EUROPEAN COMMISSION

Institute for Health and Consumer Protection

Administrative arrangement between DG ENV and JRC on "Services to support the implementation of Directive 2002/49/EC on Environmental Noise"

(Contract no. 07-0303/2007/477794/MAR/C3)

FINAL REPORT

(TECHNICAL REPORT nº 2, *22nd October 2008 to 22nd December 2008*)

on

Assessment of the equivalence of national noise mapping methods against the interim methods

Quality control insert

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EXECUTIVE SUMMARY

The Institute for Health and Consumer Protection (IHCP) of the Joint Research Centre (JRC) of the European Commission, is technically supporting the Directorate General for the Environment (DG ENV) concerning the implementation of the European Noise Directive 2002/49/EC. This is being performed through the Administrative Arrangement no. 07-0307/2007/477794/MAR/C3, stipulated on 22nd October 2007, on ***"Technical advice on the equivalence of the national assessment methods used by the EU Member States for strategic noise mapping against the interim methods, as specified in Annex II of the Directive 2002/49/EC and the EC guidelines adopted on 6 August 2003"***.

This report summarises the work performed under Task 3 on "Member State results using JRC protocols" and Task 4 on "Review and assessment of the National methods" during the last six months period of the execution of the Administrative Arrangement (1st June 2008 – 22nd December 2008) (see Annex 1 of the Administrative Arrangement on "Description of the methodologies/practical details of the work programme that the JRC would employ in undertaking the tasks"). This report ('Final Technical Report no. 2') can be considered as the final report of the Administrative Arrangement no. 07-0307/2007/477794/MAR/C3 (22 October 2007 to 22 December 2008).

Overall, based on the assessment performed by the JRC on the official replies received from the EU MS it was concluded that:

- Concerning the noise assessment methods used:
  - 7 MS provided partial or no information about the methods used;
  - 8 MS used either their national methods or the interim ones depending on the noise source (i.e., road traffic, railway traffic, aircraft, industrial);
  - 5 MS used their own national methods for all four noise sources;
  - 7 MS used the interim noise assessment methods as established in Annex II of the European Noise Directive 2002/49/EC for all four noise sources.

- Concerning the compliance of the EU MS to Art. 6 of the Environmental Noise Directive (END):
  - 7 MS were assessed to be compliant with Art. 6 of the END for all noise assessment methods used
  - 5 MS were assessed to be non-compliant with Art. 6 of the END for at least one noise assessment method
  - For 15 MS it was impossible to determine their compliance with Art. 6 of the END for at least one noise assessment method because they did not provide enough information to allow assessing whether their national methods are equivalent to the interim ones. Between these, two reported that they are going to provide information by means of the JRC protocols during the month of December 2008.

In absence of implementation of the protocols by the EU Member States by the deadlines set by this Administrative Arrangement, JRC implemented the protocols using the interim methods and evaluated statistically what part of the differences may due to software implementation of the methods and not on the methods themselves, and also prepared some indicators to describe the different results the national methods could eventually give, both in terms of change in noise levels and in the number of people exposed to environmental noise.

It was observed that in most situations for road traffic noise, railway traffic noise and industrial noise the software implementation would be relevant but not necessarily the major cause of differences (a standard deviation less than 3 dB) since the implementation in three of the most used software to predict noise levels give consistently close results. Only in the case of aircraft noise large differences between implementation of the interim method were found, depending whether the European Commission's Recommendation of 6 August 2003 (2003/613/EC) is or is not taken into account.

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1. INTRODUCTION

The Joint Research Centre (JRC) of the European Commission, in the context of its technical support to the Directorate General for the Environment (DG ENV) concerning the implementation of the European Noise Directive 2002/49/EC (END)[1], prepared and delivered to MS on 4 June 2008 a set of technical protocols. These protocols might be used in the context of the exercise on equivalency among the national environmental noise assessment methods against the interim methods as defined under Annex II of the END.

In the period from 1st June to 22nd December 2008, JRC/IHCP performed the following activities:

1. Delivered the four protocols prepared to check equivalence between the MS methods used to assess environmental noise exposure and the interim methods suggested by the Environmental Noise Directive 2002/49/EC:

    - *The four protocols were uploaded along with the necessary annexes on (and made available through) the DG ENV's CIRCA website.*

2. DG ENV sent an official communication (e-mail of 04 June 2008) to the members of the Noise Regulatory Committee: through this e-mail the MS were informed about the location of where the protocols were placed on CIRCA and they were asked to report back about the results of the exercise on equivalency by the end of July 2008.

    MS were given two months (deadline 31st July 2008) to:

    - *implement the JRC protocols for those calculation methods used to assess environmental noise sources which were not the ones suggested by the END (not the interim methods),*

    alternatively,

[1] The DG JRC is providing support to DG ENV through the Administrative Arrangement No. 07-0307/2007/477794/MAR/C3 on **"Technical advice on the equivalence of the national assessment methods used by the EU Member States for strategic noise mapping specified in Annex II of the Directive 2002/49/EC and the EC guidelines adopted on 6 August 2003" stipulated in October 2007.**

- *provide their own proof of equivalence (other than through using the JRC protocols)*

3. JRC and DG ENV collected the answers received. Only few replies were received by the deadline set which only partially faced the equivalence of the methods in all their parts. This can be eventually attributed to the fact that MS showed to be reluctant in facing discussions concerning equivalency (see minutes of the Noise regulatory committee meeting of the 7th of May 2008). Consequently, DG ENV decided for and instructed JRC not to push MS to provide their replies nor request from them more information, but to assess equivalence as far as possible only on the basis of the replies received so far.

4. JRC started assessing the information that was possible to retrieve based exclusively on the MS replies. The information contained in this report therefore includes all replies received till the 12th of December 2008 (4 ½ months after the deadline required by DG ENV and in any case 11 ½ months after the deadline set by the directive 2002/49/EC. This report therefore contains:

   - *an assessment of the differences which can be identified among the interim methods and eventual national methods used on the basis of the replies received;*

   - *full record of the MS replies and related material provided by MS in the attached CD.*

5. JRC implemented the protocols based on the interim methods with four different noise mapping software, to establish a reference for the comparison against implementations of the protocols by MS with national methods. Also, this was used to obtain a statistical basis of how existing software implement correctly the interim methods and how they differ at the calculation points corresponding to different cross sections given in the protocols because of technical choices in the implementation of a calculation code,.

In general, MS were reluctant not only to implement these protocols, but also in several cases even to reply to DG ENV letters requesting the proof of equivalence between the MS calculation methods and the interim methods.

At 31st of October 2008, 6 MS had not replied at all and 13 MS provided only partial proof of equivalence among the methods they used against the interim ones.

Given this generalised reluctance of the MS, after having discussed this with DG ENV, it was agreed not to require any further information from the MS as a consequence of the two letters sent by DG Environment the 8th of January 2008 (D(2007)24088) and the 7th of May 2008 (D(2008) 5551). It was also agreed upon to proceed with evaluating the replies received so far and evaluate the equivalence (and therefore compliance with requirements of art. 6 of the Directive) among the methods used by the MS on the basis of the information they provided.

The deadline of the 30th of July 2008, was respected by only a few countries. Some others sent their replies much later. At present, it has been informally communicated by national technical offices that some more MS will apply the protocols and report their results in the near future, most probably during December 2008. Given this highly evolving situation and given also that there is no intention for precluding any MS from providing DG ENV with their replies even late, the final report will for the time being not include any evaluation of MS having implemented the protocols, instead, an updated version will be submitted during March 2009 with the assessment of the differences based on the MS implementation of the methods.

In chapter 2, the replies reported by the MS so far are presented and critically evaluated. Some MS in the replies questioned the meaning of the exercise of equivalence and did not provide a full quantitative demonstration of equivalency. Some others instead provided their evaluation of the differences among their national methods and the interim ones, including more technical comments and also an evaluation of the numerical results provided.

In principle, as already mentioned during the noise regulatory committee meeting in May 2008 in Bruxelles, the national and the interim methods were to be considered equivalent if they would give reasonably the same results in terms of noise levels at different positions, with different combinations of the sources (i.e.: traffic type and source properties) and of the propagation conditions (i.e.: buildings height and positions, presence of barriers, different types of ground, different types of terrain height, different meteorological conditions). This interpretation of the Directive statement "methods give equivalent results to the results obtained with the methods set out in paragraph 2.2 of Annex II" was discussed and agreed upon with DG ENV. Some MS interpreted this statement as a requirement that the methods will give equivalent results if considering the same set of input parameters, however, regardless of the L_{den} and L_{night} calculated. If accepted, this interpretation would therefore allow any number of L_{den} and L_{night} noise levels to be accepted. This would be against the 2nd and the 7th preamble[2,3] to the directive and against the common sense the term "equivalence" means.

It was already presented and discussed during the noise regulatory committee meeting in May 2008 that differences that might be attributable to the software implementation of a method would not be considered. In the case of the JRC evaluation, different software implementations were considered, to understand what differences can be attributed to the usage of various software and what differences are most likely the result of the different combination of the specific method equations and parameters used. In chapters 3 to 7 the rationale of the analyses performed by JRC is presented and detailed explanation of the analyses performed as well as the results concerning the differences in implementation of the interim method in existing widely used software are given.

Also, a set of three indicators to obtain an overall picture of the differences between calculation methods was developed by JRC and is presented in chapter 6. Specifically, not only the noise levels are considered, but also how the number of people exposed is affected.

[2] In its Resolution of 10 June 1997 on the Commission Green Paper, the European Parliament expressed its support for that Green Paper, urged that specific measures and initiatives should be laid down in a Directive on the reduction of environmental noise, and noted the lack of reliable, comparable data regarding the situation of the various noise sources.

[3] In accordance with the principle of subsidiarity as set out in Article 5 of the Treaty, the Treaty objectives of achieving a high level of protection of the environment and of health will be better reached by complementing the action of the Member States by a Community action achieving a common understanding of the noise problem. Data about environmental noise levels should therefore be collected, collated or reported in accordance with comparable criteria. This implies the use of harmonized indicators and evaluation methods, as well as criteria for the alignment of noise-mapping. Such criteria and methods can best be established by the Community.

2. ASSESSMENT OF EU MS REPLIES[4]

The following table summarises the information received by the Commission in response to the request about the calculation methods used by the Member States. The different colours denote the four possible cases (i.e., *white* = no information received; *green* = interim methods used; *orange* = national methods used; *gray* = no information received because the specific noise source is not relevant for the MS).

MS	Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
AT	No information	No information	No information	No information
BE (Bruxelles)	No information	No information	No information	No information
BE (Flanders)	No information	No information	No information	No information
BE (Wallonia)	Interim method	Interim method	Interim method	Interim method
BG	National method	National method	National method	National method
CY	Not relevant	Interim method	Not relevant	Not relevant
CZ	Interim method	Interim method	Interim method	Interim method
DE	National method	National method	National method	National method
DK	National method	National method	Interim method	National method
EE	National method	National method	National method	National method
EL	No information	No information	No information	No information
ES	Interim method	National method	Interim method	Interim method
FI	National method	National method	National method	Interim method
FR	No information	No information	No information	No information
HU	National method	National method	National method	National method
IE	No information	No information	No information	No information
IT	National method	National method	National method	Interim method
LT	National method	National method	Interim method	No information
LU	Interim method	Interim method	Interim method	Interim method
LV	Interim method	Interim method	Interim method	Interim method
MT	No information	No information	No information	No information
NL	No information	No information	No information	No information
PL	National method	National method	National method	National method
PT	Interim method	Interim method	Interim method	Interim method
RO	Interim method	Interim method	Interim method	Interim method
SE	National method	National method	Interim method	National method
SK	Interim method	National method	Interim method	Interim method
SI	Interim method	Interim method	Interim method	Interim method
UK	National method	National method	Interim method	Interim method

[4] Only the replies received from the EU MS by 14^{th} October 2008 have been assessed

In the following, a detailed analysis of the replies is given, and those parts of the replies relevant to the communication of the methods used and to the demonstration of equivalence following requirements of Art. 6 of the Environmental Noise Directive 2002/49/EC are also reported.

The colour of the bullet next to the name of the MS denotes the degree of compliance of the MS with Art. 6 of the END (*green* = compliant; *yellow* = not enough information received; *red* = not compliant).

AT Austria

No official answer received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

BE Belgium (Bruxelles)

No official answer received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

BE Belgium (Flanders)

No official answer received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

BE Belgium (Wallonia)

Official letter was sent by Wallonia Region on 01/04/08. In this letter, the following was declared.

(Extract from the letter)

"2. Méthodes provisoires de calcul de L_{den} et L_{night}

Pour le BRUIT INDUSTRIEL : IS0 9613-2 : "Acoustique - Atténuation du son lors de sa propagation à l'air libre, Partie 2 : méthodes générales de calcul".

Pour cette méthode, des données appropriées d'émission (données d'entrée) peuvent être obtenues par des mesures réalisées suivant I'une des méthodes suivantes:

- *IS0 8297 : 1994 "Acoustique - Détermination des niveaux depuissance acoustique d'installations industrielles multisources pour l'évaluation des niveaux de pression acoustique dans l'environnement - méthode d'expertise";*
- *EN IS0 3744 : 1995 "Acoustique - Détermination des niveaux depuissance acoustique émis par les sources de bruit a partir de la pression acoustique - méthode d'expertise dans des conditions approchant celles du champ libre sur plan réfléchissant";*
- *EN IS0 3746 : 1995 "Acoustique - Détermination des niveaux de puissance acoustique émis par les sources de bruit à l'aide d'une surface de mesure enveloppante au-dessus d'un plan réfléchissant". Pour le BRUIT DES AVIONS :*

ECAC.CEAC Doc. 29 "Report on Standard Method of Computing Noise Contours around Civil Airports", 1997. Parmi les différentes approches de modélisation des lignes de vol, on utilisera la technique de segmentation men.tionnée dans la partie 7.5 de ECAC.CEAC Doc. 29.

Pour le BRUIT DU TRAFIC ROUTIER : la méthode nationale de calcul française "NMPB-Routes-96 (SETRA-CERTU-LCPC-CSTB)", mentionnée dans I' arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal officiel du 10 mai 1995, article 6" et dans la norme française "XPS 31-133". Pour les données d'entrée concernant l'émission, ces documents font référence au "Guide du bruit des transports terrestres, fascicule prévision des niveaux sonores, CETUR 1980".

Pour le BRUIT DES TRAINS : la méthode nationale de calcul des Pays-Bas, publiée dans "Reken- en Meetvoorschrift Railverkeerslawaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 november 1996".

Ces méthodes doivent être adaptées à la définition de L_{den} et de L_{night}. L'établissement de la moyenne sur un an demande une attention particulière. Les variations de l'émission comme les variations de la transmission peuvent contribuer aux fluctuations sur une année."

Comments:
It is declared that the methods used are the interim methods.

Conclusions:
All methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	Interim method	Interim method	Interim method

BG Bulgaria ●

Official letter was sent by Bulgaria on 26/03/08. In this letter, the following was declared.

(Extract from the letter)
"(Omitted…) the Republic of Bulgaria has adapted its noise indicators and national methods in accordance with Article 6 and Annex II to the Directive by adopting Ordinance No 6 of 26 June 2006 on environmental noise indicators"

"The methods for assessing environmental noise are described in Annex 3 to Article 6 of the Ordinance. They are adapted to the requirements of the Directive in that:
The night is included as a separate period.
Noise reflected at the façade of buildings is excluded when calculating noise levels.
The average value for a noise indicator is determined over a period of one year.
The exact place of assessment is specified. (omitted…)"

Comments:
The letter does not specify what methods are used. The fact the methods used are adapted to the requirements of the Directive does not necessarily imply either that the interim

methods are used or that national methods were used that are equivalent to the interim ones.

Conclusions:
Information obtained does not allow assessing whether the methods used are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	National method

CY Cyprus

Cyprus sent an email on 05/06/08. In this email the following was declared.

(Extract from the email)
"(omitted…)Cyprus, during the preparation of noise maps, has used the interim method NMPC – routes – 96 (SETRA-CERTU-LCPC-CSTB) as it refers to Appendix II of the European Regulation 2002/49/EC. (omitted…)"

Comments:
The methods used for the only source declared by Cyprus (i.e.,road noise) is declared to be the interim method. Cyprus did not declare about the other noise sources as not being relevant for the situations occurring in this MS.

Conclusions:
The method is conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Not relevant	Interim method	Not relevant	Not relevant

CZ Czech Republic

Official letter sent by the Czech Republic on 26/03/08. In this letter the following was declared.

