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Guide to interpreting the set of results from CEL-350 dBadge

Introduction

The CEL-350 dBadge dosimeter is a small lightweight unit that can be easily deployed on a worker for workplace noise exposure measurements. It is an advanced unit that does not need to be pre-configured with the required settings since that is done after the measurement when results are downloaded to the companion dB35 pc software package. The software is supplied as standard with all the CEL dBadge kits or can be purchased as an option if a full kit is not required.

In order to offer the user the most flexibility in assessing the results of a single measurement the dBadge stores the noise dose exposure with both the 5 and the 3 dB exchange rates at the same time. This allows for the inspection of the TWA and Dose values with almost any combination of thresholds and Criteria to be selected by the user after the run has finished. Full information is collected about the calibration of the dosimeter plus many other variations that are available to the user in the form of a row in a table in the database structure of the dB35 software.

A typical run has been recorded and downloaded to the software and is shown below with all the fields selected so that the new user can see the inter-relation of the key noise exposure parameters and how they all link together. For the purposes of this example the dBadge was worn on the shoulder for about 11 hours on July 4th during a visit to a busy city. The end of the day saw a spectacular firework display that was also quite loud as evidenced by the results shown here. The fields and the data in them are described to show what a set of measurement results will look like when used in the workplace.

The CEL-350 dBadge shown fitted to the shoulder of a worker in a typical noise measurement survey to compare the overall results against the regulations specified by OSHA and other national and international bodies.

The unit measures the Q=5 and the Q=3 noise doses and stores the 1 minute time history profile that can be inspected when downloaded to the companion dB35 software package.

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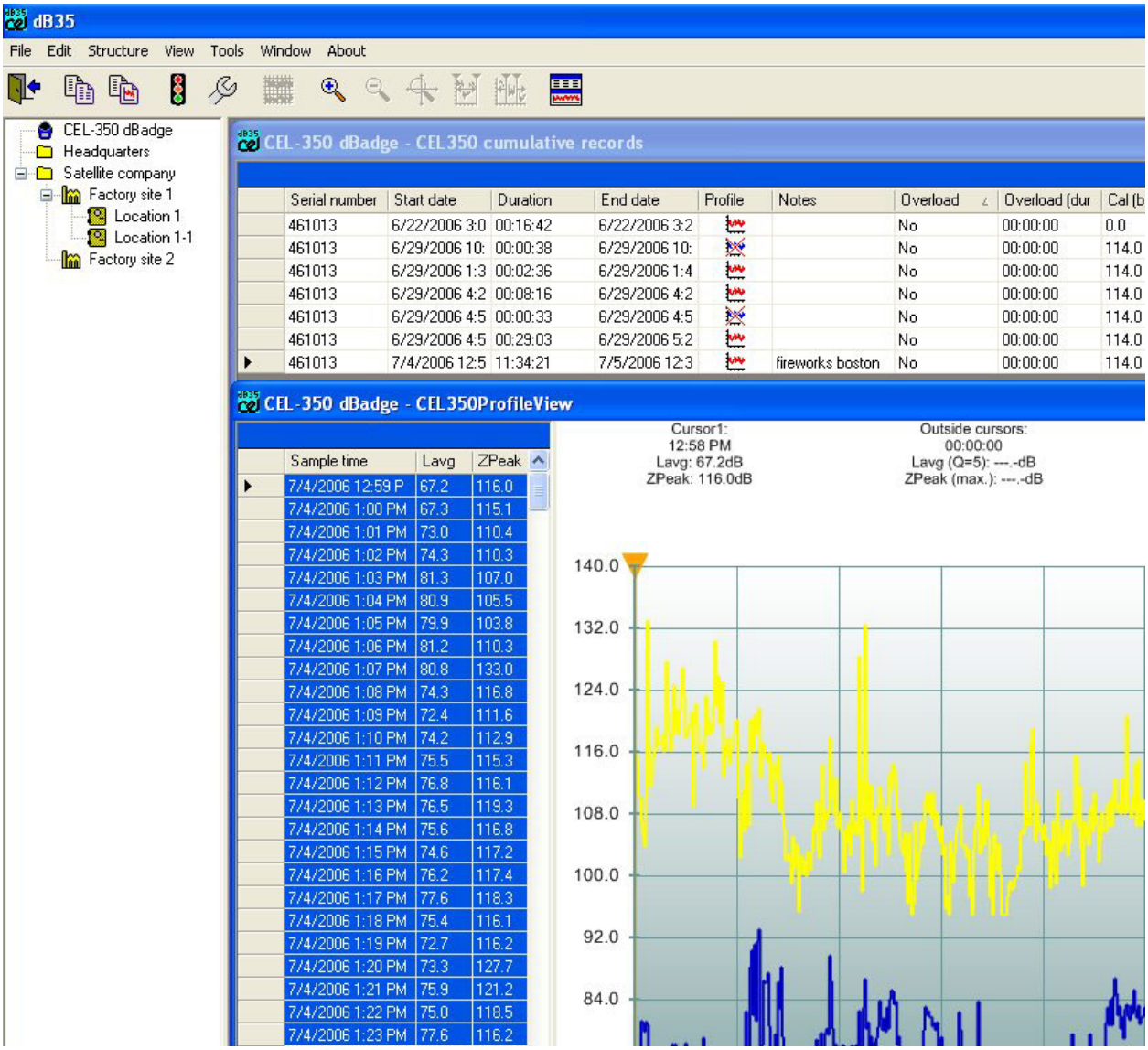
Download to dB35

