to the measurement (e.g. a barking dog).
- **SAW** at the parts from the chain saw. You want to add a tone correction of 3 dB to this part of the measurement.
- **HAMMER** at the parts of sound from a hammer. You want to add an impulse correction to this part.
- **SAWMILL** at the start and end of the profile to document the noise from the sawmill without any of the other noisy events.
- **Sound** markers automatically set at the parts where wave files have been recorded. Each sound recording has been limited to max. 30 s (settable in 2260) - this is enough to identify and document the sound source.

If some of the marker sizes need some adjustments you can do it graphically or by keying in the exact time for the marker.

Example: To adjust the first SAW marker graphically start by zooming around the marker (to make it easier to position the mouse) by clicking with the left mouse button inside the profile to the left of the SAW marker and drag it horizontally to a position to the right of the SAW marker. Release the button and select **Zoom range**.

If you want to enlarge the SAW marker then select the part of the profile you want to add to the marker with the mouse and select the SAW marker from the list.

To reduce the marker select the part of the profile with the mouse you want to remove and select **Remove Marker**, SAW.

You can key in the exact start and end of the marker by double clicking the horizontal bar representing the marker. This brings up the list of markers in the profile. The marker you double clicked is selected. Press **Details...** to edit the details of this marker.

The SAWMILL marker and all the unmarked parts of the profile represent the noise from the sawmill without any noisy events. You can either mark all the unmarked parts of the profile with the SAWMILL marker, or you can delete the SAWMILL marker and specify all the unmarked as Specific noise. The latter is the fastest, but the first method is easiest to do correctly and to use for documentation of the markers, which you will be asked to do later in the tutorial.

The most convenient way of setting all the SAWMILL markers is to zoom in on the first approx. 3 minutes of the

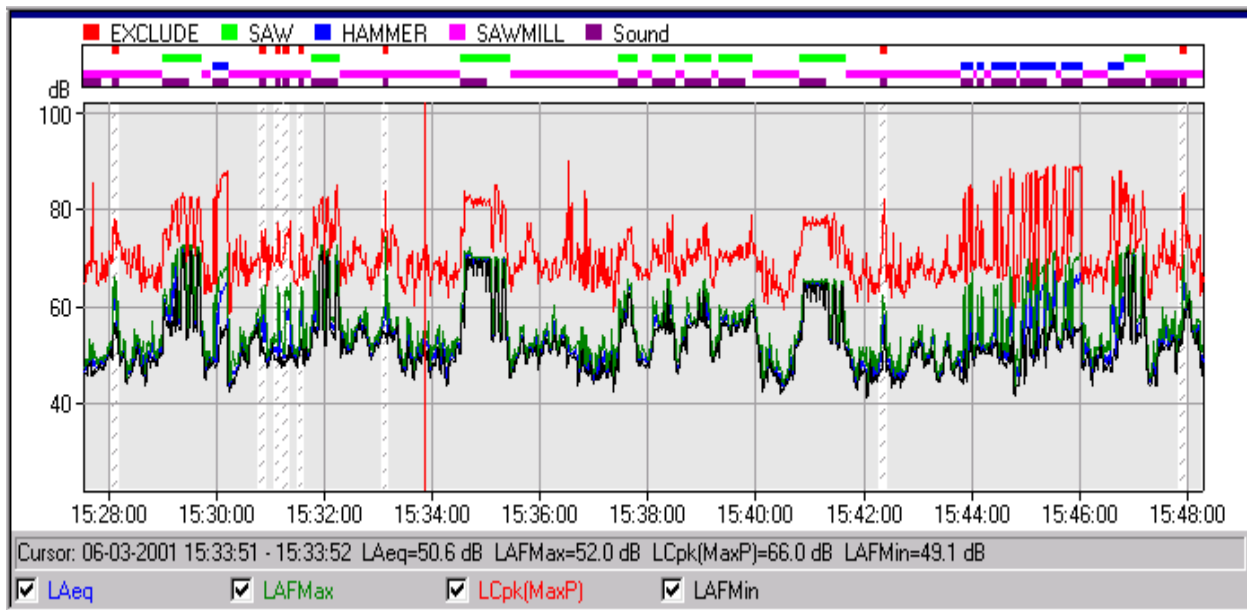
profile - left click with the mouse in the profile at approx. 15:31:00, hold the left button down and move the mouse to the start of the profile and release the button and select **Zoom range**. Now it is easy to accurately position the mouse cursor in the profile.

Left click with the mouse at the start of the first unmarked part, hold the button down and move the mouse to the start of the SAW marker and release the button and select the **SAWMILL** marker from the list. Be careful not to overlap the markers.

Select the next unmarked part of the profile and insert the **SAWMILL**. Do this for all the unmarked parts.

Note: you can overlap the **Exclude** marker, because this part will not be used in the rating level calculation.

The profile should now look like:



### 6.3. Checking the function of all the markers

Right click in the marker area and select **Markers** from the menu. This displays a list of all the markers in the profile. Press **Properties...** to check and possibly change the properties for the different marker types in this profile.

- Check that the **EXCLUDE** marker has the function **Exclude**,
- check that the **SAW** marker has the function **Manual Correction 3 dB**,
- check that the **HAMMER** marker has the function **Impulse Correction, LAF<sub>T</sub>eq-LA<sub>eq</sub>**,
- check that the **SAWMILL** marker has the function **Specific** and
- check that **Unmarked** has the function **No function**.

Copy 0002.S3A and 0003.S3A into Calculations in the same way as you did with 0001.S3D.

Note: the two measurements are converted into profiles over the measurement period they represent. The profile will just be a horizontal line. The resolution for this conversion is specified in **Tools/Configure Options.../Calculation/Sample Duration**.


Open the "=0002.S3A" profile. This measurement represents the closed sawmill. Select the whole profile with the mouse and select **New Marker**. This inserts a marker. Double click on the marker, press **Details...** to select **Marker 9** in **Marker Type**, Press **OK** and then **Properties...** to select the function **Specific** for **Marker 9** and change the name of **Marker 9** to "Closed".

Open the "=0003.S3A" profile. This measurement represents the residual noise. Select the whole profile with the mouse and select the **Residual** marker (if this is not present then select **New Marker** and re-define the marker to

Residual).

#### 6.4. Concatenating measurements into one profile

The three profiles in Calculations can now be concatenated into one profile representing the whole measurement. This is done, in the Calculations section, by first dragging and dropping the "=0002.S3A" profile onto the "=0001.S3D" profile. Select **Insert a pause (Add profiles in True Time)** when concatenating the two profiles.

This is indicated by a change in the icon of the "=0001.S3D" profile in the Calculations section to .

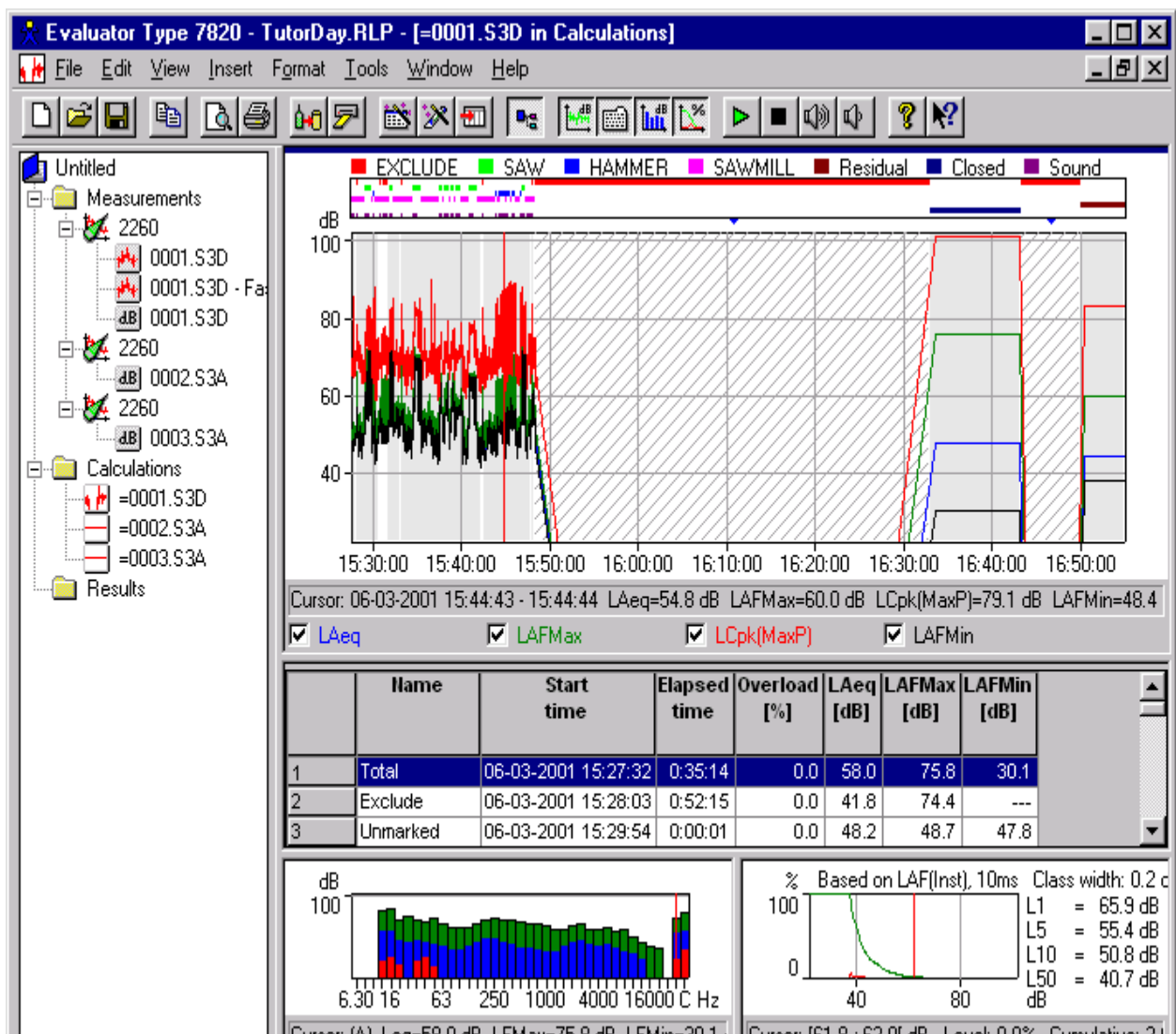
In the same way, drag the "=0003.S3A" onto "=0001.S3D", and finally double-click the "=0001.S3D" icon to see the concatenated profile.

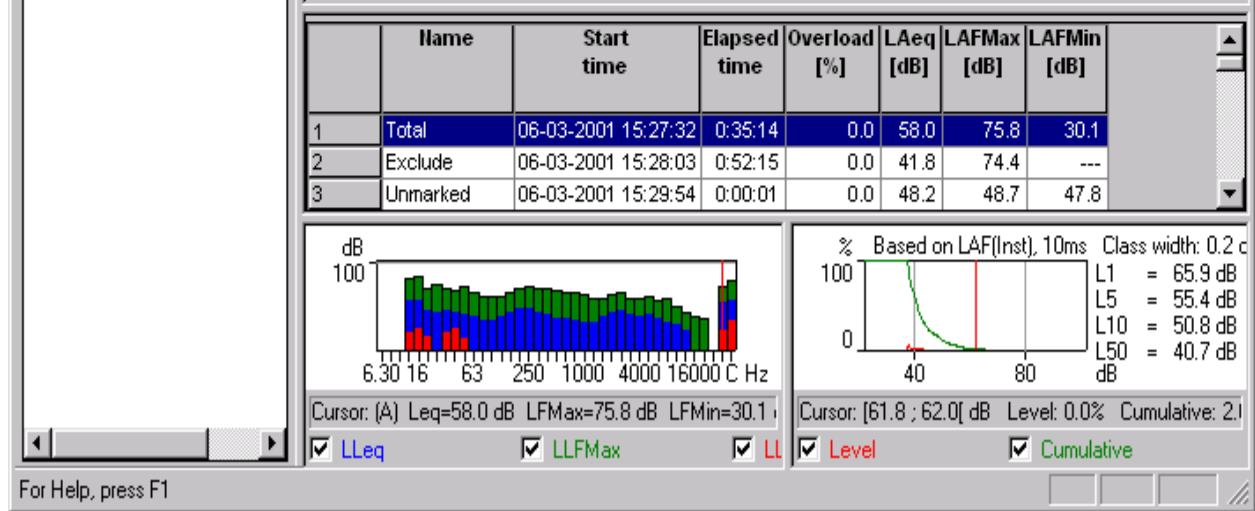
All the measurement data representing the noise from the sawmill are contained in the "=0001.S3D" profile. This is the base input data for the rating level calculation to be done in the Results branch.

**Note:** When concatenating profiles, be careful to use the same marker definitions in the individual profiles. Only the markers on the "winning" profile will be kept in the concatenated profile. The winning profile will in this case be the profile you insert new profiles into, i.e. =0001.S3D. You should check the markers in the concatenated profile for the profiles inserted.

You see in the profile, that the "Closed" marker has changed to "Marker 9" (if you haven't changed this marker on the "=0001.S3D" profile). The Residual is probably still a residual marker. Check the two markers (double click on the marker, press **Properties...** to select the function **Specific** for Marker 9 and change the name of Marker 9 to "Closed").

You should now have a display like this:





## 6.5. Viewing Data in the Calculations Branch

In the **Calculations** branch you control what to see in the profile, spectrum and statistics views by selecting a specific line in the text view (contrary to the **Measurements** branch, where the views are controlled by the cursor position in the profile).

In the **text view** you see a listing of all the markers set in the display. The list is divided into three sub-lists separated by an empty line.

The first sub-list contains calculations from the total profile (total, unmarked and excluded), the second sub-list contains calculations of all the data covered by the markers (each marker name is preceded by the text "(All)", and the third sub-list contains calculations for each individual marker.


Click on a line in the text view to select it. The contents of the spectrum and statistics views will be calculated from the data/marker selected in the text line. The data will be highlighted in the profile view (or zoomed, depending on the setting **Tools/Configure Options.../Calculation/Display Selected Marker**).