(Extract from the letter)
"(omitted…) The strategic noise maps for major roads, major railways, major airports and agglomerations in the Czech Republic were made using the recommended computation methods specified in paragraph 2.2 of Annex II to Directive 2002/49/EC, namely:

- *For railway [sic] noise: the French national computation method 'NMPB-Routes-96 (SETRA-CERTU-LCPC-CSTB)', referred to in 'Arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and in the French standard 'XPS 31-133'. This method is referred to as 'XPS 31-133' in these guidelines.*

- *For railway noise: the Netherlands national computation method published in 'Reken- en Meetvoorschrift Railverkeerslawaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, 20 November 1996'. This method is referred to as 'RMR' in these guidelines.*
- *For aircraft noise: ECAC.CEAC Doc. 29 'Report on Standard Method of Computing Noise Contours around Civil Airports', 1997. This method is referred to as 'ECAC Doc. 29' in these guidelines;*
- *For industrial noise: ISO 9613-2: 'Acoustics - Abatement of sound propagation outdoors, Part 2: General method of calculation'. This method is referred to as 'ISO 9613' in these guidelines. (omitted…)"*

Comments:
The methods used are the interim methods.

Conclusions:
All methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	Interim method	Interim method	Interim method

DE Germany ●

Official letter sent by DE on 20/02/08. In this letter the following was declared.

(Extract from the letter)
"(omitted…)National computation methods for strategic noise mapping which are based on Article 5 paragraph 1 of the Ordinance on Noise Mapping (34th Federal Immission Control Ordinance). The explanations already set out essential elements which are important for the equivalence of the results. Based on the information I have been able to gather so far from the strategic noise maps, I should like to add that the computation methods actually used correspond to those that were communicated.
As the EU Directive does not call for identical results it should not become necessary to demonstrate equivalence by means of a parallel computation of specific individual cases. Any such computation will always lead to more or less different results as long as the national computation methods are not identical to the interims methods. However, as the EU Directive specifically allows for the use of national computation methods, it should on the contrary only matter that these ***methods are based on elements which have the same objective and are just as suitable as the elements of the interim methods.***
The review protocols which the European Commission plans to introduce should set these elements forth from an experts' perspective. Since the review protocols will not be legally binding it should, however, be understood that the elements are not suited to determine conclusively the way in which the evidence is provided.
When drafting the review protocols and the elements consideration must also be given to the fact that the ***national computation methods were originally designed for the purpose of acoustical planning*** *and not for noise mapping and that this specific purpose is still inherent in the interim methods. For this reason all computation methods exhibit intrinsic strengths and weaknesses for noise mapping which become apparent in the different elements. However, when providing evidence of an equivalence of results neither the strengths* ***nor the weaknesses of the interim methods should in detail be used as a***

measure of all things*, this would be overrating the importance of the interim methods. If the individual elements are used in absolute terms it could lead to distortions in the comparison of methods. The review protocols should therefore not be dovetailed to the individual elements alone. On the contrary, important for a comparison is the totality of the elements in order to illustrate the true equivalence of the computation methods. As regards a final assessment of the results obtained after the member states have used the review protocols, please allow me to point out at this stage that no one individual computation method should be at the centre of attention but* ***that the different computation methods of the member states and the interim methods of the EU Directive should be compared among themselves and with each other.*** *Only a comparison of this kind will finally generate an accurate picture of how expressive and meaningful the computation methods are and consequently the noise maps which are based on these methods. (omitted…)"*

Comments:

Concerning the requested demonstration of equivalence among national calculation methods and interim methods as required by the Directive 2002/49/EC, Germany makes many valuable comments Although the critical position of Germany is well considered, not all the points suggested relative to the interpretation of the Directive requirements are shared.

By reading Art. 1.1 of the Directive, it is stated that "*The aim of this Directive shall be to define a common approach intended to avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to exposure to environmental noise.*". From this, it can be derived that equivalent results means (to the extent this is technically feasible) that, for any citizen of any MS where the source conditions are similar, the citizens should be rated as exposed to equivalent noise levels under these similar situations (concept of common approach). Germany points out that an equivalency should not be based on equal results, instead it should simply consider the individual elements which made up a method. However, by setting an interim method, the EU directive indicated not only a series of parameters to consider, but as it happens in other environmental fields, also set a common noise rating methodology, which is practically a specific method. Were Germany totally right in its statement that "*it should on the contrary only matter that these methods are based on elements which have the same objective and are just as suitable as the elements of the interim methods*", the Directive would not have specified any reference method, but simply listed the elements that a method should contain. By specifying an interim method and requiring demonstrating equivalence of the results, the Directive had put emphasis on these interim methods and on their results, not on their constituent elements. Although it is nowadays recognised that the interim methods have limits, and this is correctly reported by Germany when mentioning that "*national computation methods were originally designed for the purpose of acoustical planning*", the Directive was agreed among MS on using the interim methods, consequently this regards also the interim values obtained through these interim methods.

Moreover, although the statement made that the concept of "equivalence" allows for different interpretations is still acceptable, between the rigid mathematical definition of equivalence meaning "the same number as" to the more relaxed consideration that two numbers belong to the same cluster of significance, because the results required by the Directive are noise levels and number of people exposed to them, it seems reasonable that equivalence is most likely the former and not the latter interpretation. This means, as far as technically possible, the same numbers.

Germany nevertheless confirms that different methods will definitively give different results. Consequently, it is assumed that by this statement Germany declares that the German methods as well will produce different results deviating from those of the interim methods.

Conclusions:
All methods are not conforming to Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	National method

DK Denmark ●●

Official letter sent by DK on 22/07/08. The following was declared.

(Extract from the letter)
"(omitted…) It is concluded that the assessment method for road and rail noise, Nord2000, does not compare well to either of the two interim methods recommended in the Directive to countries having no national computation methods. The assessment methods for airport noise and industrial noise are identical to the interim methods.(omitted…)"
"The calculation principles recommended in guidelines from the Danish EPA no. 5/19994 "Noise from airfields" are identical to the Nordic Guidelines "Air traffic noise calculation"; Nord1993:38. The Nordic guidelines were based on the recommendations in ECAC Doc. 29 first edition (1986), but improvements were included – among others application of a segmentation technique. The improvements were later on adapted by ECAC Doc. 29, second edition (1997).
Thus we consider the method applied for noise mapping identical to the interim method."

Comments:
Denmark performed its own assessment of the differences among the national calculation methods used and the interim methods. Because of the different intrinsic characteristics of the methods, they concluded that the methods used for road and railway noise are not equivalent to the corresponding interim methods. Instead, the methods used for aircraft noise and of the industrial noise are declared being the same as the interim methods, therefore there is no need for demonstration of the latter methods.

Conclusions:
Road and railway noise mapping methods are not conforming to requirements of Art. 6 of the Directive 2002/49/EC.
Aircraft and industrial ones are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	Interim method	National method

EE Estonia●●

Official letter sent by Estonia on 08/07/08. The letter and the assessment delivered are attached in annex 1.

Comments:

In the reply received it is included an assessment of the different features among the national methods used and the interim methods for road and railway noise. The differences are mostly qualitatively addressed, however, quantitative information is not provided, except for a few simulations for road noise mapping methods.

Specifically, in their comments on the results of simulations at very close-by distance for **road** noise mapping method (less than 45 m from source), it is declared that: *"It appears from the results that the calculation results obtained using the Nordic and French calculation methods range from 0.6 to 2.8 dB, and on average by 1.3 dB."* Also that:

"the French NMPB-Routes-96 road noise calculation method and the Nordic road noise calculation method "Nordic Council of Ministers, TemaNord 1996:525" are used for the calculation of road noise;".

From the above and also by thoroughly assessing the full reply of Estonia (see Annex 1), it can be concluded that in the Estonia, depending on the team that has performed noise calculations, at least two sets of different results were presented. No attempt was made to correct for these differences, consequently, different results were obtained when comparing the same situations using the TemaNord 1996:525 method and the French interim method.

For **railway** noise, differences were not addressed, and it is only stated that two different methods are used:
"calculations of railway noise are made using the Dutch "Reken– en Meetvoorschrift Railverkeerslawaai (RMR)" or the Nordic method "Nordic Council of Ministers, TemaNord 1996:524."

For aircraft noise, it was declared that:
"The modelling of the noise of ***aircraft*** *was carried out using the INM 7.0 software.".*It is known from literature that this software conforms to ECAC Doc 29 3rd rev. and not to the European interim method. No assessment is therefore given concerning the equivalence of the results.

For **industrial** noise, only part of the recommended standards are used, but for propagation instead of the ISO 9613-2 (interim method) the Nordtest Method NT ACOU 080 is used. No assessment is therefore given concerning the equivalence of the results.

Conclusions:

Road noise mapping method is not conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

From the information provided, it is not possible to determine whether the railway, the aircraft and the industrial noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	National method

EL Greece

Official letter sent by Greece but no info on the methods used was given.

Comments:
In the reply received is not explicitly mentioned whether the methods used are the interim methods.

Conclusions:
No conclusion can be drawn whether the methods used in Greece conform to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

ES Spain

Official letter received by Spain on 24/04/08

(Extract from the letter)
"*Thus, it is confirmed that, in the case of Spain, the official evaluation methods used for the elaboration of the strategic noise maps coincide with those established as provisional recommended methods, in the annex II of the Directive 2002/49/EC*".

"*Despite what said, in the case of the Generalitat de Cataluna, within their railway infrastructures, used the calculation method NMPB-96 SETRA-CERTU-LCP-CSTB that is considered equivalent to the provisional recommended method, in the annex II of the Directive 2002/49/EC*"

Comments:
Spain used interim methods for all the sources except for the Catalunia railway network. In the answer received it is not explicitly explained on which basis the national railway noise calculation was deemed to be equivalent to the interim method and, apparently, no comparison has been performed.

Conclusions:
Road, industrial and aircraft noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

It is not clear whether railway noise calculation method is conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	National method	Interim method	Interim method

FI Finland

A first official letter sent by Finland on 17/03/08 along with 5 attachments. Another official letter sent by Finland on 08/07/08. Letters and accompagnying reports are attached in annex 2.

Comments

Finland delivered two letters and five attached documents related to the choice of the national methods. For both **road** and **railway** noise sources, in the letter dated 08/07/08 it is mentioned that "*the second report was drawn up to compare the computation results produced by amendment of the computation models with those of the interim assessment methods pursuant to the Directive (Annex 2 of the letter of 17 March 2008)*". Therefore, to understand whether the national methods used are in line with the Directive requirements, this annex was analysed.

For what concerns the **road** noise mapping method adopted in Finland, the Finnish reply dated 08/07/08 reports also that: *"there was a good match between the results obtained using the computation models for road traffic noise used in Finland and the French computation models for road traffic noise (Chapter 4.5.2 of Annex 2 of the Finnish reply of 17 March 2008). Differences in the results obtained were lower at all control points than 1.5 dB, and neither model gave consistently higher or lower results than the other."*

The entire chapter 4 of the Finnish document was analysed and the conclusion of the Finnish report under chapter 4.5.2 is indeed shared (given that the differences between calculations using the interim method and the Finnish method never exceed 1.5 dB similar results are obtained if taking into account the calculation accuracy). This conclusion is drawn on the basis of the results obtained for eight test sites, with distances between the source and the microphone lower than 240 m. It should be nevertheless underlined that the sites selected and the measurements performed (15 minutes sampling was used, at the following test sites: Munkinmäki, Jorvas, Kimmeltie, Suvikumpu, Pikkuniemi, Laajaranta, Joutsenlahti, Kokinpelt) do not cover most of the possible relevant combinations of cross sections, but are only representative of countryside situations.
Specifically, only two cross sections include an obstacle (Kimmeltie, which is made of a light noise barrier and includes the reflection of a building, and Suvikumpu, which includes a noise barrier). Multiple diffractions over two or more edges (a building or more buildings and noise barrier) are not considered, nor the effect of hard ground, nor far distances to evaluate the modelling of meteorological effect and air absorption (more than 300 m). These situations are common in urban areas, but were not considered in the Finnish study. Therefore, it cannot be concluded, whether in complex situations like the presence of different heights barriers, multiple buildings and different ground absorptions the Finnish and the interim method still give approximately the same results as in the presented eight test cases.

Regarding the selection of **railway** noise mapping method adopted in Finland, the Finnish reply dated 08/07/08 reports that: *"(Annex 2 of the letter of 17 March 2008), it was stated that using the Dutch model would require re-measuring the noise emissions data for rolling stock used in Finland. In addition, the tracks and rails used in the Netherlands and*

Finland are different, so that the rail class used in the Netherlands would not be suitable for the conditions in Finland. Although, under the Environmental Noise Directive, it is possible to use the initial values measured in the Netherlands for corresponding train types in other countries, the error this would lead to was considered to be greater than using the model in use in Finland in the report drawn up pursuant to the Directive."

These are indeed exactly the same conclusions reported in the chapter 3.3.3 of the annex 2 of the letter dated 17 March 2008.

Although it is accepted the fact that both trains and tracks might differ between Finland and The Netherlands, it should be nevertheless underlined that the physics of the noise generation remains the same and it is mostly related to quantifiable parameters like rail and wheel roughness, wheel size, sleeper type, presence of engines and fans on locomotives, braking noise. Propagation then is in general modelled differently in the national and in the interim method, regardless of the fact that in this case propagation does exactly follows the same physical principles independently of the location. Consequently, source definition might be different because of the different sound power levels of the sources defined with respect to the Dutch trains and tracks instead of the Finnish trains and tracks. But the definition of the equivalent sound sources and the effects of ground absorption, noise barriers, screening, reflection and diffraction on buildings and effect of air absorption and meteorological effects (wind direction, speed and temperature gradient) should be addressed in the comparisons. Overall, nor under point 3.3.3 not in any other part of the Finnish reply, a comparison on the results obtained using the two methods (national and interim) is given. Specifically, the fact that Dutch trains and tracks might differ from the Finnish ones cannot be accepted as an excuse for not comparing the two methods.

Finland, under point 1.3 of its letter of the 08/07/08, stated that: *"Finland does not have a national method for the computation of* ***industrial*** *noise. Consequently, national implementation of the Environmental Noise Directive is based on the computation method for industrial noise set out in point 2 of Annex 2 of the Directive"* Thus, the interim method is used.

Finland, under point 1.4 of its letter dated 08/07/08, stated that they have used the ECAC Doc 29 3rd edition in their computations for the **aircraft** noise mapping. This method is not the one indicated in the Annex II of the Directive 2002/49/EC (that being the 2nd rev.). Differences between the two methods are many, like the lateral attenuation, the segmentation technique and the use of a specific input values database. Unfortunately, given these differences, it cannot be arbitrarily considered as equivalent to the interim method, and it is not possible to agree with the Finnish statement that*: "is a supplementary version of the computation method pursuant to the Environmental Noise Directive. It is therefore considered to correspond to the Commission recommendation on acceptable methods."*
Having used this method, Finland should have produced an assessment of the equivalence of the results. Since such assessment is not provided, it is not possible to determine whether the method used is in line with the requirements of the Directive.

Conclusions:
Industrial noise mapping method is conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

It is not clear whether road, railway and aircraft noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	Interim method

FR France

No official reply received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

HU Hungary

Official letter sent by Hungary on 16/04/08. A comparative study was provided which is attached in annex 3.

Comments:

In general, in the reply received it is explicitly mentioned that the methods used for road, railway and industry are different from the interim methods.

Although the general principles of calculation using the national and the interim methods are mentioned, and there is also a clear and extensive explanation of the single parts of the national methods in comparison to the interim methods, the equivalence should be demonstrated on the results, not on the fact that the national and the interim methods take into account the same sets of input parameters (for sources, meteorological situation and screening) and propagation effects.

For each method, it is mentioned that the method is *"applicable":* please note that this does not mean that it gives "equivalent results" to those obtained using the interim methods, as required by the Art. 6(2) of the Directive 2002/49/EC.

Industrial noise method is presented in chapter 3.

In table 1 on page 8 it is presented a comparison of the different elements of the two methods. Almost all elements are the same, however, different approach is used for barrier attenuation and reflection. Since there is no quantitative evaluation of the differences that these two formulations of the same effects (barrier and reflection) could cause, nothing can thus be concluded on the equivalence over the results if the two different approaches are used.

Road noise method is presented in chapter 4.

The method used in Hungary is very well presented and figures and explanations show why this method was used and how it was fine tuned to the Hungarian situation by means of measurements and classifications of the various influencing parameters. But no information is given on differences in the results while using the Hungarian or the interim method, no conclusion can be drawn on the equivalence of the results.