The figure below shows the database structure of the dB35 software while the run under investigation is shown at the bottom of the table with the small arrow  pointing to it. The window underneath shows part of the table of results and the time history chart that allows the supervisor to inspect the results and better understand what occurred. Run information is shown in up to 65 columns across the screen and the user can customize exactly how much or how little of the information is displayed for the sake of clarity and completeness.



Part of the row of information from the highlighted run shown above that has been exported to MS Excel spreadsheet.

Serial number	Start date	Duration	End date	Profile	Notes	Overload	Overload (duration)
461013	7/4/2006 12:59	11:34:21	7/5/2006 0:33	694	fireworks boston	No	0:00:00

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Explanation of each field in the set of results from a dBadge run

Field #	Field name	Field entry	Description of entry text
1	Serial number	461013 or 0461013	This is the serial number of the dbadge and is unique to every dosimeter. It is in the form of a date code for the month and year of manufacture plus an individual dBadge number as follows: MMYXXXX
2	Start date	7/4/2006 12:59	This is the date and time of the start of the run rounded to the nearest minute. It is in the format of the locale selected for the computer that received the downloaded run data. In this example the recording started at 12:29 pm on July 4th 2006.
3	Duration	11:34:21	This is the duration of the run in hh:mm:ss. In this case the run lasted for about 11 and a half hours.
4	End date	7/5/2006 0:33	This is the date and time of the end of the run rounded to the nearest minute. It is in the format of the locale selected for the computer that received the downloaded run data. In this example the recording ended at 00:33 am on July 5th 2006 just after midnight.
5	Profile	694	This is the number of completed 1-minute time history profiles that were stored for the run. In this case for a run of 11hr and 34 minutes there are (11 x 60) + 34 = 694 intervals in the profile. A typical 8 hour run would have about 480 intervals.
6	Notes	fireworks Boston	This is a user entered text field that allows relevant notes to be added to the downloaded data for later review. Enter here any specific machinery or noise sources that may have been operating during the monitoring period. In this case the firework display is the main noisy source of the high dB levels seen.
7	Overload	No	This is the flag that shows whether an overload occurred during the run. An overload is an rms. Noise level in excess of the highest value that the instrument can respond accurately to. In this case it represents a trigger level of 140 dBA that if it was exceeded then the field would show the value - Yes.
8	Overload (duration)	0:00:00	If there were a yes in the Overload field then this would show the duration of the overload above 140 dBA in the form of hh:mm:ss. In this case there is no overload duration so we know that the noise level never went above 140 dBA. Samples are collected every 10 millisec so there will be information to 0.01 of a second here if applicable.