**Note:** You can click on a column heading for sorting the list in the text view.

## 6.6. Documenting data and attaching files to markers

Before continuing with the rating level calculation you might want to document the data further.

Rename the base input data to "All Woody data" (right-click the name "=0001.S3D" in the project tree and select rename).

All the sound records attached to the Sound marker document the measurement. You hear them by right clicking the sound marker and select Play Sound - or you can position the cursor in the profile and then press the  Play Sound button to play the sound from the cursor position.

You can attach other types of documentation to the markers. These could be maps, photos, video clips, the final report, etc., any file you can have on the disk.

Supplied with the tutorial is a map of the area, a photo, and a video clip from the measurement session. Attach the documentation to markers in the following way:

You can attach a file to any marker. In this case the documentation files will be attached to the first three SAWMILL markers.

Double click on the first SAWMILL marker, press the **Details** button to see the marker details for this marker. In the lower half of the marker details you can attach a file to the marker. Press **Browse** to find the file you want to attach, in this case the map of the area stored as a bit-map file named **Woody.bmp**.



Press **OK** and then select the next marker in the Markers list. Press **Details** and attach the photo **Meas1.bmp** to this marker.

Press **OK** and then select the next marker in the Markers list. Press **Details** and attach the video clip **Woody.mpg** to this marker. Press **OK** twice.

In order to see the content of the attached files, right click the relevant Documentation marker and select Open Attached File.

**Note:** It is an advantage to attach the documentation files to markers in the Calculations branch. When you subsequently insert the profile (or part of it including the markers) into other profiles or into the Results branch, then the documentation will follow the data.



## 7. Calculating Rating Level in accordance with German TA-Lärm - 1998

To calculate the rating level you insert the "All Woody data" into the Results branch. Do this in a way similar to how you inserted data into the Calculations branch - just select Results as the destination instead. Then you are asked to select a reference period for the data. Select the one you defined at the start of the tutorial (or you can define it now) and press **OK**.

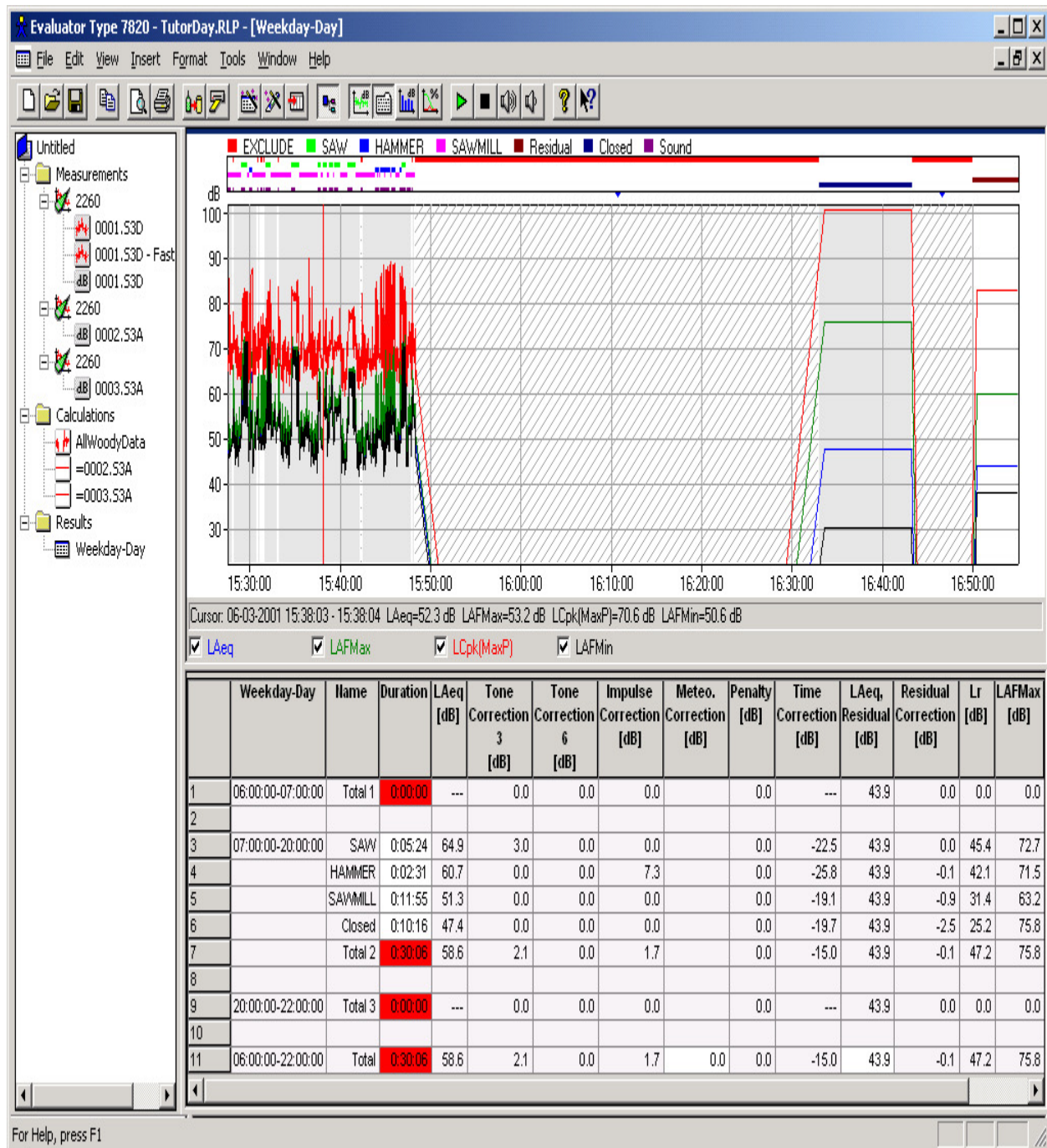
A sheet icon appears in the Results branch. Double click it and you have the Results sheet on the screen

### 7.1. Viewing Data in the Results Branch

**In the Results branch the text view contains a rating level sheet, the profile view contains a profile of all the data used for the rating level calculation, and the Spectrum and Statistics view displays the spectrum and statistics for all the specific noise.**

Close the Spectrum and Statistics view (press the  and  buttons) to get more space for the Text view of the rating level sheet.

The rating level sheet should look like:



## 7.2. Fine tuning the rating level sheet

The rating level sheet is divided into areas per penalty period and a bottom line with the total. The penalty periods are listed in the first column, the name of the markers in the second column, etc.

The red background for some of the fields indicates that the duration of the data does not match the penalty period. In the first penalty period there is no data at all, in the second period (with no penalty) between 7:00 and 20:00 there should be 13 hours of data but the duration of the data in this period is only 30 minutes and 6 seconds.

The duration of the noise samples should now be corrected to the value of a representative working day.

According to the working schedule of the sawmill, the saw in the maintenance area is active 2 hours and 10 minutes per day between 9 and 16. Click in the duration field for the SAW and enter 2:10:00. The field becomes yellow to indicate a modified value.

Modify the duration for the HAMMER, which is scheduled for 25 minutes each day, in the same way (enter 0:25:00).

The Sawmill represents the noise from the sawmill during the working day when no saw or hammer is heard. Modify the duration of the Sawmill in the period between 7 and 16:30 to 9½ hours minus 1-hour total break minus the duration of SAW and HAMMER equal to 5 hours and 55 minutes.

The Closed marker should then be representative for the remaining time in this period. Right click on the line and select Adjust Duration. This will automatically adjust the duration to the remaining of the period to make the Total time 13 hours.

The noise in the first penalty period between 6 and 7 should consist of 30 minutes from the Sawmill row (because the Sawmill opens at 06:30) and 30 minutes from the Closed row.

Right click in the Sawmill line and select Copy Row. Then right click on the 06:00 to 07:00 row and select Paste Row. Do the same with the Closed Row.

Modify the duration of the Sawmill row in the first penalty period to 0:30:00. Modify the duration of the Closed row using Adjust Duration. It will be set to 0:30:00.

The noise in the third period (20:00 to 22:00) should only consist of noise from the Closed row.

Copy the Closed row to the third period and Adjust Duration.

Now all the input from the marked data has been used and the total duration of 16 hours matches the reference period (no red duration fields).

You only need to adjust for the meteorological factor. The sawmill is north to the residences. West is the predominant wind direction. In this case a correction of -2 dB is allowed. Key -2.0 into the Meteo. Correction field in the bottom line.

The rating level sheet is finished:

	Weekday-Day	Name	Duration	LAeq [dB]	Tone Correction 3 [dB]	Tone Correction 6 [dB]	Impulse Correction [dB]	Meteo. Correction [dB]	Penalty [dB]	Time Correction [dB]	LAeq, Residual [dB]	Residual Correction [dB]	Lr [dB]	LAFMax [dB]
1	06:00:00-07:00:00	Closed	0:30:00	47.4	0.0	0.0	0.0		6.0	-15.1	43.9	-2.5	35.8	
2		SAWMILL	0:30:00	51.3	0.0	0.0	0.0		6.0	-15.1	43.9	-0.9	41.4	
3		Total 1	1:00:00	49.8	0.0	0.0	0.0		6.0	-12.0	43.9	-1.3	42.5	0.0
4														
5	07:00:00-20:00:00	SAW	2:10:00	64.9	3.0	0.0	0.0		0.0	-8.7	43.9	0.0	59.2	72.7
6		HAMMER	0:25:00	60.7	0.0	0.0	7.3		0.0	-15.8	43.9	-0.1	52.1	71.5
7		SAWMILL	5:55:00	51.3	0.0	0.0	0.0		0.0	-4.3	43.9	-0.9	46.1	63.2
8		Closed	4:30:00	47.4	0.0	0.0	0.0		0.0	-5.5	43.9	-2.5	39.4	75.8
9		Total 2	13:00:00	58.1	2.3	0.0	0.9		0.0	-0.9	43.9	-0.2	60.2	75.8
10														
11	20:00:00-22:00:00	Closed	2:00:00	47.4	0.0	0.0	0.0		6.0	-9.0	43.9	-2.5	41.8	
12		Total 3	2:00:00	47.4	0.0	0.0	0.0		6.0	-9.0	43.9	-2.5	41.8	0.0
13														
14	06:00:00-22:00:00	Total	16:00:00	57.3	2.2	0.0	0.8	-2.0	0.3	0.0	43.9	-0.2	58.3	75.8

Let us have a look at the rest of the columns in the sheet.

First of all, the sheet consists of all the columns defined in the reference period, which was set-up at the start of the tutorial.

The LAeq column displays the LAeq for each noise contribution.

The Tone Correction 3 [dB] column (renamed from Manual Correction) displays the correction term for markers with the function Manual Correction. The SAW marker is the only one. Note the correction of 3.0 dB in the SAW row.

The Tone Correction 6 [dB] column (renamed from Manual Correction #2) consists of zero's - no marker has the function Manual Correction #2.

The Impulse Correction column displays the correction term for markers with the function Impulse Correction. The HAMMER marker is the only one. Note the correction of 7.3 dB in the HAMMER row. This is the difference between the LAFteq and LAeq for the noise marked HAMMER.

The Penalty column displays the correction term for markers within the penalty period. Note the correction of 6.0 dB in the rows in the penalty periods.

The Time Correction column displays the correction term for the duration of the marker relative to the duration of the reference period.

The LAeq, Residual displays the residual noise - calculated from noise marked with the residual marker. Note: The LAeq, Residual can be overwritten in the field in the Total line.

The Residual Correction displays how much to correct the LAeq because of the LAeq, Residual.

Lr displays the rating level per row. The final rating level is in the Total row (Lr = 58.3 dB).

The LAFmax column displays the LAFmax per marker.

**The rating level exceeds the limit of 55 dB for the area.**

### 7.3. Using the rating level sheet for prediction

The rating level calculation showed an excess of the limit with 3.3 dB.

The sheet shows the contributions to the rating level and it is evident that the saw and hammer activities are the biggest contributors to the rating level.

You would like to calculate how much the saw and hammer should be damped to reduce the total rating level to be within the limit of 55 dB.

You are not allowed to change the LAeq of a marker in the sheet, but you can do it in a user defined or copied row. Copy and paste the SAW and HAMMER rows in the 07:00-20:00 period. You then have two sets of SAW and HAMMER rows and have to get rid of the SAW and HAMMER rows originating from the markers. Double click

the markers in the profile, press Properties and select the SAW marker and set the function to No function. Do the same with the HAMMER marker.

Now the rating level sheet contains the same results, but the SAW and HAMMER row can be modified.

Try to lower the LAeq for SAW and HAMMER by 6 dB. This will result in a rating level of 53.1 dB (5.3 dB lower than before). It is rather easy to lower the noise between 5 to 10 dB with a 2 m high barrier, so it should be possible to lower the noise from the saw and hammer by at least 6 dB using a barrier.

**Note:** You can also experiment with the duration or the correction terms, e.g. to predict the consequence of using the saw 5 hours a day instead of 2 hours and 10 minutes.

You can return to the correct rating level sheet by right clicking in the ROW and HAMMER rows and select Delete and then double click the markers in the profile, press Properties and select SAW marker and change the function to Manual Correction 3 dB, and select HAMMER marker and change the function to Impulse Correction, LAF<sub>Teq</sub>-LA<sub>eq</sub>.

## 8. Calculating Rating Level in accordance with Italian law no. 447 - 1995

### 8.1. Automatic Marker Wizard

The markers can be set automatically using the automatic marker wizards. These can be used for finding loudest periods, finding events, divide the profile into time blocks or they can be used to detect pure tones or impulsive noise.

You will detect pure tones and impulsive noise for a rating level calculation in accordance with the **Italian law no. 447 - 1995**.

The data used is the measurement data from the sawmill Woody Inc. described in [Section 3](#). **It is assumed you have followed the tutorial through sections 4 to 7 and calculated the rating level in accordance with the German TA-Lärm - 1998.**

Make a copy of the "All Woody data" in the Calculations branch (right click the icon and select Insert into Calculations). Rename the new "=All Woody data" to "All Woody data - Italy" and open the data by double clicking the icon.