Railway noise method is presented in chapter 5.
The method used in Hungary is very well presented and figures and explanations show why this method was used and how it was fine tuned to the Hungarian situation by means of measurements and classifications of the various influencing parameters. However, no information is given on differences in the results when using the Hungarian or the interim method, therefore no conclusion can be drawn on the equivalence of the results.

Aircraft noise method is presented in chapter 6.
For what concerns aircraft noise it is unclear whehter a specific national database (input values) has been used with the ECAC doc.29 2nd revision calculation method (to calculate levels at the receiver) or if another national method has been used, together with the aforementioned national database, to calculate the noise levels at the receiver.

Conclusions:
It is not possible to determine whether methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	National method

IE Ireland●

No official reply received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

IT Italy●●●

Official letter sent by Italy on 07/04/08. The letter and the different studies provided are attached in annex 4.

Comments:
Italy delivered many documents related to the choice of the national methods. In general, Italy adopted the interim methods, however, they allowed infrastructure operators to use different noise mapping methods (pages 5-6 of the Italian letter attached in annex 4). From this, it is concluded that only for industrial noise was certainly used the interim method, but for the other noise sources the infrastructure operators should provide information regarding equivalence of their results.

Road noise
The interim method is used. Italy performed a deep study of the possible updates necessary to the input values, and checked the performance by means of measurements. This study on the updated input values is presented in annex 4 of the documents: *"Mappatura acustica della rete di Autostrade per l'Italia"* and *"Autovie Venete – Relazione Tecnica"*.

Railway noise
In the annex provided by Italy, a study is presented that outlines the national method used and provides a detailed comparison between the two methods. It should be noticed that the national and the interim methods are based for most of the algorithms, on the same formulas. If this is not the case, the national method uses the same formulas of the ISO 9613, which is used as interim method, but for industrial noise calculations. Major differences are presented concerning:

- source height and number of line sources defined (A.3.1 and A.4.2));
- vertical directivity (A.3.3.1 and A.4.3.1);
- rail roughness (A.4.1);
- breaking noise (A.4.1);
- ground absorption over hard surface (A.4.3.4) (1 dB difference);
- barrier effect (A.4.3.5) (2 dB difference for barriers up to 4 m height);

Five test cases are then presented in detailed form (A5), but these tests are only considering the source database differences, since all tests consist of a close by measurement (25 m from railway line) on flat terrain and a comparison with the national and the interim method calculations. The differences of the two methods in real test cases (e.g.: including noise barriers, buildings, terrain effect, diffraction over other obstacles) are not considered. From the discussion above (list of major foreseen differences), it can be concluded that, far from the railway line, and therefore at the assessment positions at the building facades, differences can be found.

Aircraft noise
It is stated in the letter from Italy that all major airports in Italy used methods different from the interim one (page 6 of the Italian letter attached in annex 4). No information is given concerning the equivalence of the results concerning aircraft noise.

Conclusions:
Road and industrial noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Railway noise calculation method is not conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

It is not possible to determine whether aircraft noise mapping method is conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	Interim method

LT Lithuania●●●

Official letter sent by Lithuania on 29/02/08.

(Extract from the letter)

For **road** noise, it is stated that:
"The State and local authority institutions responsible for strategic noise mapping have selected MapNoise for ArcGIS as the software tool for strategic noise mapping relating to road traffic. MapNoise for ArcGIS uses the Nordic Prediction Model for Road Traffic Noise, NPM (third edition, 1996, TemaNord 1996:525). This software has been tested under Lithuanian conditions. A project to adapt the software was initiated by the Danish Ministry of Transport working in cooperation with the Lithuanian Ministry of Transport and Communications. The project was undertaken by the company Tetraplan A/S (Denmark) together with Carl Bro as (Denmark), the Lithuanian Transport and Road Research Institute and the Danish National Environmental Research Institute.

Since 2003 the Lithuanian Environment Ministry has recommended applying this software for territorial planning, carrying out environmental impact assessments and preparing projects. Hence, MapNoise for ArcGIS together with the Nordic Prediction Model for Road Traffic Noise can to some extent be considered the national computation method. The method has been adapted pursuant to the provisions and requirements of Annex I and paragraph 2.1 of Annex II to the Directive.

Vilnius and Kaunas municipal authorities have selected a newer version of the software tool MapNoise for ArcGIS, using the Nord2000 noise assessment method for modelling vehicle noise."

For **railway** noise, it is stated that:
"This software version and the noise assessment method have also been adapted for the assessment of railway noise and were therefore selected for assessing railway noise in the city of Kaunas."

For **aircraft** noise, it is stated that:
"For the air transport noise model at Vilnius International Airport, Vilnius municipal authority selected the method indicated in paragraph 2.2 of Annex II to the Directive (the software tool IMMI 6.2, ECAC.CEAC Doc. 29 and the segmentation technique referred to in section 7.5 of ECAC.CEAC Doc. 29). Under the first strategic noise mapping stage there are no other airports in Lithuania requiring mapping or where aircraft noise has an impact on the agglomeration."

Comments:

Lithuania used both the Nordic Prediction Method and Nord 2000 as calculation methods for road. For railway, the method used is the Nord 2000. In the letter sent, no indication is given concerning possible differences among the three adopted methods and the Interim methods. For the sake of consistency, at least for what concerns the Nord 2000 (both for road and railway noise), since Denmark declared that these two methods do not give equivalent results to the Interim ones, it can be then deduced, that this holds also for Lithuania.

The fact that two different methods are used within the same country it also means that results for the same country might differ from place to place.

It is not clear which industrial noise mapping methods were used.

Conclusions:

Road and railway noise calculation methods are not conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Aircraft noise mapping method is conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	Interim method	Not relevant

LU Luxembourg

Official letter sent by Luxembourg on 28/03/08.

(Extract from the letter)

"*La directive sous rubrique a été transpose en doit national per le règlement grand-ducal du 2 août 2006 portant application de la directive 2002/49/CE du Parlement européen et du Conseil du 25 juin 2002 relative à l'evaluation et à la gestion du bruit dans l'environnement. L'annexe II de ce meme règlement contient la description des methods effectivement utilisées pour le calcul effectués jusqu'à present dans le cadre de la directive 2002/49/CE correspondent exactement aux methods provisoires recommandées telles qu'elles sont décrites dans l'annexe II de la directive 2002/49/CE. A l'heure actuelle aucune mesure expérimentale du bruit n'a été effectuée.*"

Comments:

Luxembourg declared using all interim methods.

Conclusions:

All noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	Interim method	Interim method	Interim method

LV Latvia

Official letter sent by Latvia on 29/02/08.

(Extract from the letter)

"1. The computation methods used in preparing strategic noise maps for the Riga agglomeration are:

1.1. ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation' – for industrial noise;

1.2. the method outlined in ECAC.DEAC Doc. 29 'Report on Standard Method of Computing Noise Contours around Civil Airports' – for aircraft noise;

1.3. the French-designed computation method 'NMPB-Routes-96 (SETRA-CERTU-LCPC-CSTB', as referred to in the 'Arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and French standard XPS 31-133 – for road traffic noise;

1.4. the Dutch-designed computation method 'RMR' (published in 'Reken- en Meetvoorschrift Railverkeerslawaai '96, Ministerie Volkshuisvesting, Ruimtelijke Ordening en Milieu beheer, 20 November 1996') – for assessing railway traffic noise;
2. In preparing strategic noise maps for the five major roads with more than 6 million vehicle passages a year, the French-designed method 'NMPB-Routes-96 (SETRA-CERTU-LCPC-CSTB)' referred to in the 'Arrêté du 5 mai 1995 relatif au bruit des infrastructures routières, Journal Officiel du 10 mai 1995, Article 6' and French standard XPS 31-133 was used."

Comments:
Latvia declared using interim methods for all noise sources.

Conclusions:
All noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	Interim method	Interim method	Interim method

MT Malta

No official reply received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

NL The Netherlands

No official reply received.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
No information	No information	No information	No information

PL Poland

Official letter sent by Poland on 17/03/08.

(Extract from the letter)
"For the purposes of assessing industrial noise, in accordance with Annex 8 to the Decree of the Minister for the Environment on the requirements for taking measurements of emission volumes (Journal of Laws (2004) no 283, item 2842), calculation methods have been applied that are in line with the model of noise dissemination in the open environment in standard PN ISO 9613-2:2002 : Acoustics – attenuation of sound during propagation outdoors. General method of calculation. The basic source data for

calculating attenuation levels based on the above model, as set out in standard PN ISO 9613-2:2002, are the acoustic capacity of the sources of noise (installations and equipment) in the area occupied by the plant.

The acoustic capacity of installations or their key elements (from a noise emission standpoint) may be communicated by the producer or, where applicable, may be established in a measurable way on the basis of the procedures laid down in the following standards:

PN-EN ISO 3744:1999 Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane.

PN-EN ISO 3746: 1999 Determination of sound power levels of noise sources using sound pressure. Survey method using an enveloping measurement surface over a reflecting plane.

PN-ISO 8297:2003 Determination of sound power levels of multisource industrial plants for evaluation of sound pressure levels in the environment. Engineering method.

"In the case of aviation noise, in accordance with Annex I to the Decree of the Minister for the Environment on the requirements relating to measurements of environmental levels of substances or energy to be taken by road, railway line, tramway line, airport or port authorities (Journal of Laws (2007) No 192, item 1392), the INM calculation method has been applied. This method is laid down in international rules within the meaning of the Aviation Act of 3 July 2002 (Journal of Laws No 130, item 1112) and in particular in ICAO Circular 205-AN/1/25/1988 and in ECAC.CEAC Document 29 "Report on Standard Method of Computing Noise Contours around Civil Airports", as adapted to European requirements and adopted for implementation by Directive 2002/49/EC.

Simultaneously, the methods for assessing environmental noise as required and recommended by Directive 2002/49/EC have been established in Chapter 5 of the "acoustic maps guidelines" (drawn up in the context of the Transition Facility project No 2005/017-488.03.04) and are available for consultation on GIOŚ's internet homepage: www.gios.gov.pl/dokumenty/wytyczne_map_akust.pdf. They apply to preparation of the acoustic maps for all noise source categories.

Current practical calculations of noise distribution, essential for drawing up the acoustic maps, have been made using one of the following software packages, CadnaA, INMv.7 or SoundPlan. These packages perform calculations in accordance with the reference methods laid down in Annex II to Directive 2002/49/EC.

Under Polish legislation, responsibility for the choice of noise assessment methods lies with the acoustic map contractor."

Comments:

Poland declared using the interim method for industrial noise. For aircraft noise, it is known that the software used, INM 7.0, is not in agreement with the ECAC.CEAC Doc. 29 2nd rev. '*Report on Standard Method of Computing Noise Contours around Civil Airports*' – and therefore the method to use is not the interim method.

Road and railway noise mapping methods are not considered, at least not explicitly, in the reply.

In any case, Poland declared that the law allows for any method to be used, since the choice of the method is in the acoustic map contractor's power. Therefore, it is impossible to understand whether the final contractors have used the interim methods at the end.

Conclusions:
It is not possible to determine whether the noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	National method	National method

PT Portugal

Official letter sent by Portugal on 15/02/08.

(Extract from the letter)
"in accordance with Decree-Law No 146/2006 of 31 July 2006, which transposes Directive 2002/49/EC, the strategic noise maps being drawn up in Portugal by the Portuguese Environment Agency (APA) are being compiled using provisional computation methods for the L_{den} and L_{night} indicators as specified by Article 6(1) of, and point 2 of Annex II to, the abovementioned Decree-Law and point 2.2 of Annex II to the Directive."

Comments:
Portugal declared using interim methods for all its noise sources.

Conclusions:
All noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	Interim method	Interim method	Interim method

RO Romania

Official letter sent by Romania on 01/03/08.

(Extract from the letter)
"it uses the interim computation methods laid down in point 2.2 of Annex II to Directive 2002/49/EC (transposed in point 2.1 of Annex 3 to Government Decision No 321/2005 on the assessment and management of environmental noise, amended and supplemented by Government Decision No 674/2007). Those Decisions were notified by Romania as national measures completing the transposition of Directive 2002/49/EC relating to the assessment and management of environmental noise.
2. Order No 678/2006 of the Minister for Environment and Water Management approving the Guide to interim computation methods for noise indicators relating to industrial noise, road traffic noise, railway noise and aircraft noise in the vicinity of airports (published in Official Gazette of Romania Part I No 730 bis of 25 August 2006), which forms Annex 1 to this letter, adopts Commission Recommendation 2003/613/EC on interim computation methods."

Comments:
Romania declared using the interim computation methods for all its sources.

Conclusions:
All noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
Interim method	Interim method	Interim method	Interim method

SE Sweden

Official letter sent by Sweden the 26/03/08. The letter and the different studies provided are attached in annex 5.

Comments:

1) General remarks on the studies provided by Sweden:
   - Alhough the general principles of calculation using the national and the interim methods are mentioned in the report, the equivalence should be demonstrated on the results, as specifically mentioned under art. 6.2 of the Directive 2002/49/EC.
   - The choice of adopting only favourable propagation conditions certainly leads to differences between 0 and 3 dB. It should be noted that no indication is given about how L_{den} and L_{night} 5 dB bands are affected by differences that could be induced by differences of propagation conditions at different distances. Indeed results according to the END directive should be reported per bands of 5 dB between 55 (usually these are bands associated to distances far from the major noise sources) and 75 and more than 75 dB (usually these are bands associated to distances close major noise sources, thus not influenced by meteorological effects).
   - It is specified that differences are due to meteorological parameters and sound power of sound sources are specifically built for Sweden. Though it is acceptable that Sweden opted for using their own databases for source sound powers, the propagation part does not only depend on the expression of the meteorological parameters, but differ also because of the description of: a) the reflection on obstacles, b) the diffraction around obstacles, c) the ground reflection, d) eventually the transmission through barriers and e) on the positioning (mostly height) of the sources above ground level. These parameters are not addressed here but might most likely cause differences in the estimation of the noise levels.
   - For each method, it is stated that the method is *"compatible"*: please note that this does not mean "*equivalent*" as it required by the Directive 2002/49/EC.

2) *Road noise*
   - It is shown that the Swedish method give good results if compared to measurements, for distances of up to 200 m. The requirement of Art 6(2) of the

directive 2002/49/EC (END) does not require that a national method gives good results, but results equivalent to those obtained using the interim method. Although the assessment is interesting and precise it should had considered the results obtained using the interim method as the reference results and not the measurements.

- A table is presented with differences caused by the different choice of meteorological parameter up to 160m, but this is not necessarily the only distance from major road infrastructure at which the END requires noise maps. Rather, any other position at a house façade which yields at least to a L_{den}=55 dB(A) or L_{night}=50dB(A) should be also considered.
- Consequently, information regarding the following points was not provided, though absolutely relevant:

  a) possible differences between national and interim method caused by **reflection** on obstacles,
  b) possible differences between national and interim method caused by **diffraction** around obstacles,
  c) possible differences between national and interim method caused by **ground** absorption and reflection (on large distances),
  d) possible differences between national and interim method caused by **transmission** and
  e) possible differences between national and interim method caused by **positioning** (mostly height) of the sources above ground level.

3) *Railway noise*
   - It is shown that the Swedish method give at most 3 dB difference because of meteorological correction.
   - This is not the only possible source of differences on the overall result, therefore, information regarding the following points was not provided, though absolutely relevant:

     a) possible differences between national and interim method caused by **reflection** on obstacles,
     b) possible differences between national and interim method caused by **diffraction** around obstacles,
     c) possible differences between national and interim method caused by **ground** absorption and reflection (on large distances),
     d) possible differences between national and interim method caused by **transmission** and
     e) possible differences between national and interim method caused by **positioning** (mostly height) of the sources above ground level.

4) *Aircraft noise*
   - It is understood from the reply received that the INM database has been converted just to be used with the ECAC doc.29 2nd revision calculation. Therefore, the calculation method is the interim method.

Conclusions:
Industrial and aircraft noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

It is not possible to determine whether road and railway noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	Interim method	National method

SK Slovakia

Official letter sent by Slovakia on 07/03/08. A report is referred to which is given in annex 6.

(Extract from the letter)

"Technical guidance document No OŽPaZ/5459/2005 takes over the noise computation methodology set out in Annex II to Directive 2002/49/EC, adapted for use, except for railway-traffic and track-based road traffic noise for which it prescribes the methodology "Schall 03 – computation of sound immissions from railways".

"Based on the conclusions of the above PHARE project, the German computation method Schall 03 was designated as an equivalent method to the Dutch national computation method SRMII specified in Annex II to Directive 2002/49/EC."