9	Cal (before) SPL	113.9875 or (114.0)	This is the default level of the calibration signal that the dBadge has been told to expect. It is normally 114.0 dB but may be a different value if the user changes it in dB35 and sends the new level to the dBadge via the infrared link prior to the measurement starting. This might be the case if using an acoustic calibrator with an output level of 94.0 dB.
10	LASMax	107.5	This is the highest noise level reached during the measurement with the A frequency weighting and the Slow time response. It is measured in dB and shown to a resolution of 0.1 dB.
11	LAFMax	112	This is the highest noise level reached during the measurement with the A frequency weighting and the Fast time response. It is measured in dB and shown to a resolution of 0.1 dB.
12	ZPeak	138	This is the absolute highest noise level reached during the measurement with the Z frequency weighting and no time response. It is the peak value of the highest positive or negative sound pressure wave that arrived at the microphone during the measurement. It is measured in dB and shown to a resolution of 0.1 dB. The more "impulsive" the noise was then the higher this value will be compared to the maximum noise levels measured during the run.
13	CPeak	137.6	This is the absolute highest noise level reached during the measurement with the C frequency weighting and no time response. It is the peak value of the highest positive or negative sound pressure wave that arrived at the microphone during the measurement. It is measured in dB and shown to a resolution of 0.1 dB. The more "impulsive" the noise was then the higher this value will be compared to the maximum noise levels measured during the run.
14	LAeq	82.9	This is the equivalent continuous level that represents a notional steady state noise lasting for the duration of the measurement that contains the same amount of energy as the real variable noise. It is the same as the time average noise level with the 3 dB exchange rate. In this case it has no threshold applied to it so it includes all the noise that took place during the measurement.

15	Pa2Hrs	0.9	This is another way of specifying the absolute noise "dose" or noise energy received during the workday. Unlike a usual dose value which is quoted as a percentage of some allowable 100% limit the Pa2Hrs value is an absolute value based on the square of the instantaneous sound pressure level multiplied by the ongoing duration of the measurement. For example, a level of 1 Pascal (Pa) of noise would be measured on a sound level meter, as 94 dB so if it lasted for 4 hours 45 mins the Pa2hrs value would be 4.75. A value of 3.2 Pa2hrs over an 8-hour day is the same as a steady noise level of 90 dB and 1.0 Pa2hrs for 8 hours is the same as a steady noise level of 85 dB. In this case since the value is just less than 1.0 the noise level normalized to 8 hours (Lepd) must be less than 85 dB.
16	Pa2Sec	3240	This is simply the Pa2hrs value multiplied by 3600 since there are 3600 seconds in an hour. This value provides a better resolution of the noise exposure than does the Pa2hr number but is the same thing. In this case 0.9 x 3600 = 3240.
17	Lepd	84.5	This is the normalized 8-hour time average noise level for the run using the 3 dB exchange rate calculation. The Leq for the whole of the run is condensed to an equivalent exact 8-hour level and expressed as the "daily personal noise exposure level" in dB. In this case the LAeq value of 82.9 dB for 11hh34mm21ss has been recalculated as 84.5 dB for 8hh0mm0ss using the formula – Lepd = LAeq + 10 log t/tref (where t is the run duration in secs and tref is the 8 hour day in secs).
18	LEX8h	84.5	This is the noise unit defined in the international standard ISO 1999: 1990 clause 3.6 and is the same mathematically as the Lepd. No thresholds are used and all noise levels are included in the calculation. The A frequency weighted time average level LAeq can be used to arrive at the LEX8h result as shown here. LEX8h = LAeq (t) + 10 log (t/28800) where LAeq (t) is the time average level for the whole work shift that has a total duration of t seconds. In this case the result is 84.5 dB.

19	LAvg (Q5 T1=80)	76.7	This is the time average noise level using the 5 dB exchange rate but only including the noise levels that are greater than the threshold level of 80 dB. In this case any time the noise level is less than or equal to 79.9 dB the value is treated as 0 dB and added into the Lavg value. The average value shown here is considerably less than the time average value with the 3 dB exchange rate because there was a significant amount of time where the noise level was less than 80 dB.
20	LAvg (Q5 T2=90)	69.5	This is the time average noise level using the 5 dB exchange rate but only including the noise levels that are greater than the threshold level of 90 dB. In this case any time the noise level is less than or equal to 89.9 dB the value is treated as 0 dB and added into the Lavg value. The average value shown here is considerably less than the time average value with the 3 dB exchange rate because there was a significant amount of time where the noise level was less than 80 dB. It is also less than the “LAvg (Q5 T1=80)” because none of the noise between 80 and 90 dB has been included in this value so it will contain even more 0 dB values in the average.
21	TWA	82.2	This is the time weighted average noise level based on the 5 dB exchange rate noise calculation normalized to an exact 8-hour standard workday. It is calculated from the “Lavg(Q5)” value as follows. TWA = LAvg(Q5) + 16.61 t/tref where t is the actual run duration in seconds and tref is the 8 hour day. In this case TWA = 79.6 + 16.61 log (41661/28800).
22	TWA (T1=80)	79.4	This is the time weighted average noise level based on the 5 dB exchange rate noise calculation normalized to an exact 8-hour standard workday. However, it uses the 80 dB threshold value of the time average noise level “LAvg (Q5 T1=80)” instead of the LAvg(Q5). It is calculated as follows. TWA = LAvg(Q5 T1=80) + 16.61 t/tref where t is the actual run duration in seconds and tref is the 8 hour day. In this case TWA = 76.7 + 16.61 log (41661/28800).