The difference between the Italian and German way of calculating rating level consists mainly in the way the correction terms are evaluated.

### 8.2. Pure tone detection

In Germany the pure tone detection is a subjective evaluation of the noise (an objective evaluation may be done using FFT analysis), and a correction term is added to that part of the noise containing pure tones - as done using the SAW marker with the function Manual Correction 3 dB.

In Italy the pure tone detection is based on 1/3-octave LLF<sub>min</sub> spectra. A pure tone occurs if a frequency band is more than 5 dB above the neighbour bands. If this pure tone converted to phons is the highest of all the frequency bands converted to phons, then a correction term of 3 dB should be added to the total measurement (and not only the noise with the pure tone).

This can be done using a marker with the function Result Correction 3 dB. If this marker occurs on the profile, then the result will be corrected with 3 dB. To specify this marker double click the markers in the profile, press **Properties**, select one of the unused markers (e.g. marker no. 5) and select the function Result Correction 3 dB and change the name of the marker to Pure Tone.

The marker should be set on the profile using the automatic marker wizard. To use the automatic marker wizard the Profile window must be active (click inside the profile).

**Note:** The automatic marker wizard only uses the visible part of the profile - un-zoom the profile.

Press the **Automatic Marker Wizard** button  and select **Pure Tone Detector** and press **Next**.

Select the "**Lmin band X - Max(Lmin of neighbors)**" algorithm, select the frequency range 20 Hz to 20000 Hz, the difference 5dB and Minimum Duration 10 s and select **Test against Loudness Level Contours** - press **Next**.

Select the **Pure Tone** marker and press **Finish**.

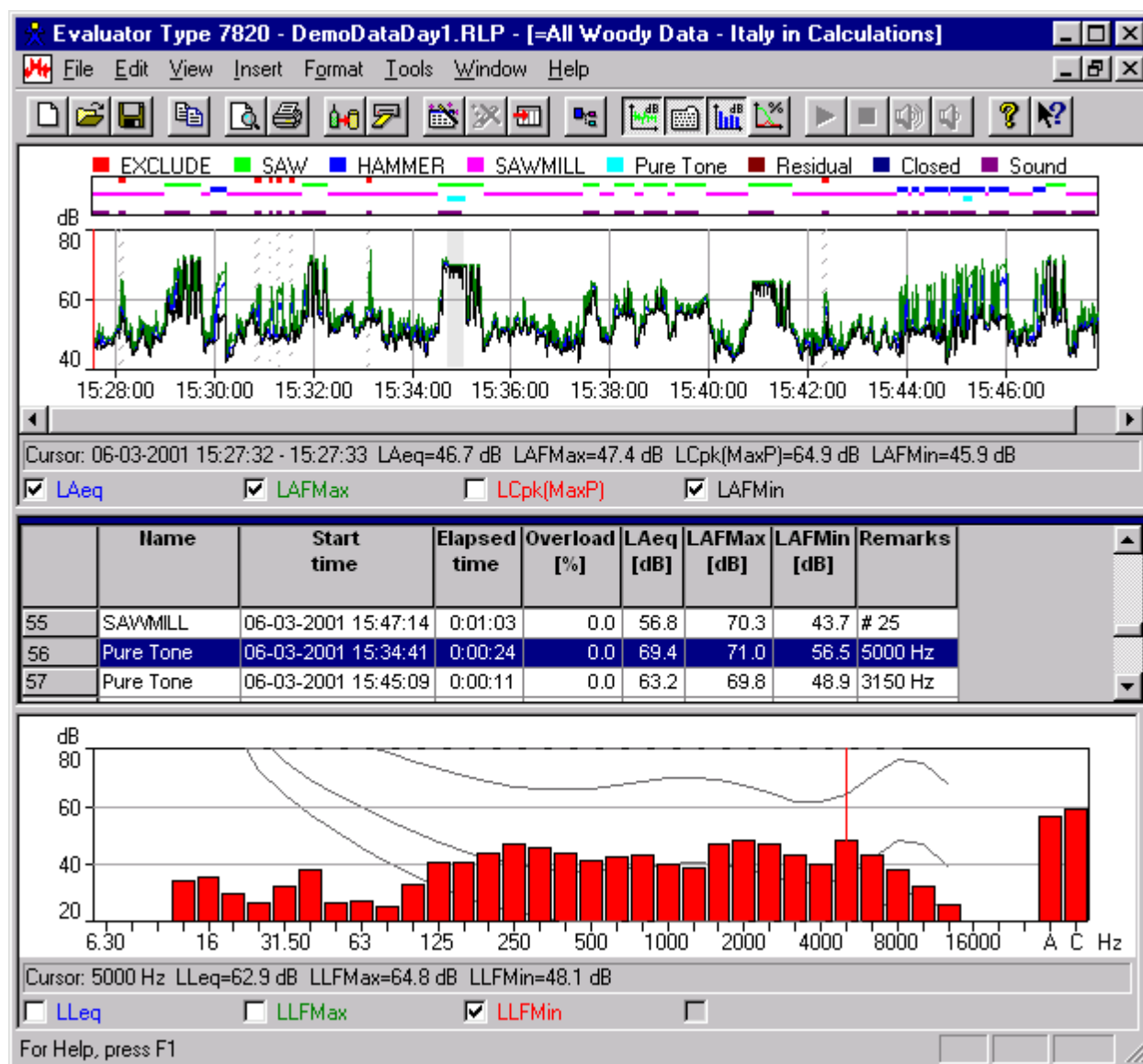
The automatic marker wizard finds two periods with pure tones and makes two Result Correction markers.

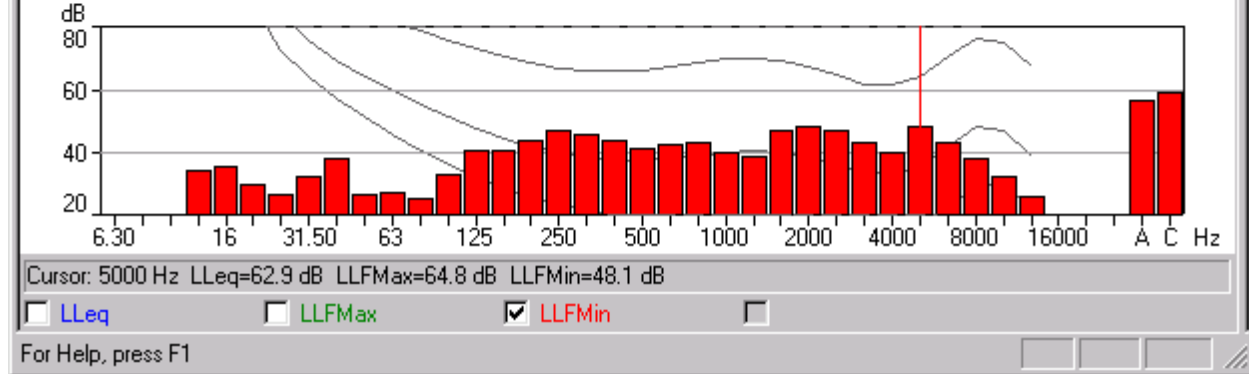
Zoom your profile to cover the first 20 minutes of the measurement.

Move the cursor to point at the first Pure Tone marker above the profile. When the cursor is exactly above the marker, then the Remarks field of the marker is displayed as a tool tip. The pure tone detector updates the remarks field with the pure tone frequency - in this case 5000 Hz.

Right click in the Text view and select Properties. Select Remarks in the list to the left and press **Add** to add it to the list of information in the text view, select save as default and press OK. Then find and select the Pure Tone marker in the list in the Text view. Note the content of the Remarks field.

Remove the statistics view and right click in the Spectrum view to select Properties. Select **Show Loudness Level Contours** and the Range settings as preferred - press OK. Deselect LLeq and LLFmax and you should have a display showing the pure tone like this:






### 8.3. Impulse detection

In Italy the Impulse detection is based on profiles with LAImax, LASmax and LAFmax.

If LAImax-LASmax > 6 dB and the duration of the event -10 dB from LAFmax is less than 1 s, then the event is an impulse. If more than 10 impulses occurs within one hour during the day, then a 3 dB impulse correction should be added to the total LAeq.

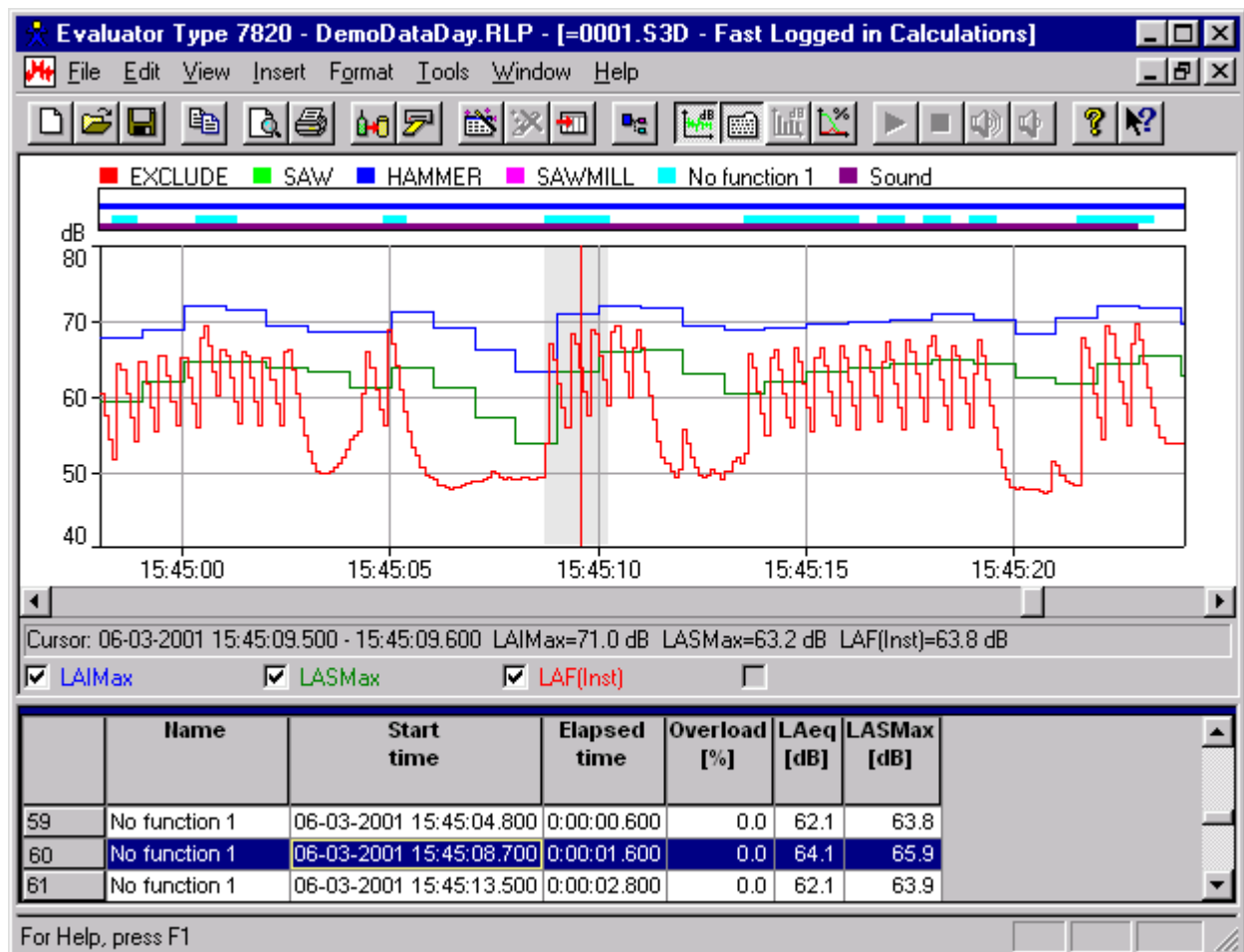
The data in the 0001.S3D - Fast Logged profile contains a LAF with 100 ms resolution, fine enough to verify the impulse criterion. Drag this profile into the Calculations branch and open it here. Then select the profile and press the **Automatic Marker Wizard** button  and select **Impulsive Noise Detector** and press **Next**.

Select the "**LAImax - LASmax and duration < 1s**" algorithm and press **Next**.

Select the **No function 1** marker - the choice of marker is unimportant (the profile is not used in the Results section) - and press **Finish**.

The automatic marker wizard finds a number of Impulses.

Zoom the profile around some of the impulses, select LAImax in the Profile Properties Legend and you can see the impulses in detail:





	Name	Start time	Elapsed time	Overload [%]	LAeq [dB]	LASMax [dB]	
59	No function 1	06-03-2001 15:45:04.800	0:00:00.600	0.0	62.1	63.8	
60	No function 1	06-03-2001 15:45:08.700	0:00:01.600	0.0	64.1	65.9	
61	No function 1	06-03-2001 15:45:13.500	0:00:02.800	0.0	62.1	63.9	

For Help, press F1

## 8.4. Rating Level Calculation - Italy

The rating level calculation is based on the "All Woody data - Italy". Open this profile again.

The markers set on the profile in section 6 point out the different noise sources correctly, but the functions of the markers must be adjusted to obey the Italian legislation.

Right click in the marker area and select **Markers** from the menu. Press **Properties...** to view the properties for the different marker types in the profile.

- Check that the EXCLUDE marker has the function **Exclude**,
- check that the SAW marker has the function **Specific** (it should not add any correction for pure tones, this is done by the Pure Tone marker just made),
- check that the HAMMER marker has the function **Specific** (it should not add any correction for impulsiveness, this is done in the Results sheet based on the result of the automatic marker wizard for impulsive noise),
- check that SAWMILL and Closed have the function **Specific**.
- check that Pure Tone has the function **Result Correction 3 dB**.

Drag the "All Woody data - Italy" profile into the Results branch. You will be asked to select a reference period. You have to make a new one to satisfy the Italian legislation:

- Select **New**
- Select **Italy**.
- Select **Day**
- Select **Next**

Now you will see the main reference period set-up dialog. Default values for the Italian law 447 - 1995 for a day are set. The reference period is from 6 to 22 (like the German reference period), but there are no penalty periods. Change the name to **Day-Italy**.