"The above project inter alia demonstrated the equivalence of the results of measurement of railway noise in Slovakia; it also provided justification for selecting the German Schall 03 method.

The main reasons for replacing the SRMII method with the Schall 03 method applied:

- *in the case of SRMII method, it is difficult to establish and set the input computation criteria, in particular as regards trainsets as these are currently not available in the Slovak Republic;*
- *computation using the Schall 03 method is straightforward and there is a possibility of calibration and verification by measuring; typical examples are available;*
- *in Slovakia, the Schall 03 method provides greater consistency between the results of measurement and of computation of railway noise, compared with the SRMII method.*

Further information on the PHARE project "Assessment and management of environmental noise" is available on the website of the Slovak Ministry of Health: http://www.health.gov.sk/redsvs/rsi.ns^0/DC4D1709AA5520E8C1256F4D00336048?OpenD ocument. The final project report is available at: http://www.health.gov.sk/redsvs/rsi.ns^0/DC4D1709AA5520E8C1256F4D00336048/$FILE/ Final Report Slovak.pdf."

Comments:

Slovakia in its reply referred to a document that is attached in annex 6. Slovakia has only one method differing from the interim method, which is the calculation method for railway noise. The document was screened and it was noticed that the only comparison available between the national railway noise calculation method adopted and the interim method is the sequence of tests with pass bys of various train types that are summarised in table 12 on page 48 of the document. These are comparisons between the two methods at an assessment point close by in the free field. From this, no general conclusion can be drawn since common situations such as the presence of buildings (reflection and diffraction), the effect of noise barriers (absorption, reflection and diffraction), meteorological effects for long distance propagation are not considered. The only assessment performed is therefore on the source description (since 25 m in free field is a typical distance at which railway noise sources are evaluated).

More test cases at different distances and with many other elements in the cross section could give information on the differences between the two methods, however, these are unfortunately missing from the report of Slovakia .

Conclusions:

Road, industrial and aircraft noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

It is impossible to determine whether railway noise mapping method is conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	**Rail traffic noise**	**Air traffic noise**	**Industrial noise**
Interim method	National method	Interim method	Interim method

SI Slovenia

Official letter received by Slovenia on 18/03/08.

(Extract from the letter)

"In reply to your query we would like to inform you that Slovenia has brought into force the Recommended Interim Computational Methods according to the Commission Recommendation 2003/613/EC concerning the guidelines on the revised interim computation methods for industrial noise, aircraft noise, road traffic noise and railway noise, and related emission data. At the end of 2005 these requirements were adopted in the Annex II and III of the Regulation relating to the assessment and management of environmental noise and published in O.J. No. 105/2005, 23 rd of November 2005."

Comments:

Slovenia declared using interim methods.

Conclusions:

All noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	**Rail traffic noise**	**Air traffic noise**	**Industrial noise**
Interim method	Interim method	Interim method	Interim method

UK United Kingdom

A first official letter was received by The United Kingdom on 06/03/08.

A longer official letter, that referenced other studies funded by the UK Government was received on 12/09/08. The latter is attached in annex 7.

(from letter of the 06/03/08)
"There are a number of practical difficulties if Member States were obliged to apply an equivalence protocol at this stage. These are listed below.

First, additional work at this stage to apply an equivalence protocol could prove a costly and time-consuming task just at the stage when Member States are working hard to meet the very challenging timetable for action planning. This may lead to a delay in the production of action plans.

Second, it will be difficult to determine what deviation from the interim method will be acceptable. It will be impossible to ensure that a national method provides identical results to the interim method so there will have to be agreement on a permitted variation from the results of the interim method.

Third, an overly rigid approach in a protocol may lead to national methods being shown not to be equivalent, and therefore not suitable for action planning. This would require them to be re-done to the required standard leading to additional cost and unnecessary delay to the action planning process.

Fourth, and arguably of greatest importance, the UK believes that any variance that may result from slight differences between adapted national methods and the interim methods, would be totally overshadowed by any differing quality of the data input used to produce the results. For example, some Member States may have relied on the levels suggested in the Good Practice Guidance for their input data whereas others may have been able to use captured data. In our view, these variances are likely to cause far greater variations between Member States' results than any issues over equivalence with the interim method. There is therefore a question of the benefit in Member States devoting high levels of resources to demonstrating equivalence according to a fixed protocol."

"There may be other means available for demonstrating equivalence rather than introducing a fixed protocol. For example, in the UK, as you will recall, we funded research for WG-AEN to look at issues of accuracy with respect of the interim road and rail methods and our own national methods. One outcome of that study showed that, for both road and rail, and for both the UK methods and the interim methods, the most crucial piece of input data regarding the accuracy of the output was vehicle speed implying a degree of equivalence. It might be helpful to convene an EU workshop to discuss alternative methods."

Comments:

United Kingdom, in its first communication, made four remarks to the application of the equivalence protocols.

First, the fact that additional work is needed is already recognised, however, this is a requirement of the Directive and had therefore to be tackled upon. The Commission decided to propose simple protocols to be applied in the context of the equivalency exercise exactly for reducing the amount of work that the MS would have required to perform..

Second, the fact that national methods differing from the interim ones would never produce exactly the same results is most probably true. Consequently, the Commission to verify that the requirements of art. 6.2 of the Directive 2002/49/EC are respected, needed to have information on the order of magnitude of the differences among the national and the interim methods. Only then an eventual discussion on the permitted variations among the methods would have been possible. This point was also answered during the Noise Committee meeting took place on 7th of May 2008, when it was stated that*: "The term 'equivalence' means 'same' or 'similar' in plain English. Through this exercise undertaken EC expects to understand the magnitude of differences among the methods used in the MSs."*

The third point of UK's reply raised the rigid approach of the protocols: it is considered necessary to quantify by means of numbers the differences among calculation methods, otherwise no information on possible amount of population misclassified between L_{den} and L_{night} bands would become available. It should be reminded that the Directive requires methods to give *"equivalent results"* and that results to be reported to the EC are noise levels and number of people exposed. It would not make sense not adding credibility to the entire exercise of strategic noise mapping if calculations which give different results though they are based on the same elements would have been accepted (e.g.: considering traffic type, meteorological effects,…).

Concerning the fourth point, it is not believed that variances due to the use of default data might overshadow the differences of the methods.

It is correct that by making arbitrarily fixed choices on the input parameters (e.g.: default values suggested by GPG) calculations will be biased, however, the use of a different calculation method, since calculation methods are fixed formulas, would introduce, without shadowing, a second bias. The second bias is that of increasing or decreasing the noise level for a given cross section, once a different method (different set of mathematical formulas) is used. A simple example could explain the previous considerations. Assuming that at a given position noise levels due to a road noise source are calculated at a façade of a house partially hidden by a noise barrier, if a wrong value of the barrier height (e.g.: higher) would be used in the calculation this would cause a lower calculated noise level at the receiver both, for method A and method B. Method A and method B they also differ for the way they model the effect of the barrier. Assume that A leads to lower values than B, these lower values will equivalently remain both, for the case when the barrier height would be correctly modelled and also for that incorrectly modelled. Therefore no shadowing occurs.

Anyhow, it is assumed that MS did their best and therefore, even when simplified default values are used, these values might certainly, locally (on a single assessment point), differ from the correct values. However, on large numbers, the most reasonable assumption is that true values of parameters (e.g.: barrier height) would be normally distributed. In this case, any fixed default value would statistically most likely produce equal number of underestimations and overestimations at the assessment points. Studies on these differences (default input values – true input values) would give information on the spread of single receiver values differences, however, the average on large numbers would remain the same. This is the case of the studies funded by the UK on accuracy and that are recalled in the UK's reply.

Finally, if a MS has used a default value for parameters, which is not close to the true average value of that parameter, this is the responsibility of the MS to check a minimum quality of the noise maps produced. Anyhow, accepting the idea that MS have not only simply used default values but even quite wrong default values this would dramatically reduce the credibility of the strategic noise mapping. It is believed that, although exceptions may exist, consultants and public offices did their best to implement the methods.

UK's reply also makes a proposal to organise a workshop on accuracy of noise mapping (mainly on accuracy of input values for the methods). The EC has already planned this before the revision of the Directive and with the aim of producing better quality maps during the next round of noise mapping.

It is believed that the work produced for UK under the Data Accuracy Guidelines project can with of great value and be a significant contribution to the outcome of this workshop.

Concerning the statements contained in the report presented in annex 7, the following can be observed:

Concerning equivalency, under point 3.7 of the aforementioned report, it is stated:

"If the same type of outcome arose from the error propagation analyses through two different models, then it can be deduced that the model is equivalent"

Also, in the text of the cited reports, it can be read the following.

In *"Data Accuracy Guidelines for CRTN",* doc. 3188.3/9/2 - May 2005, par. 3.4.2*: "The work within this current project is centred on assessing the means by which uncertainties, error or assumptions within the input datasets of noise maps propagate through the calculation tools to produce uncertainties or errors in the decibel results obtained."*

Par. 3.4.3 cited under point 3.7, also simply states that*:"Should comparative studies of the national methods be published, or error propagation analysis carried out for each of them, it could help to determine a means by which "equivalence" is demonstrated for the END."*

From all these statements, it is understood that, these studies investigated the differences in error propagation when different methods were used, not the output produced by two different methods if exactly the same input dataset and configuration are used. Therefore, equivalence of the results (values) obtained using two different methods is not addressed; instead, only sensitivity analyses were performed. The opinion expressed by UK that, sensitivity analyses constitute the mean to proof equivalency is, therefore not shared by the JRC. The reason is, as explained above when the fourth point of the letter dated 06/03/08 was commented. Moreover, during the Noise Regulatory Committee meeting of the 7th of May 2008, it was explicitly stated that the results obtained using different calculation methods should be faced, regardless of the quality of input data. This is because of the requirements of art. 6.2 of the Directive to give "equivalent results" (with the same input values).

UK correctly noticed, under point 3.8, that the software implementation will not be considered. It should be clarified that, if the protocols prepared by the JRC were used, the effect of software implementation would have been implicitly considered in the comparison. Indeed, JRC, to account for software implementation effects, performed apart an evaluation of the interim methods implemented in different software. Only this way, differences arising from different software implementation of a given method will be avoided from the direct comparison of the national and the interim methods. They would however be accounted in the final assessment of the equivalency exercise by subtracting them from the differences between the national and the interim methods.

Overall, it should be remarked that UK did not provide any mean for determining differences between the interim methods and the national ones given the same input dataset.

Conclusions:

Industrial and aircraft noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

It is impossible to determine whether road and railway noise mapping methods are conforming to the requirements of Art. 6 of the Directive 2002/49/EC.

Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
National method	National method	Interim method	Interim method

3. RATIONALE OF THE EQUIVALENCE ASSESSMENT BY MEANS OF THE JRC PROTOCOLS

The protocols developed by JRC and the subsequent analyses of the results obtained by the implementation of these protocols considered that the Environmental Noise Directive states that ***equivalent results*** must be obtained between the National methods and the interim ones. The "results" referred to in the Directive are the L_{den} levels and the L_{night} levels, and not in terms of the number of population exposed, notwithstanding this latter is part of the results to be submitted through noise mapping and might be the most relevant indicators for exposure assessment to environmental noise.

Moreover, the assessment methods mentioned in the Annex II (referred to in Article 6 of the END) refer to L_{den} and L_{night} as the "indicators set out in Annex I." As a result, it was opted by JRC to consider at first the differences of L_{den} and L_{night} values as those values that should be driving the "equivalent results." Anyhow, it was also opted to consider the effect of using a national calculation method compared to the inerim one on the derived number of population exposed, given that data required to be sent to the Commission includes the number of people exposed and the total area and total number of dwellings exposed to certain noise levels.

As far as the equivalency of results is concerned, the fact that the END might not explicitly refer to the L_{den} and L_{night} or specifically address the results on the basis of the number of population exposed is nevertheless not a real issue. Indeed, if the levels obtained using national methods are different from those calculated by the interim methods, the obvious (and banal) consideration that "the people will nevertheless remain assigned to the same dwellings" (since people are assigned to dwellings regardless of the calculation method used) would lead to the following firm conclusion: The differences between the results of the two methods would hold both when the levels are considered or the population (number of people exposed to) is considered.

An example can be useful to understand the peculiarity of the aforementioned issue. 10 people are living in a dwelling that, according to method A, is affected by a noise of L_{den}=52 dB on the façade, while method B estimates that the same façade (same cross section) is affected by L_{den}=57 dB. Obviously, the difference between method A and method B results could either be regarded +5 dB L_{den} difference between method A and B or, alternatively, as 10 more people exposed to the next 5 dB L_{den} band (10 people less in the 50-54 band and 10 people more in the 55-59 band).

Given this, the protocols were developed having in mind a set of reasonably real and average test situations that are commonly encountered in suburban and urban areas of the EU MS. These test situations should form a common basis for pointing out in a clear way the differences among two given calculation methods. As far as possible, the differences between the implementation of these two methods under a specific situation should be the basis to judge the expected differences in real mapped situations.

Any noise map built from real situations in the MS might ideally be covered by one or a combination of some of the test cross sections presented in the protocols. It should be noted that the cross sections were developed on the basis of noise mapping experts' experience and not on statistical analysis of the possible cross sections encountered in Europe. Thus, the weakness of such experts' judgement is that it cannot be proofed that the combination of the cross sections prepared constitute approximately the average of the European urban and suburban cross sections. Alternatively, only a thorough recalculation of all noise maps of a MS with the interim method would allow quantifying any differences among the national and interim methods. This being obviously an impracticable task to undertake, the protocols constituted a good basis to consider most of the possible cross sections of a noise map in a real environment. Also, bearing in mind the considerations on the population distribution in dwellings presented above, the protocols were considered to be a good compromise between a huge work of recalculation of millions of receivers for a given MS, and the need to have an overview of all possible implications of having used different calculation methods on the results to be reported to the Commission.

For any details on the specific settings of the different test configurations considered in the JRC protocols, please refer to the following report:

> UPDATED TECHNICAL REPORT no. 1 (period 22nd February 2008 to 31st May 2008) on '*Protocols for checking the equivalence of national noise mapping methods against the interim methods*' of the 31st May 2008.

4. METHODOLOGICAL ASPECTS

The four protocols (test environment and associated set of input values) as well as the subsequent analysis of the results were defined bearing in mind the following requirements and boundaries of the whole exercise:

1. The aim was to check the equivalency of the national methods but not the way these methods are implemented in software. However, as errors in software implementation may be an influential source of error in the overall analysis, these were considered by JRC using different software implementations of each method, considering the average and the standard deviation for each assessment point.
2. The assessment positions are as defined by the END at 4 m height and 2 m in front of a most exposed façade. Assessment positions are meant to be representative of the most exposed façade, bearing in mind that the general objective of the END is ***"to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise".***
3. Some assessment positions were anyway placed at 1.2 m and 3.0 m height. These were not considered in the analyses, although they could be used to verify anomalies in the source sound power definition. Indeed, these are standard assessment points for road and railway noise characterisation.
4. The number of configurations corresponding to the test environment of each one of the four noise sources were selected in a way to cover a large set of realistic situations representative of those to be mapped according to the European Noise Directive 2002/49/EC. The source conditions and propagation should match common traffic/source properties for the major environmental noise sources as defined by the END.
5. Comparisons were performed for noise levels L_{den}/L_{night} in the range 20 dB(A) to 80 dB(A), although to the purpose of the Environmental Noise Directive levels lower than 45 dB are not considered and all levels higher than 75 dB are grouped together, these values were used to verify the methods results in the vicinity of their boundaries.
6. No evaluation was performed on how the population exposed was derived. The requirements of the END are limited to the computation methods, and do not specify to check what specific technique is adopted to attribute exposure population levels. Therefore, the exercise on equivalence was limited to proof that the levels calculated at 4 m height and 2 m away from the façade are or are not equivalent, and used the assumption that population distribution among specific building would not change to examine the effect of the differences between the methods on the results related to the number of population exposed (see also the previous chapter 3 and the following chapter 7 on the indicators).
7. The calculated noise levels to be reported by the MS were compared to the ones obtained internally by the JRC strictly using the interim methods. In this comparison, the effect of the software implementation was considered (see chapter 7).

8. For road traffic noise, railway traffic noise and industrial noise, the test environments were designed to reflect:

- A free field situation, for identifying the major differences among the methods due to the propagation.
- An area with buildings, consisting of maximum two rows of buildings, for testing the response of the different methods at the assessment positions as defined by the END.
- A complex building setting, for evaluating the behaviour of the methods in complex situations in which several reflections and diffractions occur.