23	TWA (T2=90)	72.2	This is the time weighted average noise level based on the 5 dB exchange rate noise calculation normalized to an exact 8-hour standard workday. However, it uses the 90 dB threshold value of the time average noise level “LAvg (Q5 T1=90)” instead of the LAvg (Q5). It is calculated as follows. TWA = LAvg (Q5 T1=90) + 16.61 t/tref where t is the actual run duration in seconds and tref is the 8 hour day. In this case TWA = 69.5 + 16.61 log (41661/28800). It is also less than the “TWA (Q5 T1=80)” because none of the noise between 80 and 90 dB has been included in this value so it will contain even more 0 dB values in the average.
24	Criterion	90	This is the value in dB occurring for exactly 8 hours that represents the 100% noise dose in any calculations of percentage noise dose from the dosimeter. In the software the user can change the criterion to be any integer step from 70 to 90 dB to allow multiple calculations to be made on the same data.
25	Threshold 1	80	This is the lower cutoff level below which the noise is considered to have a value of 0 dB as far as the calculation of LAvg and TWA are concerned. In this case it is 80 dB but the user can select a value between 70 and 90 (or none at all) to limit the inclusion of noise readings from the calculations in the software.
26	Threshold 2	90	This is the upper cutoff level below which the noise is considered to have a value of 0 dB as far as the calculation of LAvg and TWA are concerned. In this case it is 90 dB but the user can select a value between 70 and 90 (or none at all) to limit the inclusion of noise readings from the calculations in the software.
27	LAvg(Q5)	79.6	This is the time average noise level with the 5 dB exchange rate measured during the run. In this case it is a value of 79.6 dB that is lower than the time average noise level of 82.9 as measured by the LAeq that uses the 3 dB exchange rate. No threshold limit has been applied to this calculated value.
28	LAvg (fixed)	76.7	This is the same value as the one that appears on the display screen of the dBadge at the end of the run. In this case since an OSHA mode display was selected the value was the same as the LAvg (Q5).

29	Dose% (Q5 C=90)	34.1	This is the noise dose value expressed as a percentage of the 100% criterion level here shown as C=90 dB measured with the 5 dB exchange rate. It does not have a threshold applied to it to limit the inclusion of any noise so it will show the dose for all the noise levels received during the run.
30	Dose% (Q5 C=90 T2=90)	8.5	This is the noise dose value expressed as a percentage of the 100% criterion level here shown as C=90 dB measured with the 5 dB exchange rate. In this case it does have a threshold applied to it to limit the inclusion of any noise shown as T2=90 dB. So it will show the dose value for the noise levels received that exceed the threshold selected by the user for the run. The threshold level T2 can be selected from 70 to 90 or none in integer steps.
31	Dose% (Q5 C=90 T1=80)	23	This is the noise dose value expressed as a percentage of the 100% criterion level here shown as C=90 dB measured with the 5 dB exchange rate. In this case it does have a threshold applied to it to limit the inclusion of any noise shown as T1=80 dB. So it will show the dose value for the noise levels received that exceed the threshold selected by the user for the run. The threshold level T1 can be selected from 70 to 90 or none in integer steps.
32	Dose % (fixed)	23	This is the same value that appears on the display screen of the dBadge at the end of the run. In this case since the OSHA mode was selected for the display the value is the same as for the Dose% (Q5 C=90 T1=80) result.
33	LAvg (Q3)	82.9	This is the time average noise level with the 3 dB exchange rate measured during the run. In this case it is a value of 82.9 dB that is the same as the time average noise level of 82.9 as measured by the LAeq that also uses the 3 dB exchange rate. No threshold limit has been applied to this calculated value.
34	LAvg (Q3 T2=90)	81.2	This is the time average noise level using the 3 dB exchange rate but only including the noise levels that are greater than the threshold level of T2=90 dB. In this case any time the noise level is less than or equal to 89.9 dB the value is treated as 0 dB and added into the Lavg value.