- Select **Next**

This brings you to the Sheet Layout dialog.

This dialog allows you to select which headings appear in your final rating level sheet. A default set has been chosen, but moving the headings between the Available columns and Selected columns areas can easily change these. You can also re-arrange the column order by moving headings up and down, or you can rename them.

You might want to rename some of the column headers:

Select the column header in "Selected Columns", press Rename and you can enter a new name for the column header. The original header is displayed in the grey box.

- Rename **Result Correction** to Kt,
- Rename **Unspecified Correction** to Ki
- Rename **Unspecified Correction #2** to Ktp

Select Finish, and the Reference Period set-up dialog closes and a new rating level sheet is created in the Results branch. Open the new rating level sheet.

The rating level sheet should look like:



	Day-Italy	Name	Duration	LAeq [dB]	Kt [dB]	Ki [dB]	Ktp [dB]	Time Correction [dB]	LAeq, Residual [dB]	Residual Correction [dB]	Lr [dB]
1	06:00:00-22:00:00	SAW	0:05:24	64.9				-22.5	43.9	0.0	42.4
2		HAMMER	0:02:31	60.7				-25.8	43.9	-0.1	34.8
3		SAWMILL	0:11:55	51.3				-19.1	43.9	-0.9	31.4
4		Closed	0:10:16	47.4				-19.7	43.9	-2.5	25.2
5	06:00:00-22:00:00	Total	0:30:06	58.6	3.0	0.0	0.0	-15.0	43.9	-0.1	46.5

The duration of the noise samples should now be corrected to the value of a representative working day - in exactly the same way as in section 7.

Click in the duration field for the SAW and enter 2:10:00.

Modify the duration for the HAMMER to 0:25:00.

The SAWMILL represents the noise from the sawmill during the working day when no saw or hammer is heard. Modify the duration of the SAWMILL to:

(10 hours - 1 hour total break - SAW duration - HAMMER duration) =

(10:00:00 - 1:00:00 - 2:10:00 - 00:25:00) = 6 hours and 25 minutes.

The Closed marker should then be representative for the remaining in this period. Right click on the line and select Adjust Duration. This will automatically adjust the duration to the remaining of the period to make the Total time 16 hours.

Now all the input from the marked data have been used and the total duration of 16 hours matches the reference period (no red duration fields).

The Kt column (renamed from Result Correction) displays the correction term in the Total row at the bottom of the sheet, if any marker with the function Result Correction is present. The Pure Tone marker is present, made by the automatic marker wizard. Note the correction of 3.0 dB in the Total row.

The Ki column (renamed from Unspecified Correction) should be used to hold the Impulse correction term of 3 dB, if enough impulses are present. The Impulse Correction wizard used on the fast logged profile found enough impulses to make the 3 dB correction. Enter 3.0 dB in the Total row.

The Ktp column (renamed from Unspecified Correction) should be used to hold a correction term of -3 or -5 dB, if the annoying noise is present no longer than 1-hour resp. 15 minutes during the day. Enter -3.0 dB in the Total row.

The rating level sheet is finished:

	Day-Italy	Name	Duration	LAeq [dB]	Kt [dB]	Ki [dB]	Ktp [dB]	Time Correction [dB]	LAeq, Residual [dB]	Residual Correction [dB]	Lr [dB]
1	06:00:00-22:00:00	SAW	2:10:00	64.9				-8.7	43.9	0.0	56.2
2		HAMMER	0:25:00	60.7				-15.8	43.9	-0.1	44.8
3		SAWMILL	6:25:00	51.3				-4.0	43.9	-0.9	46.5
4		Closed	7:00:00	47.4				-3.6	43.9	-2.5	41.3
5	06:00:00-22:00:00	Total	16:00:00	57.3	3.0	3.0	-3.0	0.0	43.9	-0.2	60.1

The final rating level is in the Total row (Lr = 60.1 dB).

## 9. Calculating Rating Level in accordance with British Standard 4142

## : 1997

In the UK rating level calculation is done in accordance with **BS 4142 : 1997**. The basic measurement parameter is LAeq and if the noise contains pure tones and/or is impulsive then a correction of 5 dB should be added. The main difference to the ISO 1996-2 standard is the evaluation part. The rating level is compared to the background noise level LAF90 instead of a fixed level. The reference time interval is 1 hour during the day and 5 minutes during the night.

The data used for demonstrating the calculation in accordance with BS 4142 : 1997 is the measurement data from the sawmill Woody Inc. described in [Section 3](#). **It is assumed you have followed the tutorial through sections 4 to 7 and calculated the rating level in accordance with the German TA-Lärm.**

Drag the "All Woody data" profile into the Results branch. You will be asked to select a reference period. You have to make a new reference period to satisfy the BS 4142:

- Select **New**
- Select **UK**.
- Select **Day**
- Select **Next**

Now you will see the main reference period set-up dialog. Default values for the BS 4142 : 1997 for a day are set. The reference period is from 07:00 to 23:00.

Rename the **Name** to **Day-UK**.

Note the Precision is set to 1 dB, calculation of Background Noise LAF90 based on LAF values is enabled and Loudest Period 1 hour is checked.

- Select **Next**

This brings you to the **Sheet Layout** dialog.

Select **Finish**, and the Reference Period set-up dialog closes and a new rating level sheet is created in the Results branch. Open the new rating level sheet.

The rating level sheet contains only one empty row. It is not possible to calculate a rating level because the calculation is set up to find the loudest hour of the measurement, but only approximately ½ hour of measurements is available. The loudest hour setting is most useful, if you have logged data for several hours. Right click the rating level sheet, select Properties and disable the Loudest hour setting.

You have to compose a loudest hour from the noise parts in the measurement. The easiest way of doing this is to set the Reference period to one hour covering the part of the measurement with the noise from the sawmill. Set the reference period to 15:00 to 16:00. Select the Sheet Layout and remove the Start time and End time. Press **OK**.

Four markers appear in the rating level sheet, however they are specified in accordance with the German TA-Lärm as you did earlier in the tutorial, and not specified in accordance with BS 4142.

You need to find the loudest hour from this representative measurement. It is not fair to just chose the noise from the sawing, because it will not run throughout one whole hour - it will be a mix between the saw, the hammer and the sawmill noise. The noise when closed is too low to be relevant in this calculation.

The functions of the noise relevant to the calculation must be set to Specific.

Right click in the marker area and select **Markers** from the menu. Press **Properties...** to view the properties for the different marker types in the profile.

- Check that the EXCLUDE marker has the function **Exclude**,
- check that the SAW, HAMMER and SAWMILL marker have the function **Specific** and
- check that Closed have the function **No function**.

You assume the sawing and hammering are equally spaced in time from 07:00 to 16:00 with the exception of the three breaks (totalling one hour). The saw will then be active for  $2:10:00 / 8:00:00 = 16$  minutes and 15 seconds per hour. The Hammer will be active for  $0:25:00 / 8:00:00 = 3$  minutes and 8 seconds per hour. The noise from the sawmill without these events will then be active for  $5:25:00 / 8:00:00 = 40$  minutes and 37 seconds. Set the duration for the three rows as calculated above.

The noise contains pure tones and impulses - set the Unspecified Correction to 5 dB.

The LAF90 is calculated based on data marked with the Background marker. Un-zoom the profile and select the part marked with the Residual marker (the rightmost part of the profile) and insert a Background marker together with the Residual marker. This will update the LAF90 and Lr-LAF90 columns.

	Day - UK	Name	Duration	LAeq [dB]	Unspecified Correction [dB]	Time Correction [dB]	LAeq, Residual [dB]	Residual Correction [dB]	LAF90 [dB]	Lr [dB]	Lr-LAF90 [dB]
1	15:00:00-16:00:00	SAW	0:16:15	65		-6	44	0	40	59	19
2		HAMMER	0:03:08	61		-13	44	0	40	48	8
3		Sawmill	0:40:37	51		-2	44	-1	40	48	8
4	15:00:00-16:00:00	Total	1:00:00	60	5	0	44	0	40	65	25

The final rating level is in the Total row (Lr = 65 dB).

Lr - LAF90 = 25 dB; a very high level indicating complaints are likely.

## 10. Rating level based on unattended measurements

In some situations you would like to measure the noise emission from a plant without being there, e.g. to measure the whole night. This requires that you are able to distinguish between the noise events which happened when you were not there.

The Brüel & Kjær sound level meters 2238 mediator and 2260 Investigator/Observer can be set up to log the noise for several days. You can reduce the amount of necessary measurement data to what you need and you can control sound recording on a laptop computer for identification and documentation of the noise events.

Consider the following case:

Neighbours are annoyed by the noise from some small compressors starting and stopping during the night at Woody Inc. You have to evaluate whether the compressors are too noisy or not.

You have to measure and log LAeq values at suitable time intervals in order to find the loudest hour or loudest 5 minutes (required by your local legislation) and to be able to exclude irrelevant noise.

The measurement will be disturbed by trains passing by in the late evening and early morning and maybe of aircraft, road traffic and birdsong.

You choose a 2260 Investigator running the BZ 7206 Enhanced Sound Analysis software and [connect it to your laptop computer](#) running Evaluator using the Sound Recorder tool.

You set-up the 2260 Investigator to **Event Logging**.


To reduce the amount of measurement data, you log all broadband values including statistics and Leq spectra every minute. The statistics are needed to calculate background level in UK. Each time an event occurs (the noise exceeds the trigger level) the measurement changes to logging every second (this time without statistics - the statistics is only needed for background calculation). The event trigger is set to suit the noise levels, requiring the noise level to be above the trigger level for at least 2 seconds. A pre-trigger of 3 seconds is used.

The PC sound recording is set-up to be controlled by events. Each sound recording is limited to max. 30 s - this is enough to identify and document the event.

Some typical data has been stored in the file 0004.S3D.

Before inserting data be sure that the default marker set-up suits your needs:

- Rename Marker 1 to "Night Noise" with function Specific - this marker will be used to mark all night noise from the sawmill except the compressor noise.
  - Rename marker 2 to "Compressor" with function Specific - this marker will be used to mark the noise from the compressors.
- see the details for setting up the markers in [section 4](#).

If you have a software key for Evaluator then click on the  icon to insert the files **0004.S3D**, **WOODY01.FFT** and **WOODY02.FFT**.

Press **Browse** to locate the directory **DemoData\tutorNight.emb** with the sound records.

If you don't have a software key, then you can open the **TutorNight.RLP** project.

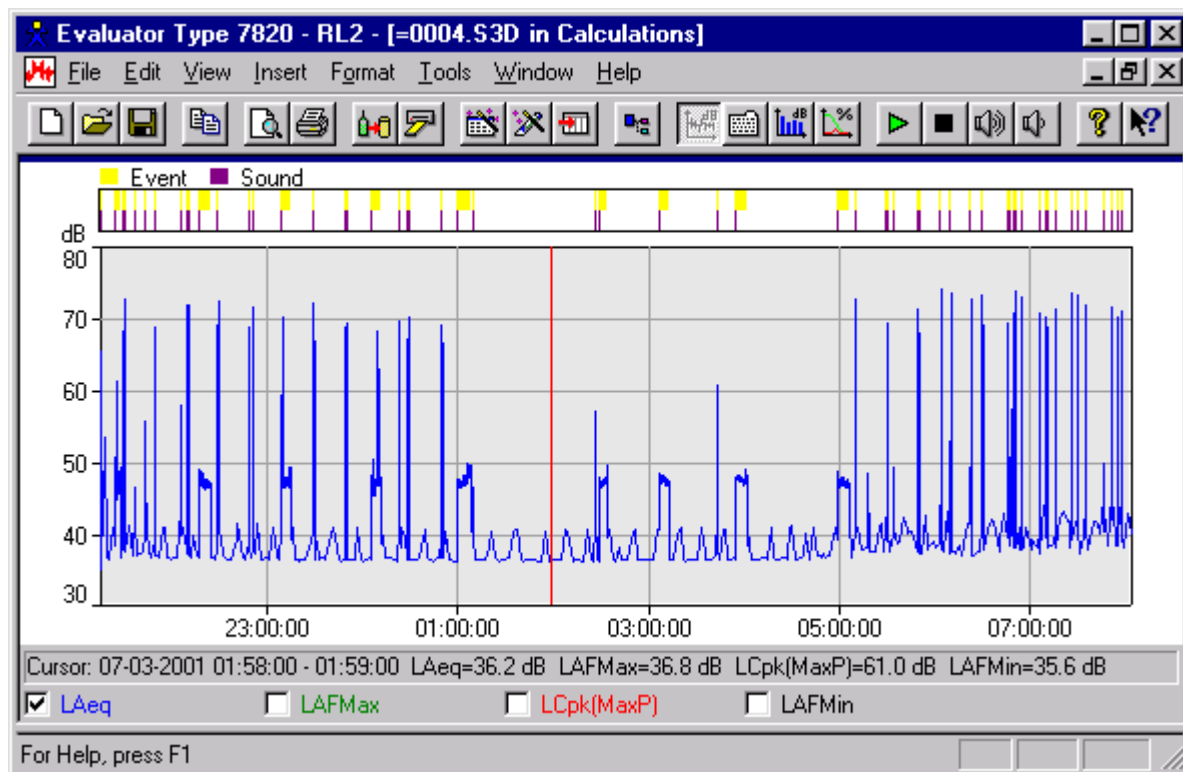
Insert the profile 0004.S3D into the Calculations branch and open it.

In the profile view you see the profiles of four parameters and a lot of Event markers.