9. To avoid testing the software performance that becomes critical if many reflections are considered, two reflections were considered in this exercise.
10. For aircraft noise, based on data on major European airports, a set of representative aircrafts was identified and standard flight procedures applied.
11. The definition of the input values was based on a selection of the most frequent situations occurring in the MS, bearing in mind that the scope of this exercise on equivalence was to point out those differences (among the methods) that mostly affect the noise maps to be produced. Noise maps were indeed mapping major infrastructures, major industrial sites and agglomerations.
12. Various configurations are well described through a complete specific set of parameters, however allowing flexibility for the national methods to use their own databases of specific input values.

In the protocols which the MS were required to fill in, there were several source configurations and several cross-sections configurations which were tested.

For ***road***, ***railway*** and ***industrial*** site, the following situations were tested:

1) flat and free field (without buildings);
2) embankment with about 45° slope;
3) depressed, about 45° slope;
4) with 1 barrier;
5) with a double barrier;
6) combinations of absorbing/reflecting barriers;
7) different ground effects (totally absorbing/ totally reflecting);
8) a close by set of various buildings representing urban situations;
9) buildings at different distances from the source;
10) neutral and favourable meteorological conditions.

For ***aircraft*** traffic noise, a simplified environment was used because the usual aircraft noise mapping methods adopted nowadays (the EU interim method included) do not consider buildings reflections and shielding of walls, nor ground absorption (all assume soft ground, though this is wrong in urban areas) and they usually do not include meteorological differences along the day, evening and night periods. Therefore, only standard take off and landings were used in the calculations.

The several datasets of results obtained implementing the protocols were reduced grouping the single point calculations. Unfortunately, it is impractical to judge the single values obtained (e.g.: for road traffic noise, 1741 single points representing specific configuration settings are calculated for each method and each software). Instead, a priori know how was used to aggregate values in a reasonable and consistent way. A first grouping was performed on the traffic type, then on the meteorological conditions, and finally on the relevance of the cross sections.

Specifically for roads, based on common experience and analyses of a few major roads and agglomerations, it was concluded that the following can be reasonably assumed:

- on average 20% of the traffic on a major road is made of heavy vehicles;
- in urban environments meteorological conditions are not very relevant;
- in the countryside the day presents homogeneous conditions while the night presents favourable propagating conditions.

Specifically for railways, based on common experience and analyses of agglomerations, it was concluded that the following can be reasonably assumed:

- the traffic composition as given in the protocols is a representative average number of trains pass bys on a major railway line.

Specifically for industries, based on common experience on a few major industrial sites, it was concluded that the following can be reasonably assumed:

- on average industrial sites are never too close to dwellings;
- major industrial sites are always a combination of many sources at many locations around the site and the buildings, thus the cross sections presented in the protocols can be averaged linearly since they have approximately the same probability to represent real cross sections;
- in urban environments meteorological conditions are not very relevant;
- in the countryside the day presents homogeneous conditions while the night presents favourable propagating conditions.

Specifically for aircrafts, based on common experience and analyses of the aircraft traffic in the major EU airports, it was concluded that the following can be reasonably assumed:

- a combination of the aircraft types and configurations presented is an average EU airport situation..

Based on the aforementioned considerations, the values obtained for specific traffic/source configurations and meteorological conditions were grouped together to give a set of combined and representative L_{den} and L_{night} values that can constitute the basis to judge the equivalence of the results on the several test situations described in the JRC protocols.

The values eventually reported by the MS would have been analysed strictly following the same procedure (a specific Matlab© code was compiled to consistently analyse all datasets, both JRC and MS ones). The specific technique used and the formula used to combine the assessment points and the configurations is presented in the next chapter 5.

5. CALCULATIONS PERFORMED

The JRC performed its own calculations implementing the protocols as in their updated version sent to MS, using 4 different software implementations.

For road:

- 20 specific configurations for each of the three software were implemented in 36 different specific models;
- 5223 $L_{(A)eq}$ were calculated and resulting values are reported in the calculation file folder attached in the accompanying to this report CD-ROM.

For railway:

- 19 specific configurations for each of the three software were implemented in 32 different specific models;
- 6537 $L_{(A)eq}$ were calculated and resulting values are reported in the calculation file folder attached in the accompanying to this report CD-ROM.

For industry:

- 3 specific configurations for each of the three software were implemented in 6 different specific models;
- 237 $L_{(A)eq}$ were calculated and resulting values are reported in the calculation file folder attached in the accompanying to this report CD-ROM.

For aircraft:

- 57 specific configurations for each of the three software were implemented in 99 different specific models;
- about half a million $L_{(A)eq}$ were calculated and resulting values are reported in the calculation file folder attached in the accompanying to this report CD-ROM.

Given the large amount of noise maps that should have eventually been included in the report, as well as the large amount of calculated points, it was decided not to include these maps in the main text of the report. Instead, only a few example maps are reported in the report, and eventual additional maps can be viewed or obtained by means of the data and figures reported in the calculation folder attached in the accompanying to this report CD-ROM.

The different software used allowed implementing the protocols according to the interim methods. Input values were introduced according to the protocols requirements. Only in the case of aircraft noise, each software implementing the interim method allowed using only one type of database: either the one based on the Austrian-German database, suggested by the Commission's recommendations, or the ANP database, hosted by Eurocontrol, which is a subset of the US software INM v6.1. It was recognised that it would be impracticable to convert NPD (Noise Power Distance data) taken from the US database and convert it into the Austro-German format or vice versa.

Calculations were anyhow performed having in mind this restriction, though this fact leads to the following two relevant consequences:

- when using those software implementing the Austrian-German database, in several configurations prescribed by the JRC protocols, the aircrafts defined in the protocols should be calculated with the same NPD data;

- results obtained using the interim method differ considerably between themselves if considering or not considering the Commission's recommendations (i.e.: if using the Austrian-German database or not).

6. INDICATORS USED FOR ASSESSING DIFFERENCES AMONG THE METHODS

Differences in the calculations between the MS method and the interim method will be a result of two basic components:

- one is due to the software implementation of the method between two different software for each point to point calculation;
- the other is the difference of the formulas prescribed in the two different methods to calculate each receiver position (also for each point to point calculation).

The indicators developed by JRC to assess method differences consider these two elements and separate the two effects in order to clearly addressing only the differences due to the method chosen.

Before performing any analyses of the results, the values calculated at each single receiver or, in the case of aircraft noise, on the grid, were aggregated to obtain environments representative of common European situations for major noise sources to be mapped according to the END (art. 2, art. 7 and art. 8). The aggregation of the single receiver values was necessary since the results presented as single points calculation would lack in statistical significance and because of the difficulty of drawing overall conclusions on large amount of values.

Results are aggregated in the following to represent:

ROAD

1) situation representative of countryside or open areas, where the light and heavy vehicles are combined to have an overall mixed traffic; this is repeated for flat terrain, depressed road and embanked road;

2) situation representative of urban areas, where the light and heavy vehicles are combined to have an overall mixed traffic; this is repeated for flat terrain, depressed road and embanked road;

3) specific outline of the differences for propagation on hilly terrain and around a short noise barrier.

RAILWAY

1) situation representative of countryside or open areas, where the different train types are combined to have an overall mixed traffic; this is repeated for flat terrain, depressed road and embanked road;

2) situation representative of urban areas, including a railway station, where the different train types are combined to have an overall mixed traffic; this is repeated for flat terrain, depressed road and embanked road;

3) specific outline of the differences for propagation on hilly terrain and around a short noise barrier.

INDUSTRIAL

1) situation representative of cross sections typical of large industrial plans, only for flat terrain;

2) specific outline of the differences for propagation on hilly terrain.

AIRCRAFT

1) situation representative of an average European major airport for straight departure;

2) situation representative of an average European major airport for turned departure;

3) situation representative of an average European major airport for straight approach.

The calculation points used in the indicators to assess the differences were treated as described in the following. Each calculated $L_{(A)eq\ (i,j,k)}$ was combined having in mind that:

- **i** identifies the i-th assessment point on the map;
- **j** identifies the j-th cross section, that has e.g.: different noise barriers and ground absorption values and different positions of the buildings;
- **k** identifies the k-th configuration, that has, e.g.: three variants for road and railway (flat terrain level, embankment and depressed), and one for industrial (only flat); two types of road traffic, five types of railway traffic. Configurations differ also for meteorological propagation, and one meteorological class is 100% favourable, corresponding to the night time when typical favourable propagating conditions occur. The other is 50% favourable and 50% homogeneous and it represents the daytime condition. Evening is included since it will be a mix of day and night time.

In the case of aircraft noise, three single maps (grids of values) exist for each relevant aircraft type, depending on the operation, thus in that case the analyses reduces to an homogeneous evaluation of all points of the grid.

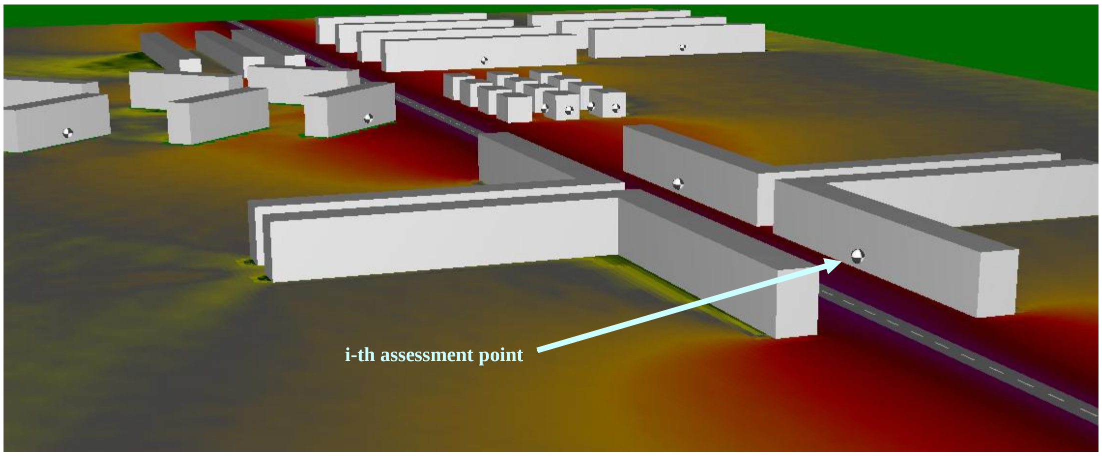


Figure 1
i-th assessment point, j-th cross section, k-th configuration for road in urban environment and flat terrain.

Since it was considered that the given configurations can by themselves constitute a set of complete and averaged set of combinations of source conditions, meteorological conditions and cross sections (including barriers, different buildings height and shapes and distance from the source), it was decided that all points of a specific configuration would be treated as equally weighting. Therefore, although at the beginning of the development of the protocols it was proposed to weight all points depending on their relevance (e.g., the weight of the points closer to the source will be greater of those far away from the source), it was later on decided to equally weight all points of a specific configuration. For what concerns the relevance tables that were proposed at the beginning of the exercise by the consultants to weight different configurations, these are respected and reflected in the combination of the configurations that is further reported and was used in this evaluation.
Result values were aggregated as described hereafter.

ROAD

a) Configurations including the same cross sections (and same height of source, i.e.: flat with flat, depressed with depressed, embanked with embanked) but different traffic type (light or heavy vehicles) were added energetically.
b) The results were grouped by different meteorological conditions (night = favourable, day and evening = homogeneous) to obtain L_{den} and L_{night} values at each single receiver position (note that if different configurations are including the same cross sections, then the receivers are located in the same position).
c) An evaluation of the differences between the interim results and the MS method results was performed on the L_{den} and L_{night} values as obtained after grouping following a) and b). Aggregated indicators were then obtained for the open situation, the urban situation and the hilly terrain and short noise barrier.
The procedure used to evaluate by means of the aggregated indicators expressing L_{den} and L_{night} differences and effects on the population distribution is explained in the next pages

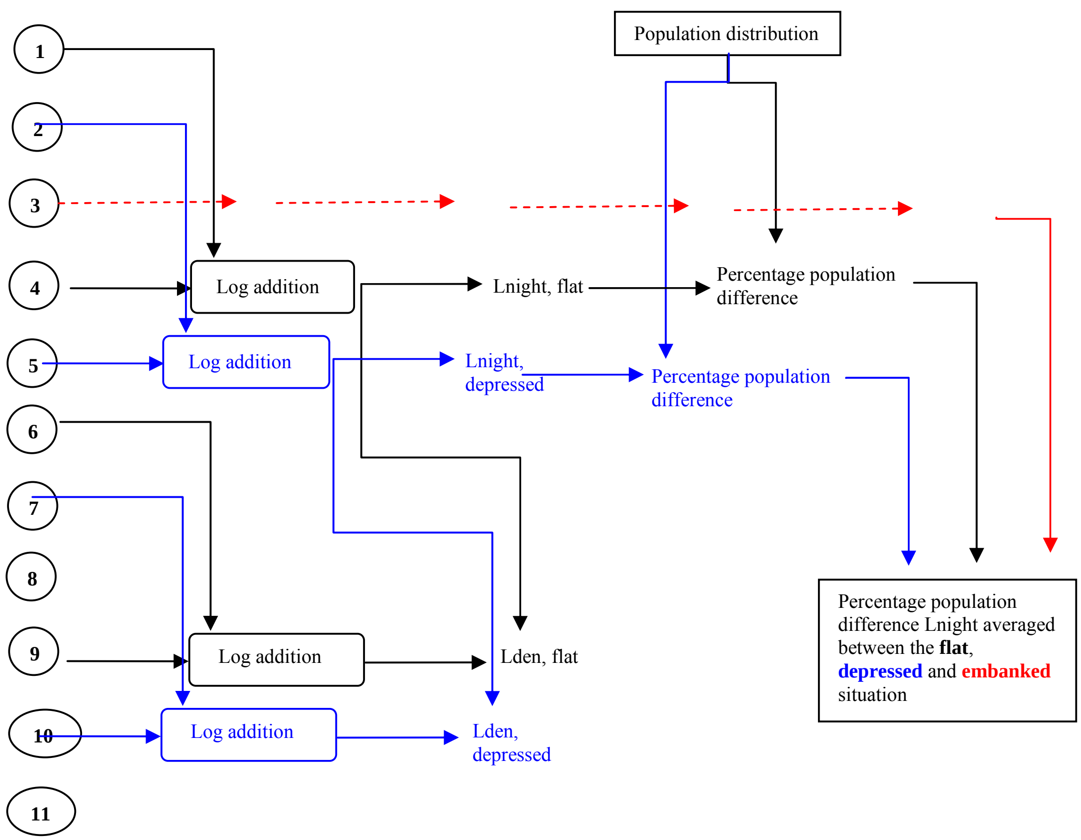


Figure 2.Scheme of the combination of the configurations for road

RAILWAY

a) Configurations including the same cross sections (and same height of source, i.e.: flat with flat, depressed with depressed, embanked with embanked) but different traffic type (different train types) were added energetically to obtain L_{den} and L_{night} values at each single receiver position.

b) An evaluation of the differences between the interim results and the MS method results was performed on the L_{den} and L_{night} values as obtained after grouping following a). Aggregated indicators were then obtained for the open situation, the urban situation including the railway station and the hilly terrain and short noise barrier.

INDUSTRIAL

a) Configurations were grouped by different meteorological conditions (night = favourable, day and evening = homogeneous) to obtain L_{den} and L_{night} values at each single receiver position.

b) An evaluation of the differences between the interim results and the MS method results was performed on the L_{den} and L_{night} values as obtained after grouping following a). Aggregated indicators were then obtained for a single averaged case and in addition for the hilly terrain.

AIRCRAFT

a) Configurations calculated for different aircrafts but under the same procedure (straight departure, turned departure, landing) were grouped considering the number of movements of each aircraft type to obtain a set of three maps representing straight departure, turned departure and landing.

The equivalence exercise is based on three indicators (that were presented to MS during the Noise Regulatory Committee meeting of the 7th of May 2008) which evaluate the following three differences:

1. ***Weighted percentage of $L_{national\ method}$*** at single assessment points which fall outside the error boundaries estimated by using different software.

2. ***Overall averaged difference L_{Δ}*** (considering the error boundaries estimated by using different software and allowing possible compensations between points where the difference $L_{interim} - L_{national\ method}$ is positive and points where the same difference is negative within the same noise band).