35	LAvg (Q3 T1=80)	82.5	This is the time average noise level using the 3 dB exchange rate but only including the noise levels that are greater than the threshold level of T1=80 dB. In this case any time the noise level is less than or equal to 79.9 dB the value is treated as 0 dB and added into the Lavg value.
36	LAIeq	83	This is the time average noise level in dB with the A frequency weighting and the Impulse time response. It does not have any threshold applied to it so all the noise that was measured will be included in the overall answer. In this case it is shown as 83.0 dB.
37	LAE	129.1	This is the sound exposure level in dB that represents the same amount of noise energy that occurred during the run as measured by the LAeq. The LAeq is for the whole duration of the run but the LAE is that same amount of noise energy "shrunk" down to an equivalent time of just 1 second. The relationship between LAE and LAeq is shown below. LAE = LAeq + 10 log t where t is the measurement duration in seconds. In this case 129.1 = 82.9 + 10 log 41661. This unit is useful for comparing 2 different sources of noise energy since the time element is always standardized to a nominal 1-second duration. The noise with the higher LAE has the most noise energy.
38	Dose% (Q3 C=90)	28.1	This is the noise dose value expressed as a percentage of the 100% criterion level here shown as C=90 dB measured with the 3 dB exchange rate. It does not have a threshold applied to it to limit the inclusion of any noise so it will show the dose for all the noise levels received during the run.
39	Dose% (Q3 C=90 T2=90)	19.1	This is the noise dose value expressed as a percentage of the 100% criterion level here shown as C=90 dB measured with the 3 dB exchange rate. In this case it does have a threshold applied to it to limit the inclusion of any noise shown as T2=90 dB. So it will show the dose value for the noise levels received that exceed the threshold selected by the user for the run. The threshold level T2 can be selected from 70 to 90 or none in integer steps.

40	Dose% (Q3 C=90 T1=80)	25.6	This is the noise dose value expressed as a percentage of the 100% criterion level here shown as C=90 dB measured with the 5 dB exchange rate. In this case it does have a threshold applied to it to limit the inclusion of any noise shown as T1=80 dB. So it will show the dose value for the noise levels received that exceed the threshold selected by the user for the run. The threshold level T1 can be selected from 70 to 90 or none in integer steps.
41	ZPeak (time)	7/4/2006 22:49	This is the actual time of the first occurrence of the ZPeak value shown in the format of the currently selected locale of the pc. In this case it is shown as 7mm4dd2006yy 22hh49mm or 10:49 pm on July 4th 2006.
42	CPeak (time)	7/4/2006 22:49	This is the actual time of the first occurrence of the CPeak value shown in the format of the currently selected locale of the pc. In this case it is shown as 7mm4dd2006yy 22hh49mm or 10:49 pm on July 4th 2006.
43	APeak (time)	7/4/2006 15:35	This is the actual time of the first occurrence of the CPeak value shown in the format of the currently selected locale of the pc. In this case it is shown as 7mm4dd2006yy 15hh35mm or 3:35 pm on July 4th 2006.
44	APeak	134.4	This is the absolute highest noise level reached during the measurement with the A frequency weighting and no time response. It is the peak value of the highest positive or negative sound pressure wave that arrived at the microphone during the measurement. It is measured in dB and shown to a resolution of 0.1 dB. The more “impulsive” the noise was then the higher this value will be compared to the maximum noise levels measured during the run.
45	LASMin (time)	7/4/2006 13:03	This is the actual time that the first LASMin noise level occurred during the run. It is shown in the format selected for the locale in the pc running the software so here it is 7mm4dd2006yy 13hh03mm or 3 minutes past 1pm on July 4th 2006.