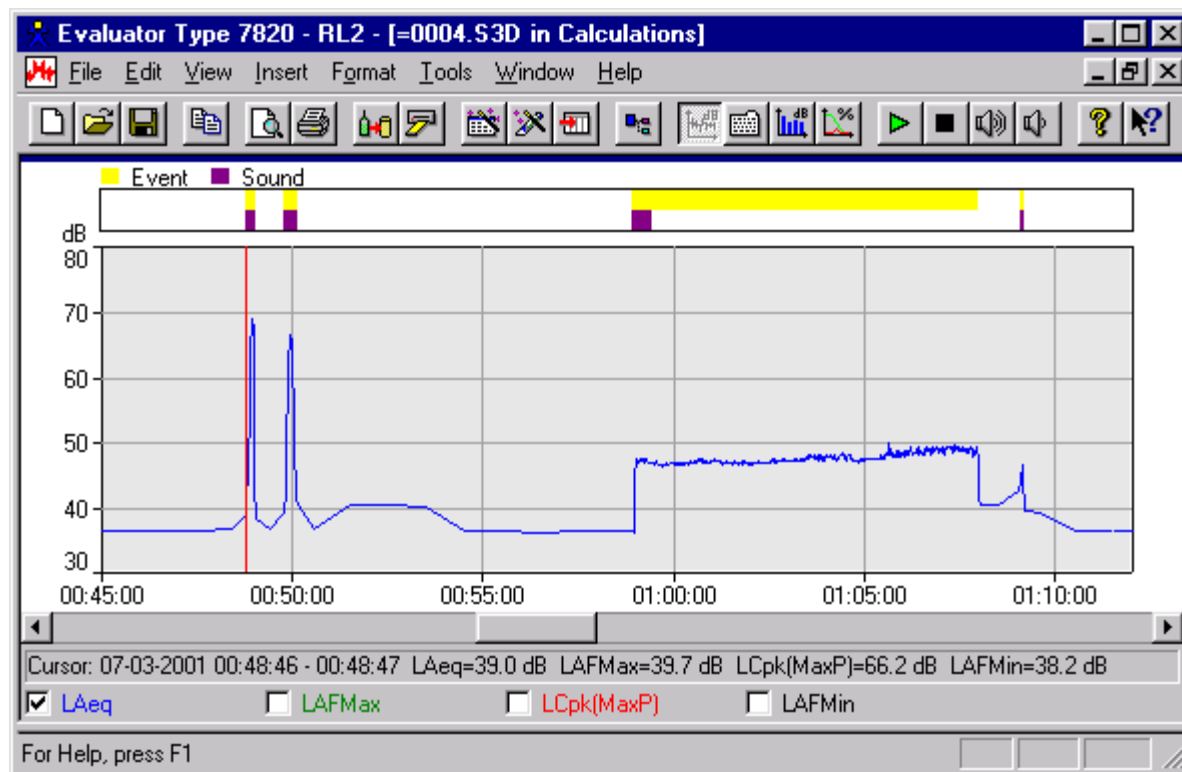
### 10.1. Evaluating the events


In order to qualify the events you need to study each event.

Close the Tree, Text, Spectrum and Statistics views to get more space for the Profile View. Then uncheck some of the parameters in the profile, except the LAeq profile. Double click on the Y-axis and set Range to User Defined 30 to 80 dB. Your Evaluator screen should look like:



Click in the profile and drag the cursor to zoom around some of the events, e.g. from 00:45:00 to 01:12:00. Click at the leftmost position in the Profile (position 00:45:00) and press the Right Arrow key on the keyboard to move the cursor one position to the right. Notice how the cursor moves 1 minute for each press - the resolution of the measurement is 1 minute. When the cursor comes to an Event the resolution changes to 1 s and the cursor now moves in 1 s intervals:



The first two Events are trains passing by. Click the Play Sound button  to hear the sound from the trains. The next Event is the compressor running for 9 minutes. The first 30 s have been recorded. The last event is an airplane fly-over.

You can investigate all the events in this way and find out that they are all irrelevant to the noise from the sawmill except the 9 compressor events easily recognized on the profile.

You then have to exclude all the events except the 9 compressor events. The 9 compressor events should be regarded as Specific noise together with all the unmarked.

You do this by marking all the compressor noise with the "Compressor" marker and all the other noise with the "Night Noise" marker. It would be easier just to use one marker with function "Specific" to cover all the noise, but using two markers to distinguish between the noise types has the following advantages:

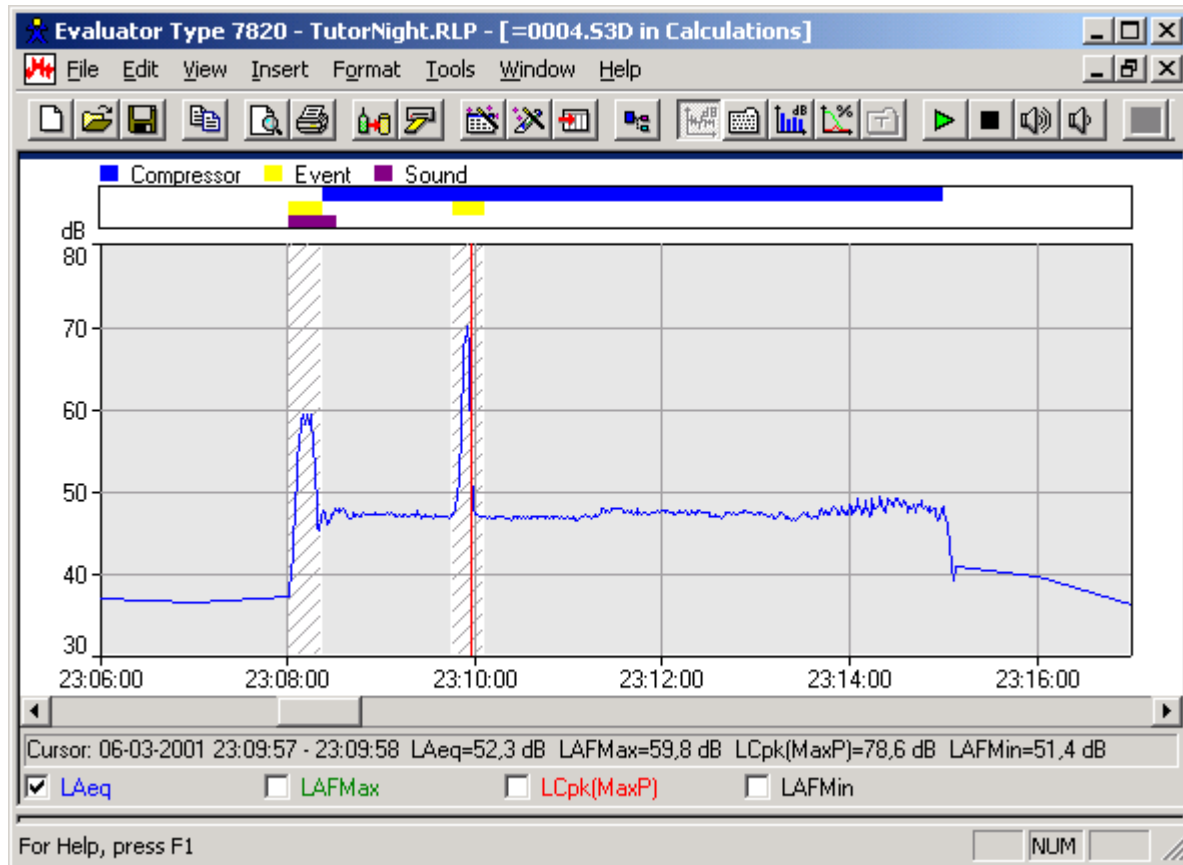
- The correction for residual noise will be more correct if it is done per noise type instead of for the average noise.
- It is easy to make corrections for impulsiveness or pure tones, if one of the noise types shows up to be impulsive or contain tones - you will see this in [section 11](#).

Set the correct markers in the following way:

- Make the function of all the Event markers to Exclude (double click the markers, select Properties and set the function of the Event marker to Exclude).
- Locate the 9 compressor events and change them from Event markers to Compressor markers. Do this in the

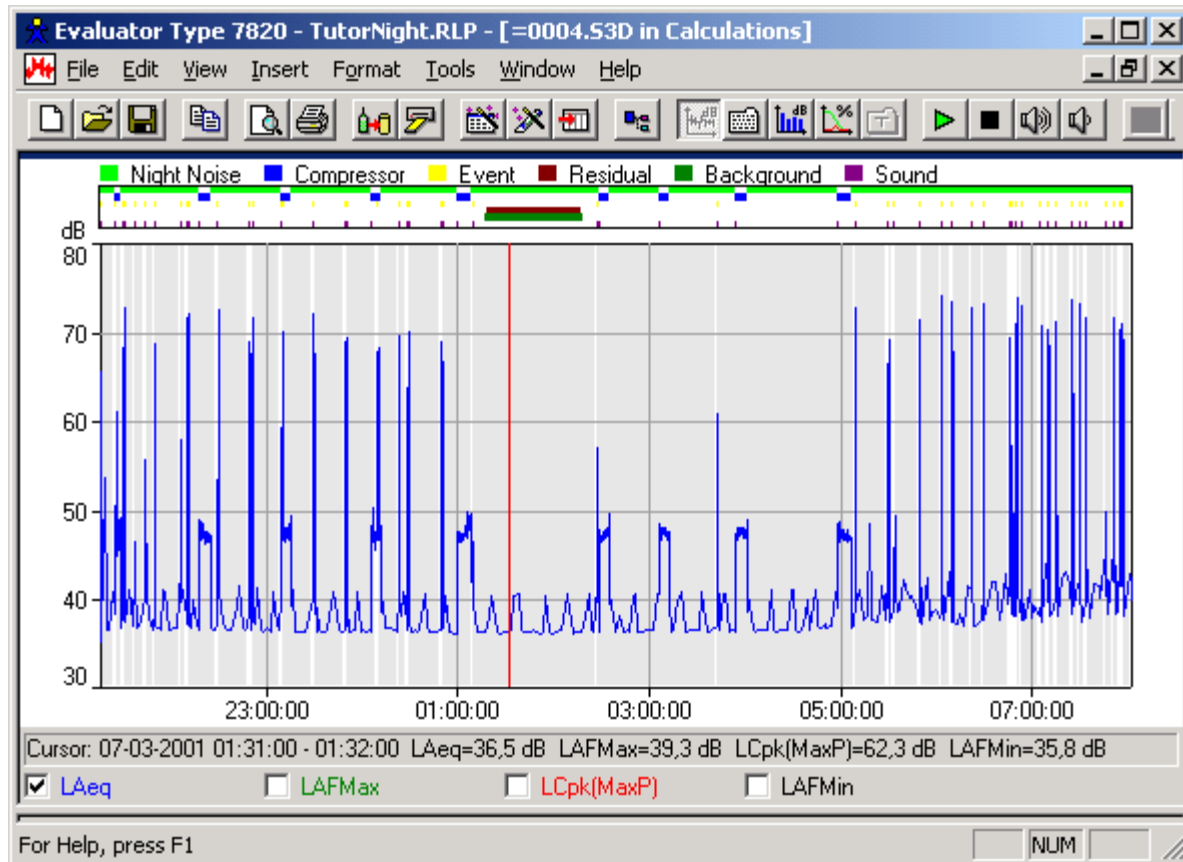
following way:

- Zoom around the 9 compressor markers one by one and select the part in the profile covering the marker and select Remove Marker, Event. Be careful not to remove that part of the compressor event overlapped with e.g. a train pass by at 23:10:00.
- Select the part in the profile covering the Compressor and insert the "Compressor" marker:



- Select all the parts not covered by the nine "Compressor" markers one by one and insert the "Night Noise" marker.
- Select a suitable part of the profile representative for the residual noise and mark it with a Residual marker and a Background marker.

Your Evaluator screen should now look like:



### Deleting wave-files not in use

The wave-files attached to the Sound markers take up a lot of space on the disk (57 Mbyte for the night measurement). In order to reduce the space used for wave-files you can delete all the Sound markers you don't need any more for identification or documentation. The wave-files not referenced by any Sound marker will be deleted next time you save the project.

**Note:** you have to delete the Sound markers not needed any more in all branches (the Measurements, Calculations and Results branches) - and be sure the wave-files are not write protected.

## 10.2. Rating level calculation in accordance with TA-Lärm - 1997

The data is now ready for rating level calculation.

Open the Tree view again and drag the profile from the Calculations branch to the Results branch. Make a new Reference Period for Germany Weekday-Night.

Note the Reference Period is from 22:00 to 06:00, no penalty periods, and Loudest Period 1 hour Fixed Time has been selected.