3. ***Percentage differences of people exposed*** to the several bands: 25-30 $p_{25\text{-}30}$, 30-35 $p_{30\text{-}35}$, 35-40 $p_{35\text{-}40}$, 40-45 $p_{40\text{-}45}$, 45-50 $p_{45\text{-}50}$, 50-55 $p_{50\text{-}55}$, 55-60 $p_{55\text{-}60}$, 60-65 $p_{60\text{-}65}$, 65-70 $p_{65\text{-}70}$, 70-75 $p_{70\text{-}75}$, >75 $p_{>75}$.

The assumptions under which the indicators can be used are the following:

- the noise maps performed under the END requirements are run on a very large number of cross sections, therefore the number of buildings affected by different noise levels can be assumed to be a continuous function of the levels (also, this corresponds to the fact that a shift in the noise contours will continuously increase/decrease the number of buildings affected);
- the people are attributed to the same buildings regardless of the noise mapping method adopted, and therefore if the new method attributes higher values to that building all population therein present will be exposed to these new values;
- the number of people affected by noise levels and living in the buildings is very large (and therefore it is possible to assume that it is continuously distributed among buildings).

Under the aforementioned assumptions, the following can be assumed:

- a shift in the noise levels at a given position due to different method will produce as an effect the shift of a certain amount of people from one class to another one;
- the shift in bands of a certain amount of people from the i-th band with $\mathbf{X_i}$ people exposed in this band to the j-th band with Xj people exposed in this band can be approximated under the hypothesis of continuous distribution of buildings and people in buildings.

The following are the indicators used and based on the previous assumptions:

- **Indicator number 1** intends to measure the order of magnitude of the number of points being most probably distant from the values calculated using the interim method. This is expressed as:

$$\Delta_{\%,average} = \frac{1}{N_{points}} \sum_{i,j,k} \Delta_{\%,i,j,k}$$

Where:

$$\Delta_{\%,i,j,k} = 100 * \left(1 - \frac{PDF_{i,j,k}(L_{(A),eq,MS\,(i,j,k)})}{PDF_{i,j,k}(L_{(A),eq,\text{interim}\,(i,j,k)})} \right)$$

and where in the last equation a sort of "weighting" is introduced using the PDF (Normal Probability Density Function determined by the mean and standard deviation obtained for each point by the different values calculated by the software). Originally it was assumed only to count those points falling outside the interval $L_{(A),\ eq,\ interim,\ i,j,k}$ +/- $2\sigma_{i,j,k}$, where $\sigma_{i,j,k}$ is the standard deviation obtained as:

$$\sigma_{i,j,k} = \sqrt{\frac{1}{n_{software}} \sum_{\eta=1}^{n_{software}} \left(L_{\eta,i,j,k} - \overline{L_{i,j,k}} \right)^2}$$

This was a workaround to consider the software uncertainty while evaluating differences between the methods results. But it was noticed that a continuous approach would be preferable not to discriminate too roughly between points falling just outside or just inside the boundaries. Therefore, the averaging by means of a normalised Probability Distribution Function that weight the distance between the MS value and the interim value was used. This way, the indicator's value can be between 0 and 100%, however, being very close to 0 if the MS value laid not too far from the interim including the software uncertainty, while easily approaching 100% in case most of the MS values would be very far from the interim values.

In the following figure the differences between calculated levels and sigma are schematically shown.

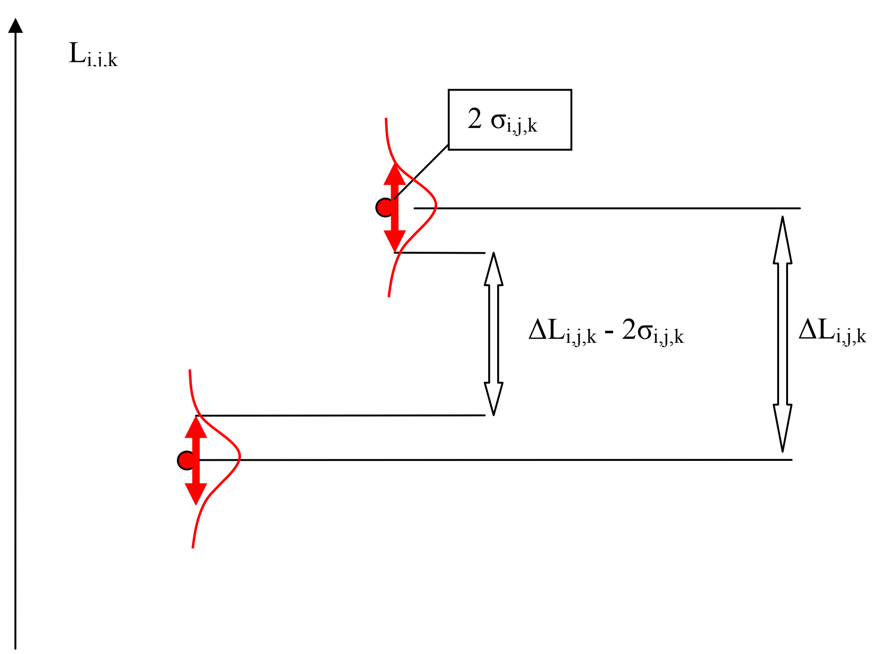


Figure 3
Differences in calculated levels and standard deviation due to software implementation

- **Indicator number 2** counts the average difference for the values falling in a specific 5 dB band for all the points and each grouped condition as explained previously in this chapter. It is expressed as:

$$\Delta_{\lambda-band} = \frac{1}{n}\sum_{n}\left(1-\frac{PDF_{i,j,k}(L_{(A),eq,MS(i,j,k)})}{PDF_{i,j,k}(L_{(A),eq,\text{int}\,erim(i,j,k)})}\right) * \left(L_{(A),eq,MS(i,j,k)} - L_{(A),eq,\text{int}\,erim(i,j,k)}\right)$$

- **Indicator number 3** uses the indicator number 2 and a specific population distribution (presented in figure 4), obtained from an averaging of data reported under the END requirements for major sources.

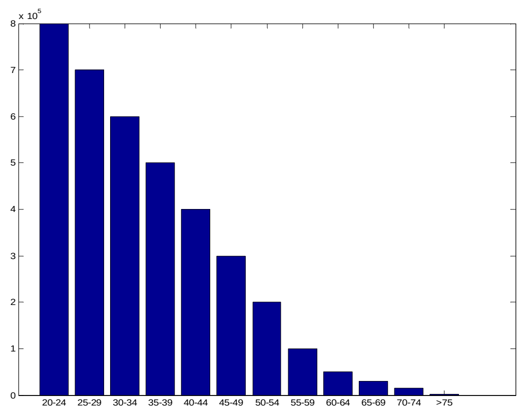


Figure 4
Reference number of people exposed to different noise levels between 20 dB L_{den} and more than 75 dB L_{den}.

By assuming that the population is still distributed in the same dwellings, the new population distribution between 5 dB band classes with the MS method was reconstructed from the following interpolating functions defined on intervals:

$$x = Pd(L) = \begin{cases} for\ L_k \le L < L_i & \\ for\ L_i \le L < L_j & \longrightarrow \dfrac{x_j - x_i}{\Delta band}\cdot(L - L_i) + x_i \\ for\ L_j \le L < L_\gamma & \longrightarrow \dfrac{x_\gamma - x_j}{\Delta band}\cdot(L - L_j) + x_j \\ for\ ... & \end{cases}$$

$$x' = Pd'(L) = \begin{cases} for\ L_k + \Delta_k \le L < L_i + \Delta_i & \\ for\ L_i + \Delta_i \le L < L_j + \Delta_j & \longrightarrow \dfrac{x_j - x_i}{\Delta band}\cdot(L - L_i - \Delta_i) + x_i \\ for\ L_j + \Delta_j \le L < L_\gamma + \Delta_\gamma & \\ for\ ... & \end{cases}$$

$$X_i' = \int_{L_i - \frac{\Delta_b}{2}}^{L_i + \frac{\Delta_b}{2}} x \cdot dL = \left\{ \left[\frac{x_j - x_i}{\Delta band} \left(-\Delta_i - L_i \right) + x_i \right] \cdot L + \left(\frac{x_j - x_i}{\Delta band} \right) \frac{L^2}{2} \right\}_{L_i + \Delta_j}^{L_i + \Delta band/2}$$

$$+ \left\{ \left[\frac{x_i - x_k}{\Delta band} \left(-\Delta_k - L_k \right) + x_k \right] \cdot L + \left(\frac{x_i - x_k}{\Delta band} \right) \frac{L^2}{2} \right\}_{L_i - \Delta band/2}^{L_i + \Delta_j}$$

where:

x = population density function (Pd) per dB of the assumed reference population distribution: the function is defined on subsequent intervals as a line equation being obtained from interpolation of points; the reference x_i are obtained from the integral of the number of people exposed to the i-th 5 dB noise band, which is the bandwidth;

x' = population density function (Pd') per dB of the population derived with the MS calculated values;

X_i'=population attributed to the i-th band if using the MS calculation method;

Δ_{band}=5 (the width of a band, e.g.: 55-60 dB);

Δ_i=overall averaged difference (indicator 2) corresponding to the i-th band;

L_i=i-th central band level (e.g.: for 55-60 dB band it is 57.5 dB).

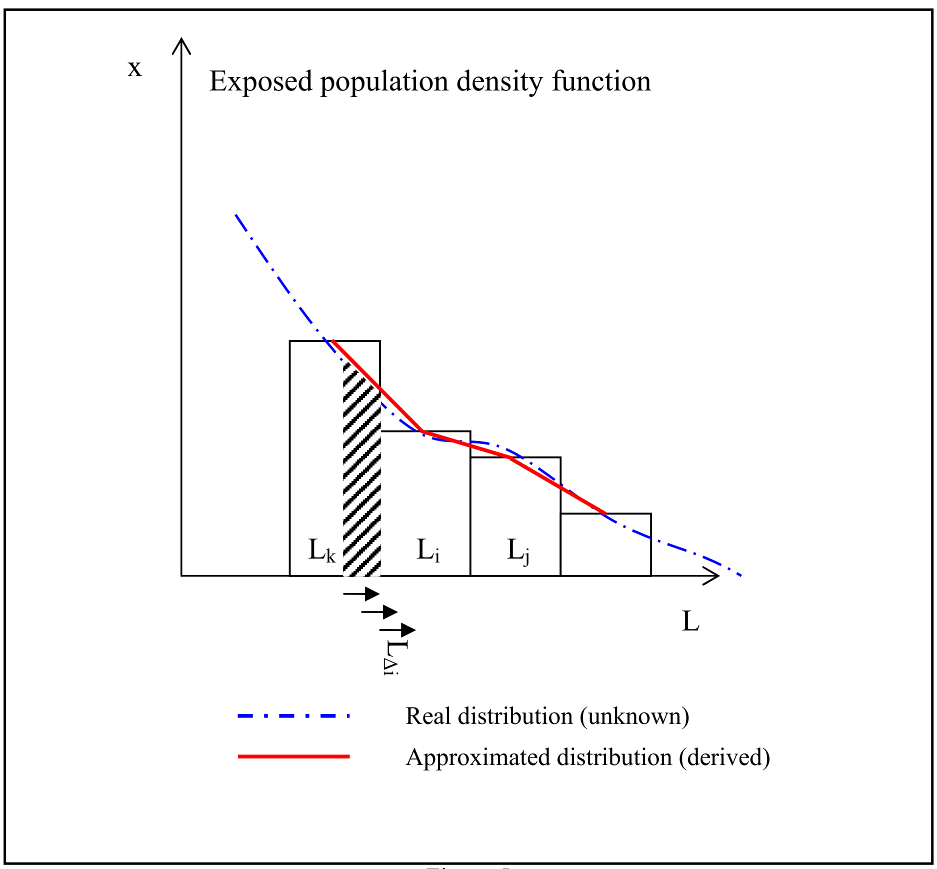


Figure 5
Continuous (real) and discrete (approximated) population distribution with levels and difference in population estimation due to different assessment methods

The ***percentage difference between the MS and the interim method of population exposed*** to noise in each of the i-th bands (p_i) will then be:

$$p_i = \frac{X'_i}{X_i} * 100$$

where:

X_i=population attributed to the i-th band if using the interim calculation method.

7. RESULTS

7.1 ANALYSIS OF THE DISTRIBUTION OF STANDARD DEVIATION PER dB RANGE

The distribution of the standard deviation per dB class is an indicator obtained as follows:

1) for each given assessment point in each configuration the results obtained by means of the different software used are compared, and a standard deviation is obtained using the following common expression (standard deviation), where the L_i is the level obtained using the i-th software and the $\overline{L}$ is the average level:

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(L_i - \overline{L}\right)^2}$$

2) the different assessment points are grouped together depending on the calculated standard deviation at the assessment points in 1 dB wide bands. This allows having an overview of the expected deviations within the specific configuration. It should be remarked that at this stage of the analysis, the traffic conditions, the differences due to meteorological conditions and the terrain height are not weighted. Therefore, this distribution of standard deviation is used to have an overview of the range of deviations that such a combination of configuration and cross section is expected to result due to software implementation of the interim method. The more the deviations cumulate under low standard deviation values σ, the easier it will be to identify differences due to software implementation only. So, ***only when this analysis presents a large number of assessment points with high standard deviation it can be concluded that the software implementation might overshadow the differences between two calculations performed with two different methods***.

If, on one hand, the distribution of the standard deviation per dB class is one of the two parameters that should be carefully considered to understand how different software implementations of the same method could lead to different results in the exercise of noise mapping, on the other, the different standard deviation as a function of the cross section allow identifying the most difficult cases to model. In the following chapter 7.2 the standard deviation as a function of the cross section is discussed.

It should be first reported that, to consider it relevant to the purpose of the statistical analysis, the cross sections proposed in the context of the protocols should be considered as representative of the possible existing cross sections that could be find in real situations. For the moment, there is no mean to establish whether the cross sections prepared for the purpose of the equivalence exercise are a good estimation of the real situations. In any case, these cross sections were prepared after discussions with noise mapping specialists, and there was a consensus on the fact that a combination of these cross sections constitutes most of the possible real cross sections.

ROAD

In the case of standard deviations between different software calculations for **road traffic noise**, it can be considered that for most assessment points this is lower than 2-3 dB. It is then expected that differences in methods lower than 2 dB between the interim and the MS method will be overshadowed by the software implementation. Hilly terrain is well modelled and short noise barriers as well, therefore in that case differences in the calculation method will be evident.

Configuration / Level considered	Flat Lnight	Flat Lden	Depressed Lnight	Depressed Lden	Embanked Lnight	Embanked Lden
Standard deviation						
0-1	51	51	18	18	32	32
1-2	48	48	38	38	52	52
2-3	3	3	34	34	17	17
3-4	0	0	9	9	1	1
4-5	0	0	0	0	0	0
5-6	0	0	2	2	0	0
6-7	0	0	1	1	0	0
7-8	0	0	0	0	0	0
8-9	0	0	0	0	0	0
9-10	0	0	0	0	0	0
10-11	0	0	0	0	0	0

Table 1
Road, open situation, number of points falling in different dB standard deviation ranges.

Configuration / Level considered	flat Lnight/Lden	depressed Lnight/Lden	embanked Lnight/Lden
Standard deviation			
0-1	23	14	18
1-2	28	17	21
2-3	8	20	12
3-4	0	8	8
4-5	0	0	0
5-6	0	0	0
6-7	0	0	0
7-8	0	0	0
8-9	0	0	0
9-10	0	0	0
10-11	0	0	0

Table 2
Road, urban situation (since there is no meteo difference between night and day the same values are obtained for Lden and Lnight) , number of points falling in different dB standard deviation ranges.

Assessment point	**Standard deviation**
01P19	1.4
02P19	1.4
03P19	1.8
04P19	1.6
05P19	0.2
06P19	0.2
07P19	0.1
08P19	0.1
09P19	0.1

Assessment point	**Standard deviation**
10P19	0.1
11P19	0.2
12P19	0.2
13P19	0.2
14P19	1.1
15P19	0.2
16P19	0.5
01Q19	0.1
02Q19	0.1
03Q19	0.2

Table 3
Road, hilly and short noise barrier, dB standard deviation.

RAILWAY

In the case of standard deviations between different software calculations for **railway traffic noise**, it can be considered that for most assessment points this is lower than 2-3 dB in the urban and in the railway station situations, while, for the open situation large differences were encountered. It is then expected that differences lower than 2 dB between the interim and the MS method will be overshadowed by the software implementation both for the urban situation and the open situation. Hilly terrain is well modelled and short noise barriers as well, therefore in that case differences in the calculation method will be evident.