46	LASMin	64	This is the lowest noise level in dB with the A frequency weighting and the Slow time response that occurred during the measurement. Since the bottom of the measurement range of the instrument is 65 dB then the reading here of 64 indicates that the true level is actually off the scale and cannot be correctly indicated.
47	LASMax (time)	7/4/2006 21:24	This is the actual time that the first LASMax noise level occurred during the run. It is shown in the format selected for the locale in the pc running the software so here it is 7mm4dd2006yy 21hh24mm or 9:24 pm on July 4th 2006.
48	LAIMin (time)	7/4/2006 13:03	This is the actual time that the first LAIMin noise level occurred during the run. It is shown in the format selected for the locale in the pc running the software so here it is 7mm4dd2006yy 13hh03mm or 3 minutes past 1pm on July 4th 2006.
49	LAIMin	64	This is the lowest noise level in dB with the A frequency weighting and the Impulse time response that occurred during the measurement. Since the bottom of the measurement range of the instrument is 65 dB then the reading here of 64 indicates that the true level is actually off the scale and cannot be correctly indicated.
50	LAIMax (time)	7/4/2006 21:24	This is the actual time that the first LAIMax noise level occurred during the run. It is shown in the format selected for the locale in the pc running the software so here it is 7mm4dd2006yy 21hh24mm or 9:24 pm on July 4th 2006.
51	LAIMax	107.5	This is the highest noise level reached during the measurement with the A frequency weighting and the Impulse time response. It is measured in dB and shown to a resolution of 0.1 dB.
52	LAFMin (time)	7/4/2006 13:03	This is the actual time that the first LAFMin noise level occurred during the run. It is shown in the format selected for the locale in the pc running the software so here it is 7mm4dd2006yy 13hh03mm or 3 minutes past 1pm on July 4th 2006.
53	LAFMin	64	This is the lowest noise level in dB with the A frequency weighting and the Fast time response that occurred during the measurement. Since the bottom of the measurement range of the instrument is 65 dB then the reading here of 64 indicates that the true level is actually off the scale and cannot be correctly indicated.

54	LAFMax (time)	7/4/2006 22:49	This is the actual time that the first LAFMax noise level occurred during the run. It is shown in the format selected for the locale in the pc running the software so here it is 7mm4dd2006yy 22hh49mm or 10:49 pm on July 4th 2006.
55	Cal (before) Offset dB	0.2	The calibration setting in the dBadge has a range of automatic adjustment of about +6 to –6 dB about the nominal central value. This is to allow for slight variations in the sensitivity of the individual microphone capsules that may be fitted to the dBadge. The value shown in the field shows the adjustment made since the last calibration in the Cal (before) date to bring the instrument back to its nominal correct setting. Variations may also be caused by local environmental conditions such as weather changes or changes due to altitude. In this case the adjustment was a small 0.2 dB before the start of the run.
56	Cal (before) date	7/3/2006 16:28	This is the date and time of the last calibration that was carried out before the run started. In this case it is shown as 7mm3dd2006yy 16hh28mm or 4:28 pm on July 3rd 2006.
57	Cal (after) Offset dB	0	This is the adjustment made in the post run calibration compared to the last time at the start of the run required to bring the instrument's circuits back to their correct setting. In this case no adjustment was necessary. This indicates that the dbadge held its calibration steady all during the run when the unit was recalibrated for the first time the day after the measurement took place as shown at the Cal (after) date.
58	Cal (after) date	7/5/2006 09:10	This is the date and time of the first calibration that was carried out after the run stopped. In this case it is shown as 7mm5dd2006yy 09hh10mm or 9:10 am on July 5th 2006.
59	Under range (duration)	1:47:52	This is the amount of time that the measurements were below the lower limit of the instrument. Since the minimum range of the meter is 65 dB then the time indicated represents how long the accumulated time was for the noise being less than 65 dB. In this case it shows 1hh47mm52ss or about 15.5% of the total measurement duration.
60	Over 140dB (duration)	0:00:00	This shows the numbers of 10 millisec noise dose samples that exceeded the upper limit. That represents a noise level of 143.4dB peak or an A weighted level of 140.4 dB.

61	Battery	Ok	This is the flag that warns of any low battery problems during a run. In this case the OK message means that the instrument ran without getting to the end of its normal working battery life of 32 hours.
62	Site	Boston	This is a free text entry that can be applied to the field after the run is downloaded to the dB35 software to allocate a particular measurement site. In this case it has been called “Boston”.
63	Process	July 4th	This is a free text entry that can be applied to the field after the run is downloaded to the dB35 software to allocate a particular measurement process. In this case it has been called “July 4th”. Normally it could be set as “machining” or “stamping” for example.
64	Person	Bob Selwyn	This is a free text entry that can be applied to the field after the run is downloaded to the dB35 software to allocate a name for the worker who was wearing the dBadge during the measurement. In this case it has been called “Bob Selwyn”.
65	Location	Charles River bridge	This is a free text entry that can be applied to the field after the run is downloaded to the dB35 software to allocate a name for the location of the wearer of the dBadge during the measurement. In this case it has been called “Charles River Bridge”. Normally, it would be “warehouse” or “paint shop” for example.

Note that since the display order of these values can be changed by the user to appear in any order that is required the same results may not be in the same place relative to the order shown in the example above.