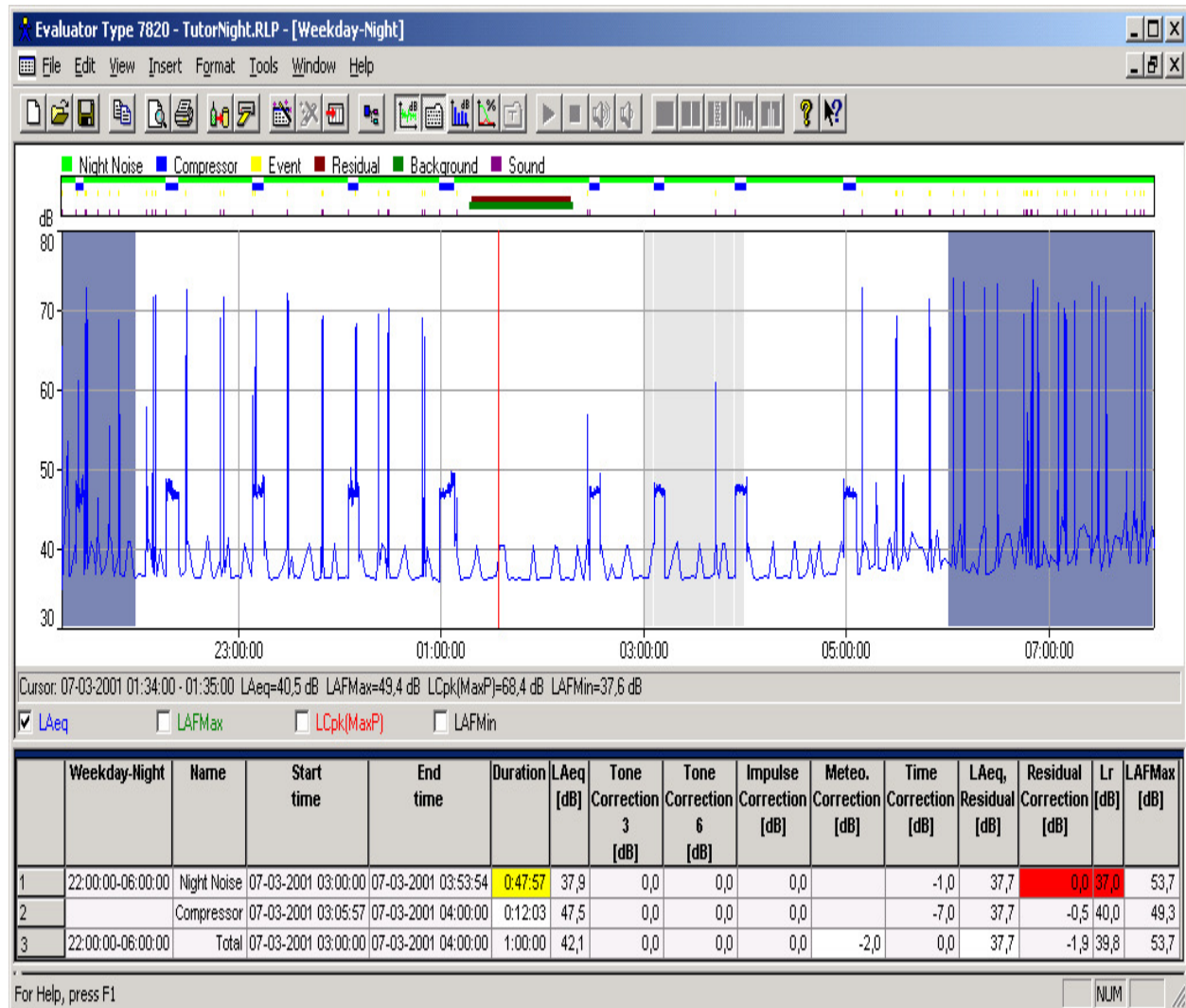
Make the same changes in the Sheet Layout as you did in section 4:

- Rename **Manual Correction** to "Tone Correction 3" (or "Zuschlag für Ton 3" or "KT3" - you can then use the "Tone Correction 3" marker for tonal correction of 3 dB).
- Rename **Manual Correction #2** to "Tone Correction 6" (or "Zuschlag für Ton 6" or "KT6" - you can then use the "Tone Correction 6" marker for tonal correction of 6 dB).
- Rename **Impulse Correction** to "Impulse Correction" (or "Zuschlag für Impuls" or "KI").

- Rename **Unspecified Correction** to "Meteo. Correction" (or "Cmet").
- Rename **Time Correction** to "Time Correction" (or "Korrektur für Einwirkdauer" or "KE").

Open the Results sheet. The loudest hour has been recognized (greyed out on profile display) but the Duration of the loudest hour is only 59 minutes and 27 seconds. This is because 33 s has been excluded from the profile. Right click on the Night Noise line and select Adjust Duration. This will automatically adjust the duration of Night Noise so that the total duration will be 1 hour. Enter -2 for Meteo. Correction.

The rating level is calculated to 39.8 dB.



### 10.3. Rating level calculation in accordance with Italian law no. 447 - 1995

Open the Tree view again and drag the profile from the Calculations branch to the Results branch. Make a new Reference Period for Italy-Night.

Make the same changes in the Sheet Layout as you did in section 8.4.

- Rename **Result Correction** to Kt (will contain a correction from a "Pure Tone" marker with the function Result Correction = 3 dB),

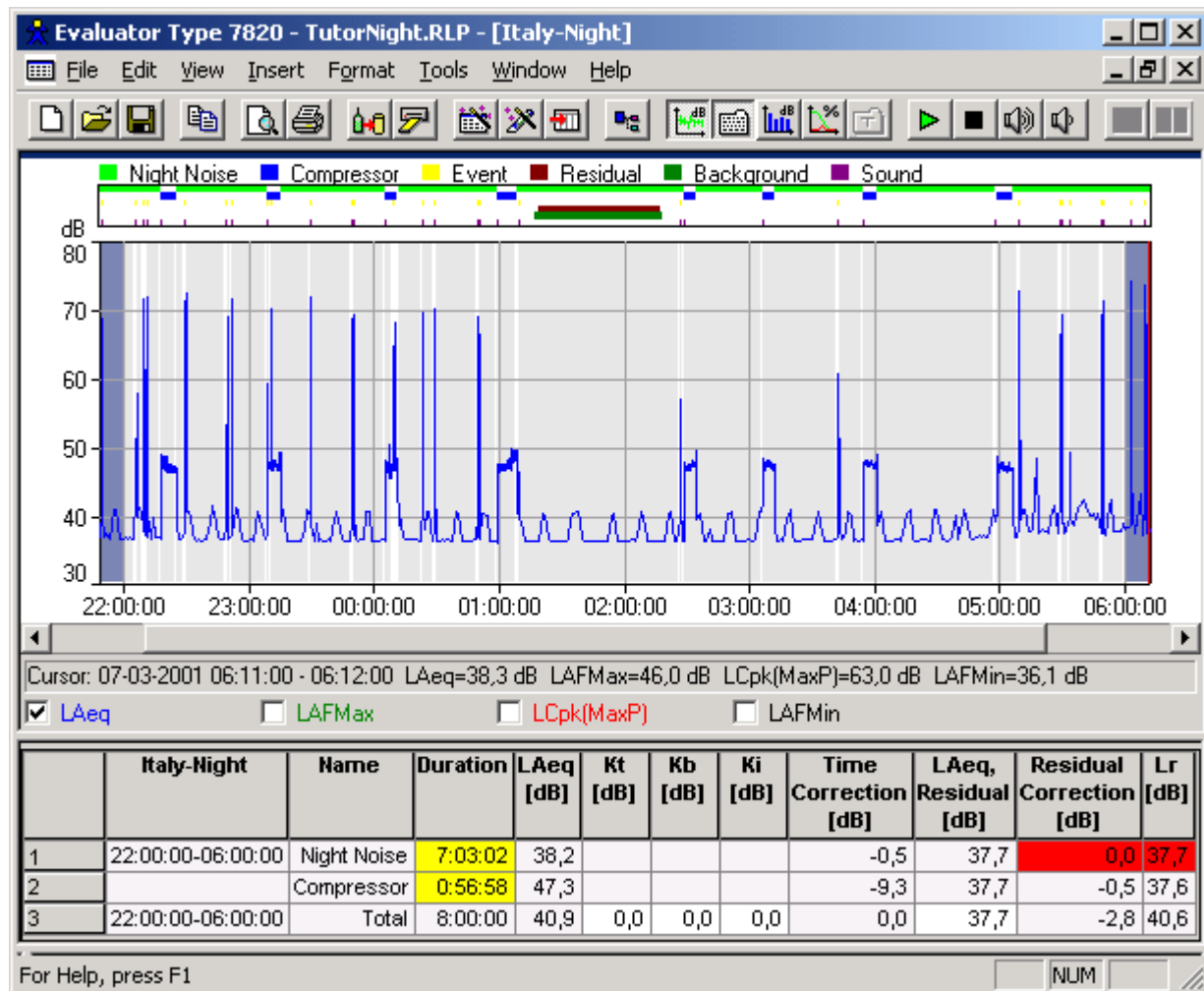


- Rename **Result Correction #2** to Kb (will contain a correction from a "Pure Tone < 200 Hz" marker with the function Result Correction #2 = 3 dB),
- Rename **Unspecified Correction** to Ki

Open the Results sheet.

You have not measured all the required spectra (LAFmin) and not made the fast logging of LAF measurement because the noise during the night does not have any tonality or an impulsive character. The test for pure tones and impulsive noise are not made.

Adjust the duration of the Compressor marker with +2 min for the excluded part of the compressors and adjust the duration of the Night Noise marker so the total duration becomes 8 hours. The result is:



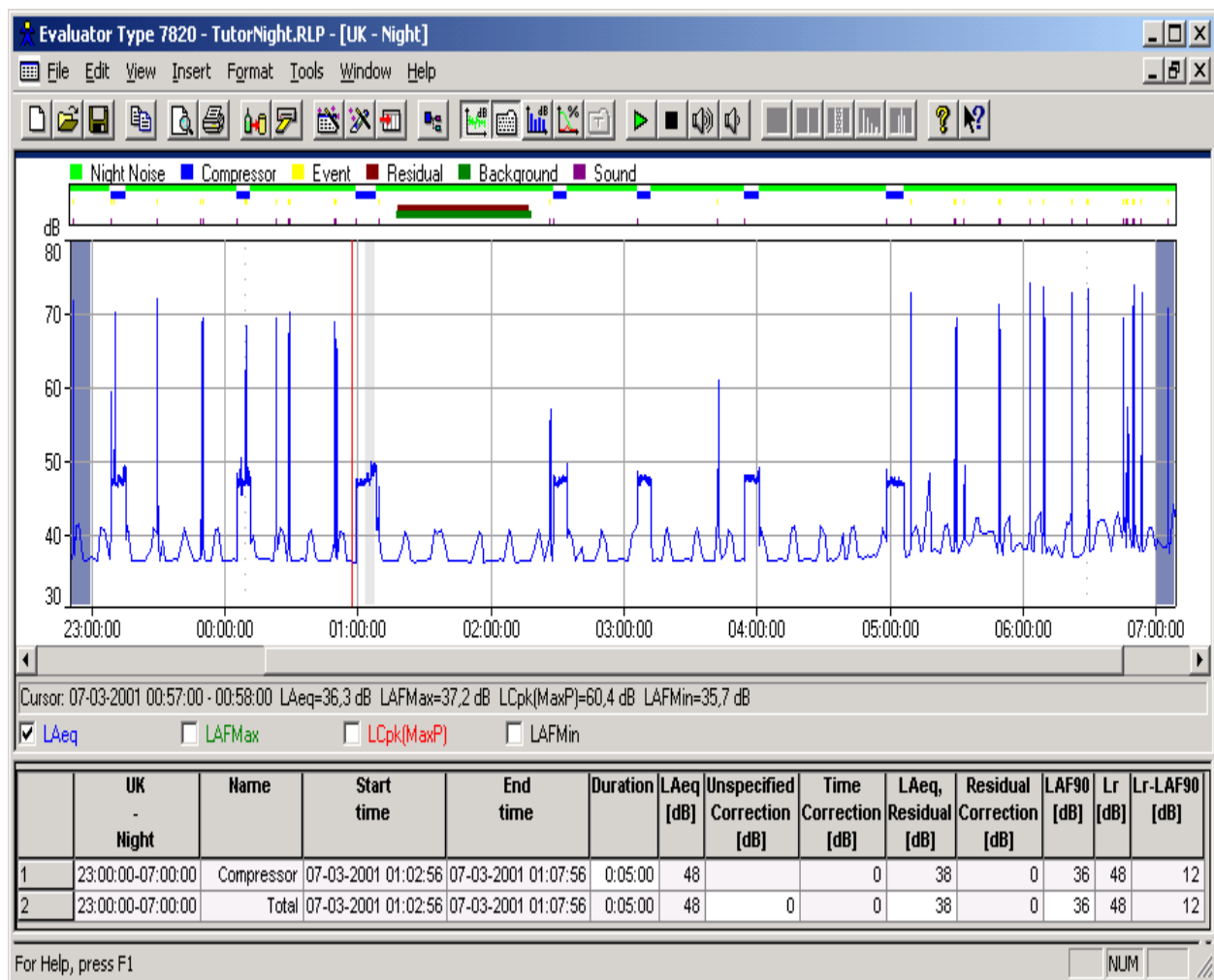
#### 10.4. Rating level calculation in accordance with BS 4142 : 1997

Open the Tree view again and drag the profile from the Calculations branch to the Results branch. Make a new Reference Period for UK Night.

Note the Reference Period is from 23:00 to 07:00, Loudest Period is 5 minutes, precision is 1 dB and calculation of background level is based on LAF.

Open the Results sheet.

The loudest 5 minutes has been recognized (shown greyed out on the profile display) and the rating level is calculated to 48 dB, which is 12 dB above the background level (Lr-LAF90).



## 11. Tone Assessment using FFT Measurements

### 11.1. Standards

Tone assessment using FFT measurements is an objective method to rate the annoyance of tones. The aim is to achieve equivalent results to those obtained from the average subjective listener.

Three standards are implemented in the BZ 7208 FFT software for 2260 and in the 7820 Evaluator:

**JNM2** Joint Nordic Method - Version 2 - 1999.

**DIN** DIN 45681 - 1992.

**ISO/ISO/CD 1996-2** - 2001-05.

Please refer to these standards for a detailed description of the methods. (The document "Objective Method for Assessing the Audibility of Tones in Noise - Joint Nordic method - Version 2" from DELTA Acoustics & Vibration is supplied on the ENV CD\_ROM BZ 5298.)

The application note BO 0499 "Tone Assessment using the 2260H Sound Level Analyzer" from Brüel & Kjær (can be found on the ENV CD-ROM BZ 5298) and the Technical Documentation for the BZ 7208 FFT software describe in some detail how to make measurements in accordance with the standards and how to interpret the results.

## **11.2. Tone Assessment Procedure**

The procedure has three main steps:

1. Analyse the noise at the receiver locations using FFT.
2. Determine the tones, their audibility and consequently the tone penalty.
3. Insert the tone penalty in the rating level sheet.

### **Step 1. Analyse the noise at the receiver locations using FFT.**

In this tutorial a FFT measurement has been made using 2260 Investigator running the BZ 7208 FFT software.

A few preliminary measurements indicated tones at approximately 400 Hz, 2400 Hz and 4800 Hz. The measurement is divided into two in order to cover these frequencies with a suitable resolution (as a rule of thumb - derived from the definitions below - the Noise Bandwidth of the FFT lines should be less than approx. 1 % of the tone frequency in question). The first measurement WOODY01.FFT covers the frequency range from 1800 Hz to 6800 Hz, the second WOODY02.FFT covers the frequency range from 300 Hz to 1550 Hz.

The tones from the compressor are varying slightly in frequency. To get detailed information of the tonal variation, both measurements are 2 minute loggings of FFT spectra with 1s resolution - instead of just two averaged measurements with possibly smeared tones.