Configuration / Level considered	flat Lnight/Lden	depressed Lnight/Lden	embanked Lnight/Lden
Standard deviation			
0-1	11	12	10
1-2	32	25	18
2-3	17	25	10
3-4	3	4	24
4-5	3	0	2
5-6	0	0	2
6-7	0	0	0
7-8	0	0	0
8-9	0	0	0
9-10	0	0	0

Table 4

Railway, open situation, number of points falling in different dB standard deviation ranges.

Configuration / Level considered	flat urban Lnight/Lden	depressed urban Lnight/Lden	embanked urban Lnight/Lden	flat station Lnight/Lden	depressed station Lnight/Lden	embanked station Lnight/Lden
Standard deviation						
0-1	20	4	14	6	10	3
1-2	19	11	11	5	4	1
2-3	4	26	7	3	0	5
3-4	3	5	14	0	0	5
4-5	0	0	0	0	0	0
5-6	0	0	0	0	0	0
6-7	0	0	0	0	0	0
7-8	0	0	0	0	0	0
8-9	0	0	0	0	0	0
9-10	0	0	0	0	0	0

Table 5

Railway, urban situation and railway station, number of points falling in different dB standard deviation ranges.

Assessment point	**Standard deviation**
01M19	1.4
02M19	1.7
03M19	1.6
04M19	1.8
05M19	1.6
06M19	1.8
07M19	1.5
08M19	1.7
09M19	1.5

Assessment point	**Standard deviation**
11M19	1.8
12M19	1.6
13M19	1.4
14M19	2.0
15M19	3.2
16M19	1.8
01N19	2.5
02N19	2.0
03N19	1.9

Table 6

Railway hilly and short noise barrier, dB standard deviation.

INDUSTRIAL

In the case of standard deviations between different software calculations for **industrial sites**, it can be considered that for most assessment points this is lower than 2-3 dB. It is then expected that differences lower than 2 dB between the interim and the MS method will be overshadowed by the software implementation. Hilly terrain also presents the same range of standard deviations, thus the conclusion drawn for all other positions holds also in this case.

Configuration / Level considered	Lnight	Lden
Standard deviation		
0-1	18	18
1-2	11	11
2-3	9	10
3-4	7	6
4-5	0	0
5-6	0	0
6-7	0	0
7-8	0	0
8-9	0	0
9-10	0	0

Table 8
Industrial site, number of points falling in different dB standard deviation ranges.

Assessment point	**Standard deviation**
01I3	3.3
02I3	2.8
03I3	2.3
04I3	1.3
05I3	1.0
07I3	1.0
08I3	1.2
09I3	2.3
10I3	4.3
11I3	4.6

Assessment point	**Standard deviation**
01I3	1.8
02I3	1.6
03I3	1.5
04I3	1.3
05I3	1.0
07I3	1.0
08I3	1.2
09I3	1.5
10I3	3.0
11I3	3.1

Table 9
Industrial site with hilly terrain around, dB standard deviation.

AIRCRAFT

For **aircraft traffic noise**, the situation is rather different: three different software all three implementing the interim calculation method, however, two of them use the Austrian-German database and the third one uses the INM 6.1 database.

Differences in the areas of the different bands are therefore not only a result of the software implementation (which is most likely only the first type of difference) but a result of the database of input values used as well. It was decided therefore, instead of giving tables or 3-D graphs of the standard deviation, to present graphs of differences per 5 dB bands per each possible configuration (according to the Austrian-German aircrafts classification a grouping was necessary, and 7 classes of aircrafts were analysed, see table 10).

INM 6.1	Austrian-German
DHC830	P 2.1
BAE300	S 5.1
EMB14L	
F10065	
737300	S 5.2
737400	
737500	
737700	
737800	
757RR	
A319	
A320	
A32123	
MD82	S 5.3
MD83	
767300	S 6.1
777300	
A340	S 6.3
747400	S 7

Table 10
The table presents the correspondence between the INM 6.1 aircraft classification and the Austrian German classification.

Plots of these differences are presented in annex 8. An example is given in figure 1. The bars represent the rate of the area change between:

A - interim method + software 1 + Austrian-German database
and
B - interim method + software 2 + Austrian-German database
and
C - interim method + software 3 + INM 6.1 database

Software 1 is taken as the reference, then the **blue** bars represent the areas ratio:

B / A

and the **red** bars represent the ratio:

C / A

In the example given it can be noticed that for most of the mapped area the two software implementing the interim method and using the same database do match very well. The last two 5 dB bands (corresponding to higher noise levels) are generally not to be considered since they correspond to the levels in very small areas close by to the runway.

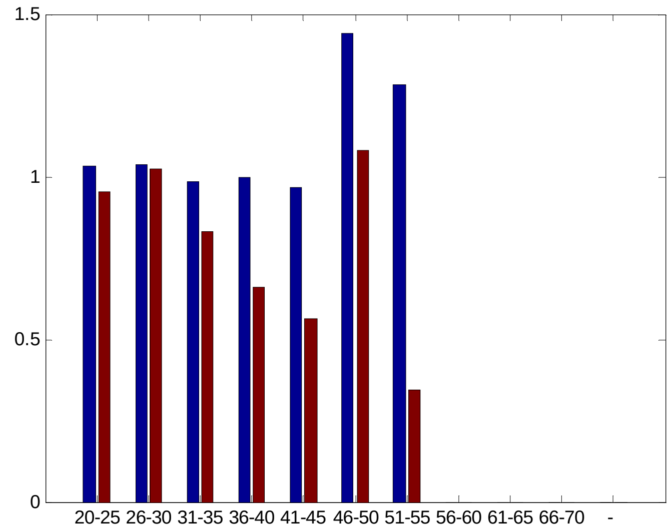


Figure 1
Bars representing the differences in between the area estimated to be subject to the noise levels specified. In blue difference between two software using the same input values database, while in red differences for two software using two different input values database.

7.2 DISTRIBUTION OF STANDARD DEVIATION FOR EACH ASSESSMENT POINT

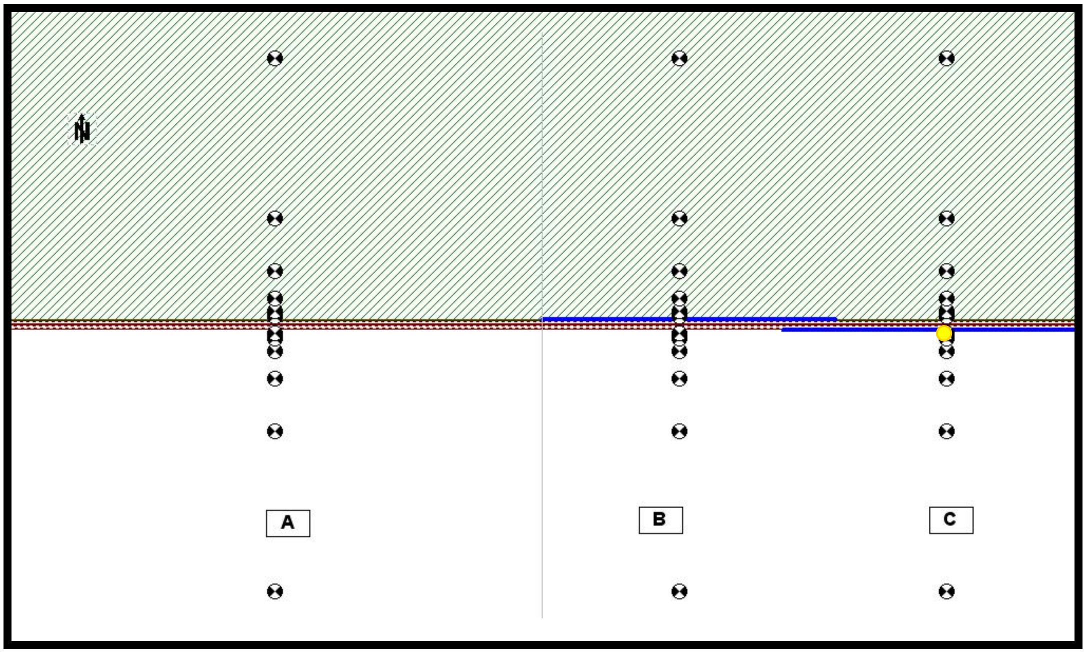
In this chapter an overview is given of the receiver positions which give larger differences between the different software implementations in those aggregated situations summarised at the beginning of this chapter (i.e.: 3 for road traffic noise, 3 for railway traffic noise, 2 for industrial noise and 3 for aircraft noise).

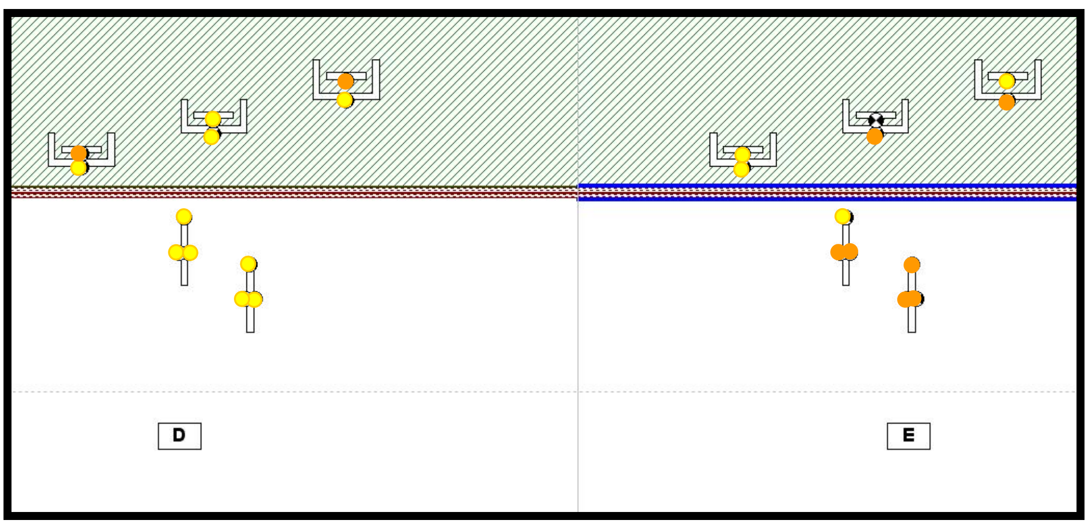
In order to reduce the number of graphs, among the most relevant situations only one (i.e. the flat one for road noise, L_{den}) is presented here as an example. L_{night} values, depressed and embanked situation data as well as data on railway and industrial noise are only discussed. The corresponding values can be anyway viewed in the attached tables that include all calculated values and standard deviations for each assessment point in each configuration. Please refer to the CD-Rom attached to this report.

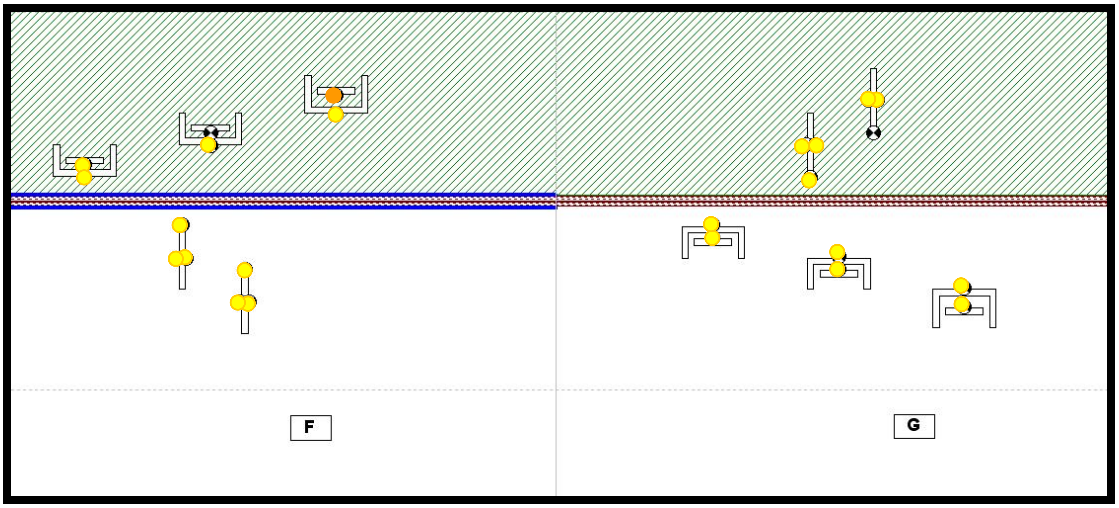
ROAD EXAMPLE ON FLAT TERRAIN

In the following figures, points in yellow present a software implementation standard deviation between 1 and 2 dB, points in orange between 2 and 3 and points in red more than 3 dB. All uncoloured points showed standard deviations of less than 1 dB.

As it can be seen, the different software implementations lead to standard deviations higher than 2 dB at locations mostly if noise barriers are present and in the case of buildings reflections. This result is also reported for other situations, and it seems reasonable to conclude that barriers are the most critical parameters to consider in looking at software differences, still relevant but a bit less critical are the reflections and screening of buildings. Propagation in a free field is absolutely consistent among existing software.