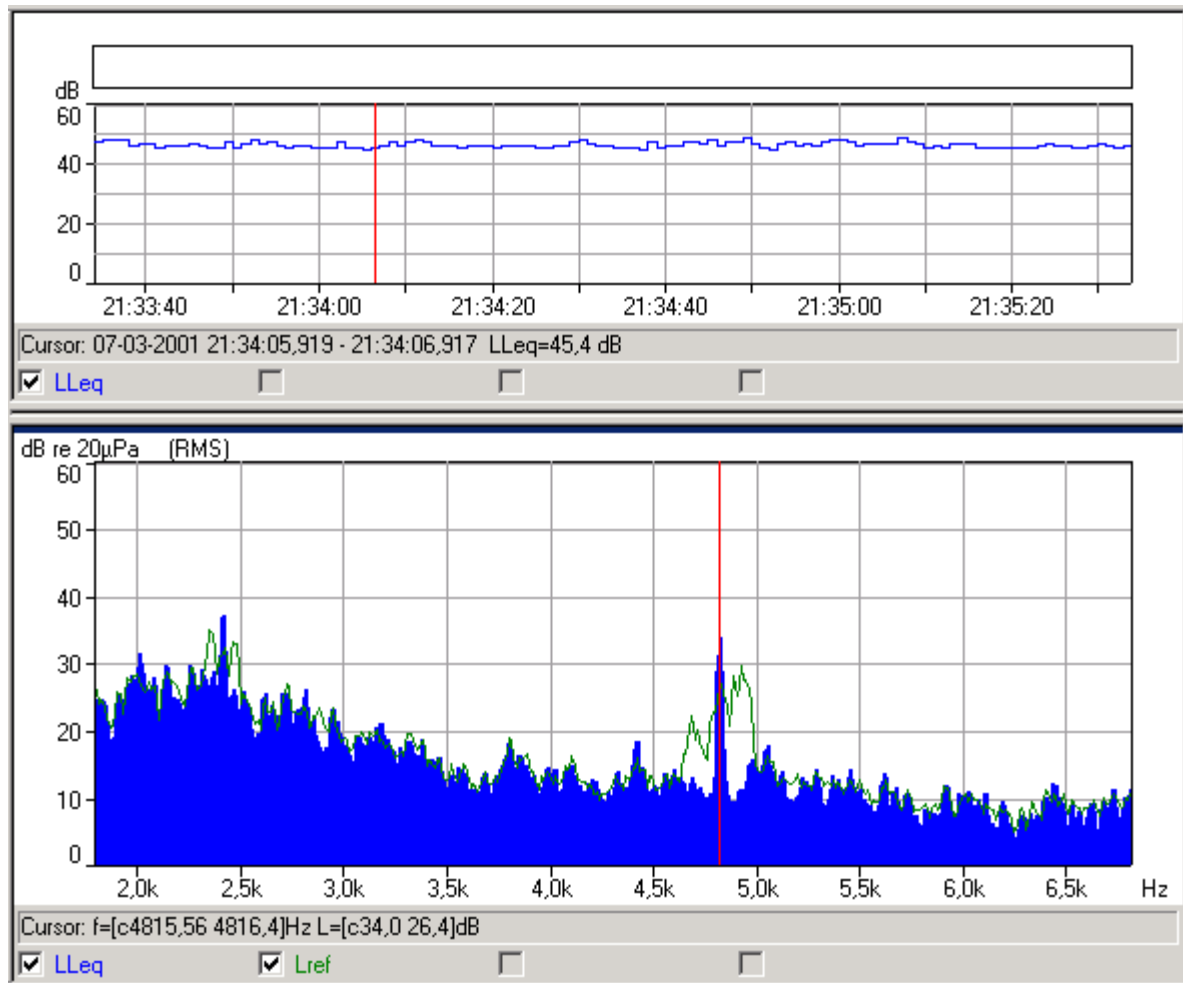
### **Comparing Spectra**

Before analysing the measurement results you might browse the data in the Measurements Branch to observe the varying tones. Open the WOODY01.FFT profile, double click the y-axis in the spectrum and select User Defined Range from 0 to 60 dB. Then click in the profile and use the left and right arrow keys to browse through the profile and observe how the FFT spectra are updated below the profile.

Open the WOODY01.FFT total measurement which only contains one spectrum covering the total measurement time. Observe how the tones have been smeared caused by the long averaging time.

You can compare the total spectrum directly with all the individual logged spectra by the "Use as Reference" tool. Right click with the mouse in the total spectrum and select the "Use as Reference in" menu. This lists all the FFT measurements in the project compatible with the selected. The list is made by parsing all data in the project tree from the top to the bottom. In this case it suggests two FFT measurements, both named WOODY01.FFT. The first is the topmost WOODY01.FFT measurement in the project, that is the profile, the second is the total measurement. Select the first one and use the total measurement as a reference spectrum in the profile measurement. Select the profile again and observe a new spectrum Lref as a curve together with the LLeq spectrum. Browse through the profile again and observe how the short term FFT spectra varies within the reference spectrum.

Your screen should look like:



You can do the same to the WOODY02.FFT measurement to observe how the low frequency tones varies.

**Note:** The "Use as Reference" tool is a general tool for comparing FFT spectra. You can use any FFT spectrum in Evaluator (e.g., it could be the spectrum of a marked period in a profile in the Calculations Branch) and use it as a reference in any of the FFT measurements in the project - the FFT spectra just have to be compatible (i.e. equal Centre Frequencies and equal Frequency Spans).

## Step 2. Determine the tones, their audibility and consequently the tone penalty.

A few useful definitions before doing the tone assessment:

### Tones

A tone is defined as a maximum in the spectrum that is high enough and narrow enough to be audible as a tone. In the JNM2 standard, "High enough" means more than 6 dB above the surrounding frequency spectrum; "Narrow enough" means the tone must have a 3 dB bandwidth less than 10% of the width of the surrounding critical band. The tone level is the total level of all tones within the critical band (JNM2 and ISO) or just the maximum tone (DIN if tones are separated more than 10 Hz).

Noise Pauses (neither tones nor noise) are local maxima in the spectrum with a probability of a tone, but not classified as a tone.

### Critical Band and Masking Noise:

Only noise within the critical band around a tone (the masking noise) can mask the tone and thus affect the audibility. This definition also includes narrow bands of noise. The width of the critical band is 100 Hz for tones below 500 Hz, and 20 % of the tone frequency above 500 Hz.

#### **Tone Audibility**

The audibility of a tone is the difference between the tone level and the masking noise level (plus a small frequency dependant correction).

#### **Tone Penalty**

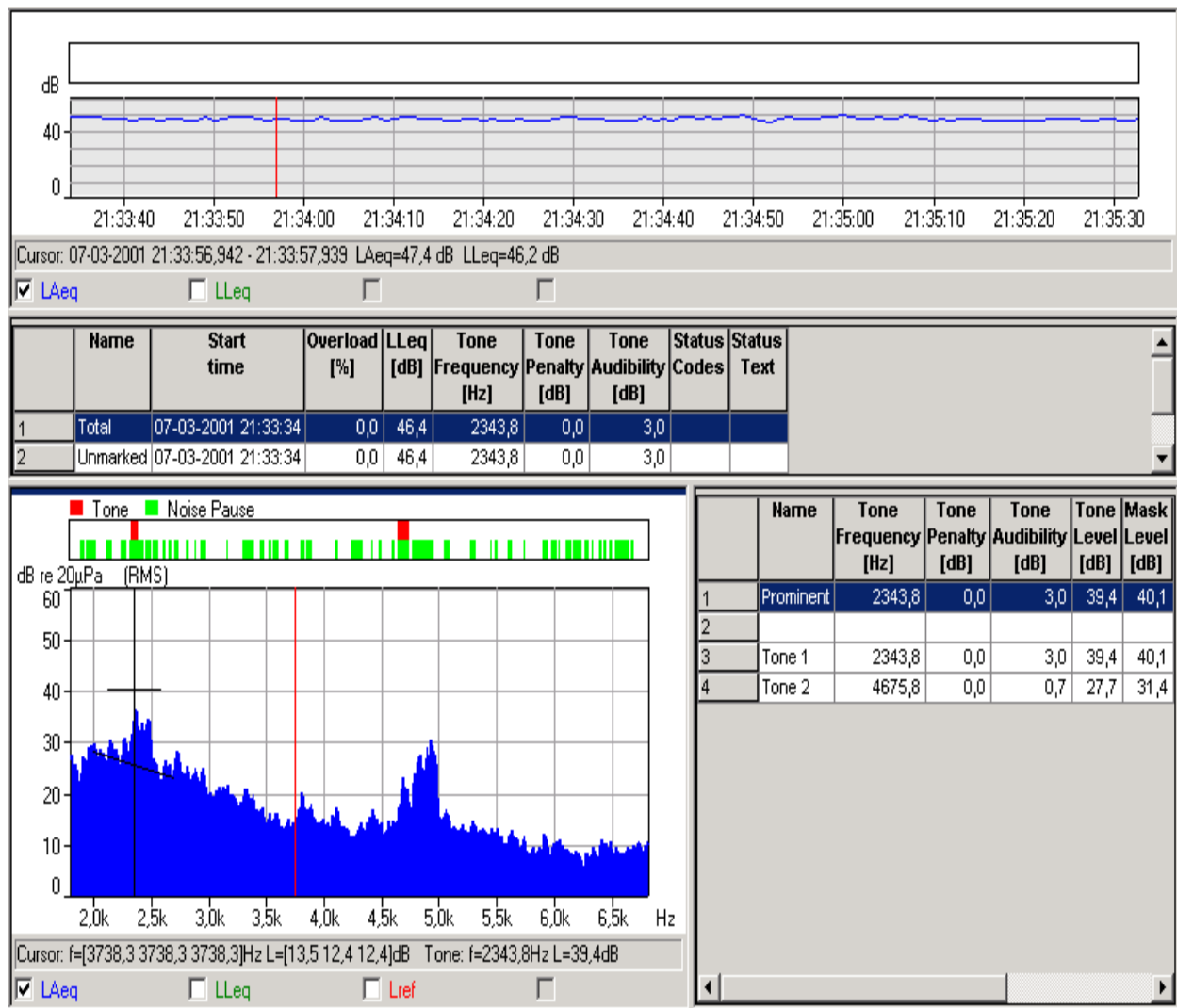
The tone penalty is derived from the tone audibility. For JNM2 it is 0 dB for audibility less than 4 and 6 dB for audibility higher than 10 dB - and it is simply the audibility minus 4 dB when the audibility is in the range 4 dB to 10 dB.

Tone Assessment in Evaluator is made using the **Pure Tone Wizard** on profiles in the Calculations Branch:

- Insert the profile of the WOODY01.FFT measurement into the Calculations Branch.
- Open the profile in the Calculations Branch.
- Run the Pure Tone Detector wizard on the profile (even if you only have one FFT spectrum - the profile will then be one sample long), select Tone Assessment in accordance with the JNM2 standard and Tone Seek criteria 1 dB.

The tone assessment in accordance with JNM2 and ISO will automatically be done based on the A-weighted spectrum - whether LAeq is displayed in the Profile View or not. However, select LAeq in the Spectrum view to display the tone cursor on the A-weighted spectrum.

The Tone Assessment is made on all the markers and totals in the profile (in this case we have not made any markers yet). Unlike the other marker wizards, which generate new markers, the tone assessment wizard operates on existing markers adding results to both **Text View** and **Spectrum View** and opening a new **Tone Text View** to the right of the spectrum with details of the tone assessment for the spectrum:



### Text view


The main results of the tone assessment are added to the marker list in the Text View above the Spectrum.

The Tone Penalty automatically appears in the view when the tone assessment is performed. A number of additional parameters can be chosen in the property legend tab such as Tone Audibility, Tone Frequency, Status Codes, Status Text etc. (these parameters have been selected in the text view above). If the "save as default" box is ticked when parameters are selected/deselected this will be remembered at the next tone assessment (tone penalty, however, will always automatically appear).

### Spectrum view

Above the spectrum a classification is added describing where noise pauses have been investigated and where tones have been found. The Tone Cursor is automatically displayed and selects the classified tones in the spectrum. The tone frequency and tone level are displayed in the cursor readout line below the graph. The critical band and masking noise level are marked together with the tone cursor as a horizontal line and the average level of the masking noise (the noise floor) is marked with a line, which for JNM2 and ISO follows a linear regression of the A-weighted noise, and for DIN is simply a horizontal line based on the un-weighted noise.

In the spectrum shown above a tone is located at 2343.8 Hz with level 39.4 dB. The masking noise level is approx. 40 dB. The audibility of the tone is then very low and no penalty is expected from this tone.

**Note:** A button for selecting the tone cursor  becomes active and is automatically selected after making a tone assessment.

### **Tone text view**

Details of the tone assessment for each Spectrum (one spectrum per marker in the marker list) are added in a new Tone Text View to the right of the spectrum.

In the property legend box the relevant parameters can be chosen.

**Note:** A button for toggling the tone text view on or off becomes active in the toolbar:



The result of the tone assessment of the compressor in the frequency range 1800 Hz to 6800 Hz seems to be an audibility of 3 dB and a Penalty of 0 dB - however, this is for the spectrum of the total profile with a duration of 2 min. If the tone is varying slowly in frequency, then the tone assessment should be done on short parts of the profile instead.

### **Step 3. Insert the tone penalty into the rating level sheet**

Inserting the tone penalty in the rating level sheet will be covered in [section 11.4](#) after getting some results from tone assessment of frequency varying tones.

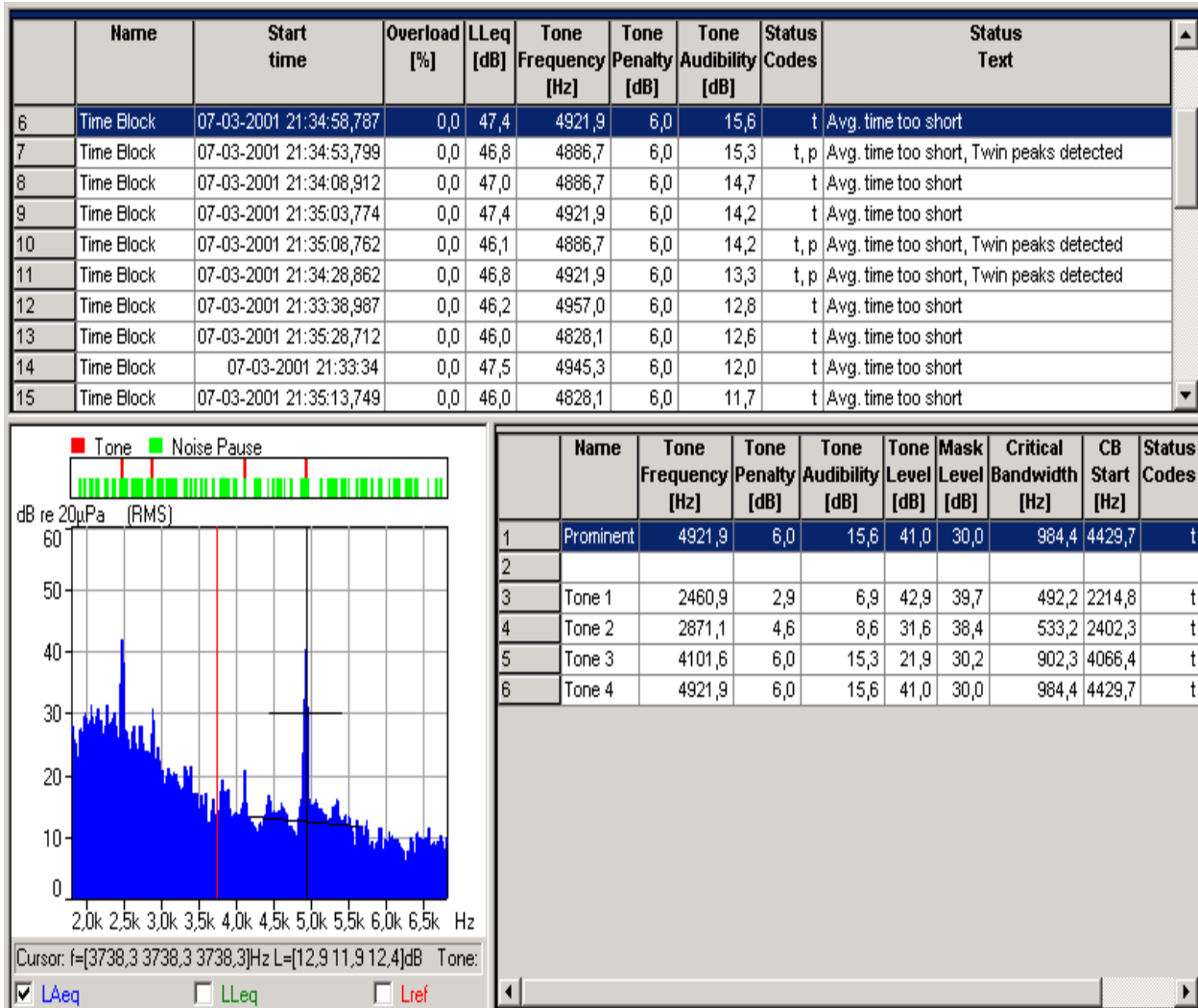
## **11.3. Tone Assessment of Frequency Varying Tones**

In order to make a tone assessment on shorter periods of time you can insert short markers in the profile. The FFT spectrum for each marker is then calculated and the tone assessment is automatically done for the marked spectra. Instead of making a lot of short markers you can use the "Mark Time Block" wizard on the profile. Select 5 logs per time block (equals approx. 5 s) and run the wizard.

The profile is now divided into a number of 5 s time blocks and tone assessments are made automatically for all the time blocks.

Select the first time block in the marker list and step through the time blocks by pressing the up and down arrow keys. Note how the Spectrum and Tone Text Views are updated accordingly.

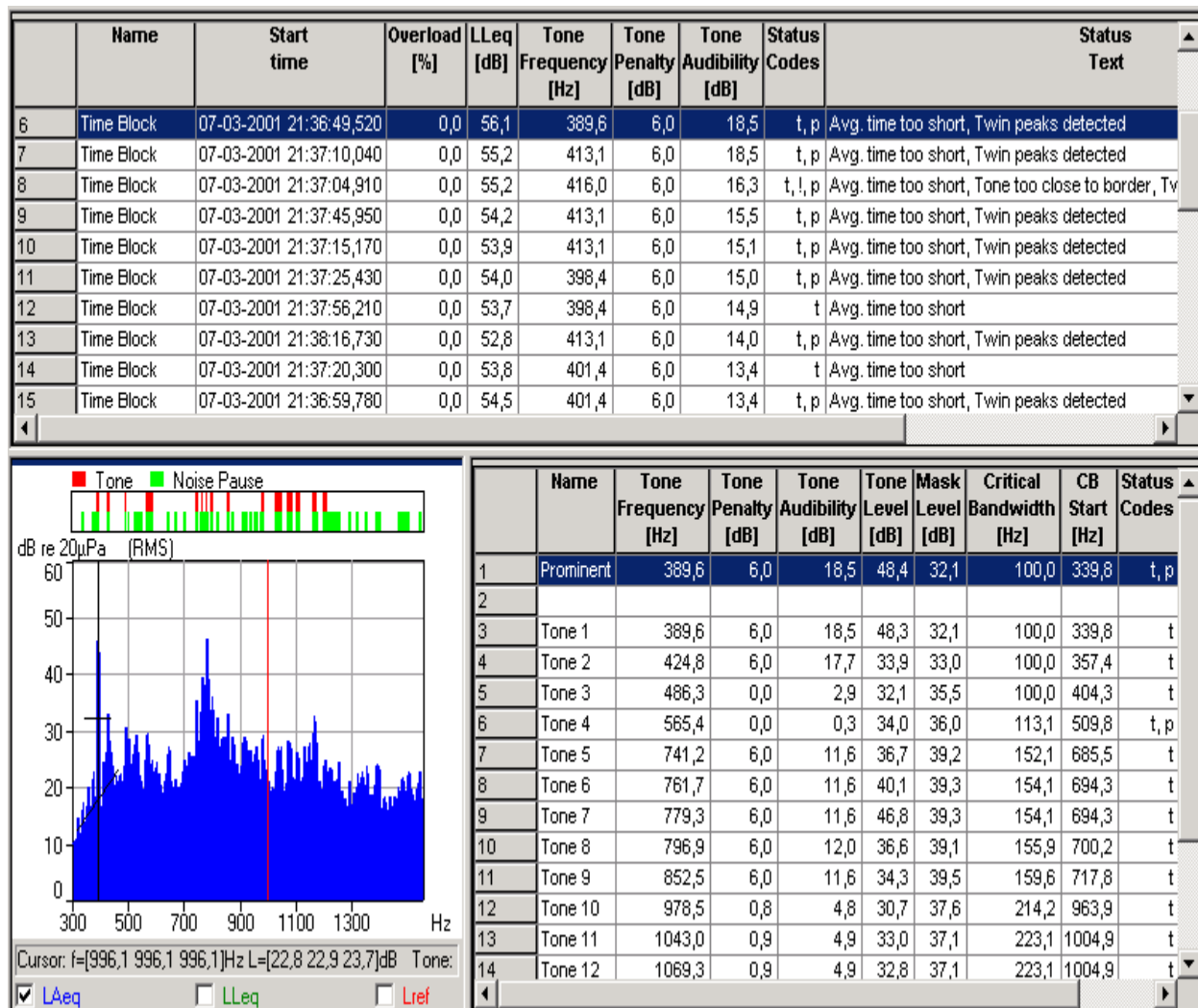
You can sort the markers in the Text View based on the content of any of the columns by left clicking with the mouse in the column heading. The first click will sort in ascending order; the second click will sort in descending order. Click two times in the Tone Audibility column to sort the markers in descending audibility order. You then get an overview of the parts of the measurement with the highest audibilities:



Make the tone assessment on the low frequency measurement WOODY02.FFT profile in the same way as described above: Insert the profile in the calculations branch and run the Pure Tone wizard (set the Tone Seek criteria to 3 dB to reduce the number of tone candidates) on the profile. The tone assessment of the total measurement indicates a penalty of 4.1 dB.

Run the Mark Time Block wizard with 5 logs per time block (approx. 5 s).  
Sort the markers in descending audibility order:





### Browsing the results:

To facilitate easy browsing between the text view, the tone text view and the spectrum view, a number of navigation keys have been defined:

- **Text view (Marker List):** Pressing up or down arrow keys selects another marker - pressing right or left arrow keys steps one tone up or down in the tone text view.
- **Tone text view:** Pressing up or down arrow keys selects another tone - pressing left or right arrow keys steps one marker up or down in the text view.

Browsing in the text view (marker list) always updates the tone text view and the spectrum view.

Browsing in the tone text view always updates the tone cursor in the spectrum view and vice versa.

### Tracking a tone over time:

After the tone assessment, the tone cursor in the spectrum view will be positioned on the most prominent tone.

When browsing the markers in text view, the tone text view (and the tone cursor in the spectrum) will by default highlight the most prominent tone.

If a non-prominent tone is selected in the tone text view, then the tone text view (and tone cursor) will track this tone placing the cursor on the tone with the frequency closest to this when the markers in the text view are browsed. This makes it easy to track the development of the tone (and mask) over time for all tones in the spectra.

### Status codes:

In contrast to the BZ 7208 FFT Software for 2260, status codes are here local and relate to the critical band, except for the prominent tone, which will reflect "overall" status codes as in BZ 7208. The z-code appears as in BZ 7208 on the prominent tone, and on individual tones when these do not fulfill the requirements for noise bandwidth. For convenience both a "Status codes" parameter with short BZ 7208-like status codes as well as a "Status text" parameter with long descriptive names can be observed in the text view and the tone text view.

## 11.4. Insert Tone Penalty in the Rating Level Sheet

The tone audibility of the compressor assessed above is very high for most of the 5 s time blocks - giving a tone penalty of 6 dB.

In order to use this tone penalty in the rating level calculation you simply enter this value in the rating level sheet - either as a correction term directly in the sheet, or allocating the marker (pointing out the part with the tones) to have the function Manual Correction and enter the tone penalty as the correction term.

We will correct the example "Rating level calculation in accordance with TA-Lärm - 1997" in section 10.2 to use the results of the tone assessment.

First we have to make the tone assessment in accordance with DIN instead of JNM2. This is done by running the pure tone detector again with the DIN standard selected - for both WOODY01.FFT and WOODY02.FFT. The results are similar to the result using the JNM2 standard: a tone penalty of 6 dB should be added.

Open the Weekday-Night result again. Double-click on the Compressor marker, press the Properties button and select the function Manual Correction #2 for the Compressor marker and enter the correction 6.0.

Press OK twice and the Compressor marker will now add a penalty of 6 dB in the rating level sheet.

The final result is then a rating level of 44.5 dB

## 12. Exporting and Printing Data

### 12.1. Export

When you right-click on a display in the workspace a pop-up menu appears. One of the items on this menu is the **Export to spreadsheet...** option.


With this option you can create a new file in either tab separated ASCII (.txt) or Microsoft Excel (.xls) format. The file contains the visible measurement data.

For example, if you have zoomed in on a profile graph, selecting the Export to spreadsheet... option creates a character-based file using the data that you can see.

You should note that in the case of the text window, you may have selected (using the right-mouse properties pop-up) more parameters to display than can be shown on the screen. By using the scroll bars you can see all of the data. The Export function creates a file for all of the data within the scrollable window.

When you select the Export option, a standard Windows file save dialog is displayed. Use this to navigate to the directory where you want your exported file to be saved. Remember to specify which file format you want to use before saving using the **Save as type** field. (Choose either tab separated ASCII (.txt) or Microsoft Excel (.xls) format using the **Save as type** field.)

## 12.2. Copy / Paste


You can copy the content of the Profile, Text, Spectrum and Statistics views to the Windows clipboard by using the **Copy** command on the Edit menu, by pressing **Ctrl+C** or by clicking on the copy icon: 

You can then paste the content of the clipboard to your word processor or spreadsheet.

**Note:** To be sure that the content of right view is copied to the clipboard, click anywhere within the view to bring it to »focus« before using the copy command.

## 12.3. Print

Evaluator has a powerful print function that allows you to print to a Windows system printer the data from measurement files.

The print function is invoked using the  icon.

In the **Select print items** field, set a tick by the items you want printed out. Depending on where you have focus, Evaluator will suggest which items will be printed.

### For example:

- with focus on a display in the workspace, Evaluator suggests to print the display and the instrument properties associated with it. The other printable items available are those within the same measurement file. If selected, they will be printed using the last saved axis scaling.
- with focus on a item in the project tree, Evaluator suggests that all the data associated with the item/node - including sub-folders and files - are printed. The selected items will be printed using the last saved axis scaling.

Highlighting the project folder, , selects all the data.

Pressing the **Print** button sends the selected items to the printer, or to an .rtf file depending upon the **Output** option selected.

## 12.4. Page Layout

The page layout function allows you to decide how a printed page is laid out. It is accessed from the **File/Page Setup...** menu function.


In the **Logo** section you can specify a graphics file in the **Filename (\*.WMF):** field. The filename you specify in this field is the windows metafile graphic that will be used to create a logo on the final printed paper. Typically your company logo, saved in metafile format, would be your choice. If you do not know exactly where the file is stored, use the **Locate...** button to find it.

The **Position from left**, **Width** and **Position from top** fields allow you to place the top left corner of the logo relative to the top left corner of the page.

The **Print Logo** box should be active if you want the logo to be printed.

If you want to print a page number, activate the **Print page number in lower right corner** box.

## 12.5. Print Preview

When you select Print Preview () , the Print Selection window appears. Select which items you want to print, then press the **Print Preview** button.

Use print preview to see exactly how your selection is going to be printed. For closer inspection of the details use the **zoom in** button.

For printouts that have more than one page, use the **Two Page** button to see how the pages will look if presented in book form. **Prev Page** and **Next Page** move you backward or forward through the printing stack.

You can print directly from the print preview window by pressing the **Print...** button.

To **exit** from Print Preview, use the **Close** button

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End of Tutorial