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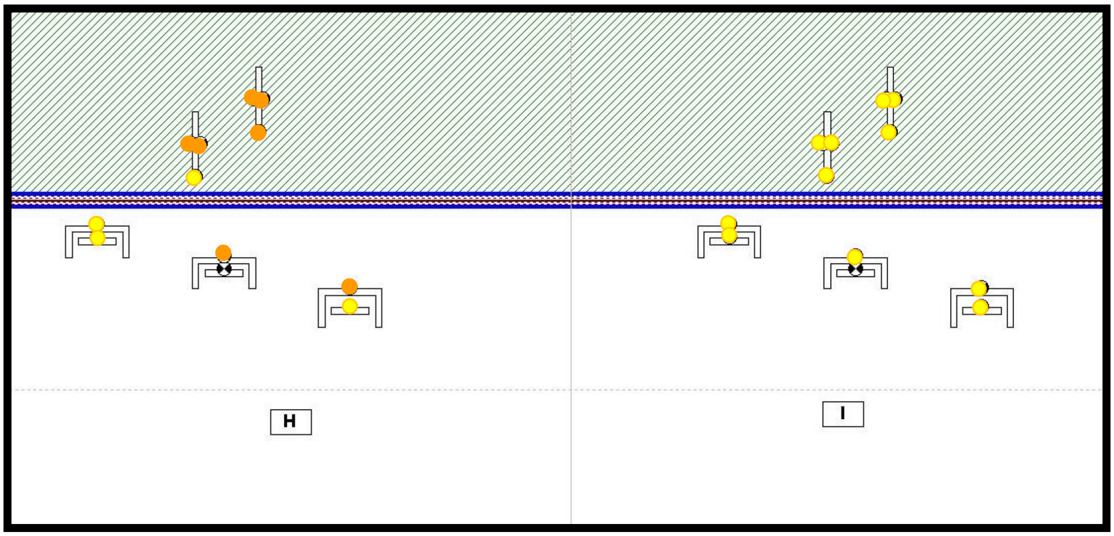
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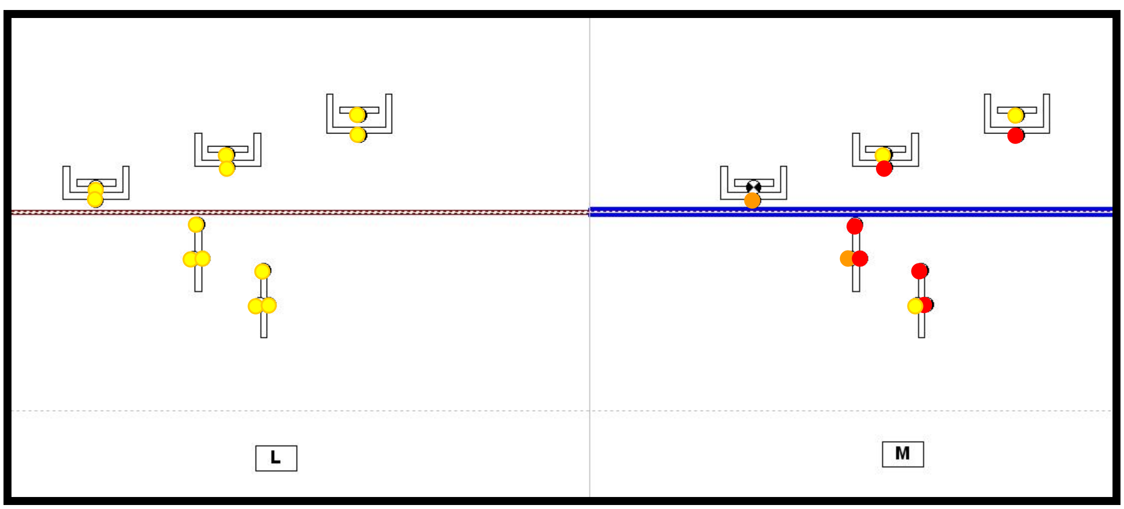
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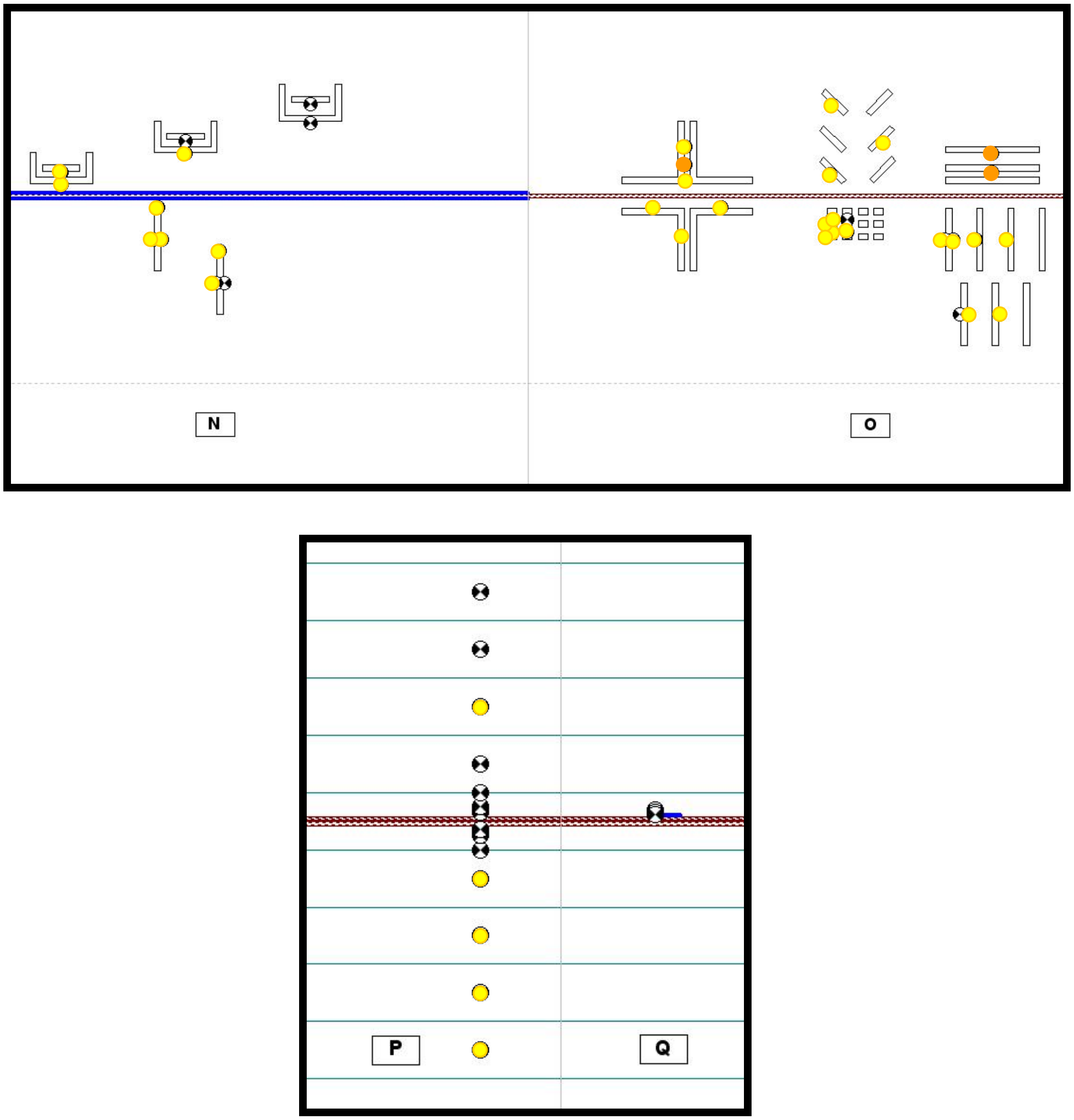


Figure 2-8
Plots of the road cross sections for flat terrain. In yellow the points which standard deviation was found between 1 and 2 dB, in orange between 2 and 3 dB, and in red more than 3 dB.

Analysis of aircraft noise is also presented, although, in the case of aircraft noise, it was already noticed that the input values database gave large differences between the same method implementation and not the implementation of the interim method in the software. From the graphs in annex 8 it can be seen, in any case, that the standard deviation is expected to be rather low between two different software implementations. (It should be anyway kept in mind that in this case it is a result of only two calculation samples per each assessment point). An example of the points where the standard deviations were observed to be large is given in figures 9 to 11. Here, the standard deviation of the two software implementing the interim method together with the Austrian – German database is given for aircrafts of the Group S 5.2 of the Austrian – German database, corresponding to configurations 13 to 39 in the JRC protocols. The standard deviations are very high only on and around the runway, where the calculated values are anyway not relevant to the purpose of the Environmental Noise Directive. It is instead relevant the case of turned departure, where the two software differ not much in the overall area covered by different noise levels (see figure 8 in annex 8), but in the specific positions where these noise levels are calculated. For straight departure (Figure 9) and approach (Figure 11) the two software are in very good agreement.

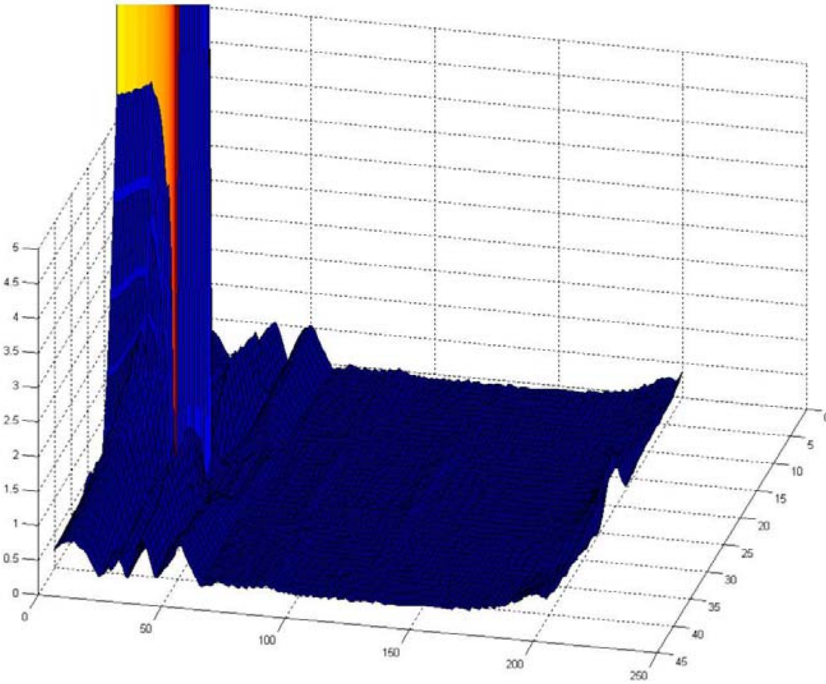


Figure 9
Plots of the standard deviation between two methods implementing the interim method and the Austrian – German database for straight departure group. X and Y axis represent the assessment point number, Z the standard deviation.

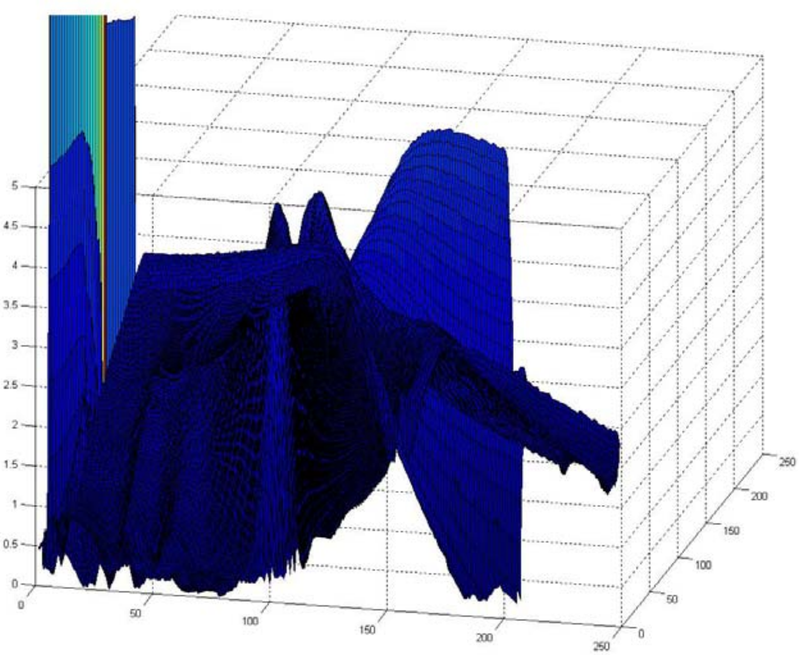


Figure 10
Plots of the standard deviation between two methods implementing the interim method and the Austrian – German database for turned departure. X and Y axis represent the assessment point number, Z the standard deviation.

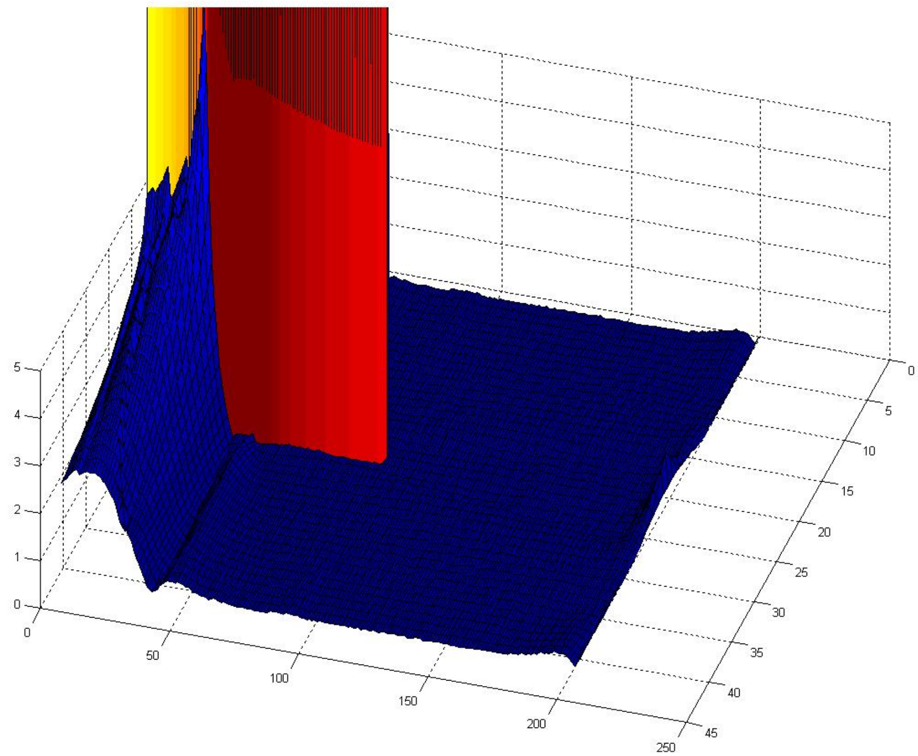


Figure 11
Plots of the standard deviation between two methods implementing the interim method and the Austrian – German database for approach. X and Y axis represent the assessment point number, Z the standard deviation.

8. GENERAL CONCLUSIONS

Only one National method (i.e., Swedish for industrial noise) was found to give overall equivalent results to the corresponding interim method. However, good matching between the national methods and the interim methods were also found in a few cases for specific situations. Unfortunately, even for these situations, it was impossible to draw general conclusions since the tests performed were only considering a very limited number of simple situations. JRC stresses the fact that this is not sufficient for concluding about the equivalency on the results, because noise mapping methods are to be applied for real situations which both include long distances and complex cross sections as those reflected by the JRC protocols. These situations were not considered by any MS.

Given the non implementation of the JRC protocols by the MS, the analysis performed by JRC could only focus on the implementation of the interim methods in different software. This revealed that differences in software implementation might not be always negligible, however no assessment could be made for the part of the differences among the national methods and the interim ones that could be attributed to the intrinsic features of the methods themselves and not to the software implementation.

A specific attention should be paid to aircraft noise calculation methods, since they are including a database as part of the method which is clearly expected to determine large variations between different implementations of a given method.

MS were in general against proving equivalence of the results, unless the equivalence is interpreted as that the same parameters are considered. MS attempted to claim that their methods were developed for their own country, therefore, it was not possible to apply a foreign method that did not consider the specificity of this country (e.g.: national infrastructure).

Except for a few MS that explicitly declared the non-equivalence of their results against the interim methods, most of the MS did not provide enough information to allow assessing whether their national methods are equivalent to the interim ones. In practical terms, this can be considered as non-compliance with the European Noise Directive (END) requirements under art. 6.

The following table outlines the status of compliance of the MS with the art. 6 of the END: (a) compliant (green); (b) non-compliant (red); (c) status of compliance impossible to determine (yellow).

Member State	Road traffic noise	Rail traffic noise	Air traffic noise	Industrial noise
AT				
BE (Bruxelles)				
BE (Flanders)				
BE (Wallonia)				
BG				
CY				
CZ				
DE				
DK				
EE				
EL				
ES				
FI				
FR				
HU				
IE				
IT				
LT				
LU				
LV				
MT				
NL				
PL				
PT				
RO				
SE				
SK				
SI				
UK				

Annex 1

Estonian reply and studies are in the attached CD-Rom.

Annex 2

Finnish replies and studies are in the attached CD-Rom.

Annex 3

Hungarian reply and studies are in the attached CD-Rom.

Annex 4

Italian reply and studies are in the attached CD-Rom.

Annex 5

Swedish reply and studies are in the attached CD-Rom.

Annex 6

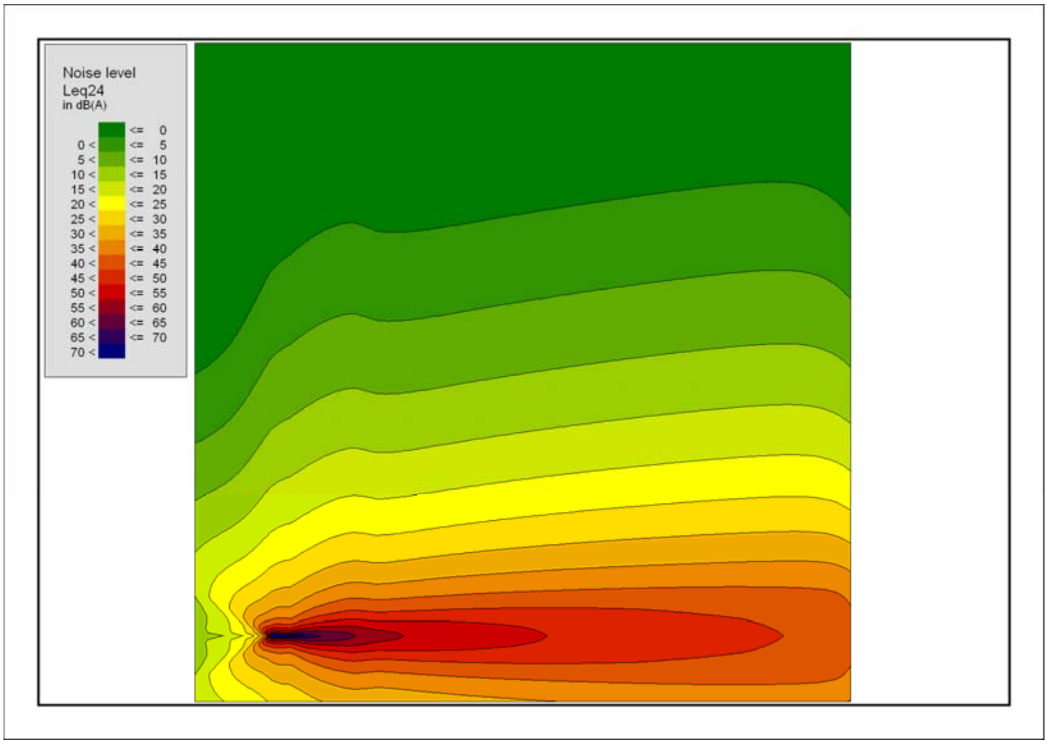
Slovakian studies are in the attached CD-Rom.

Annex 7

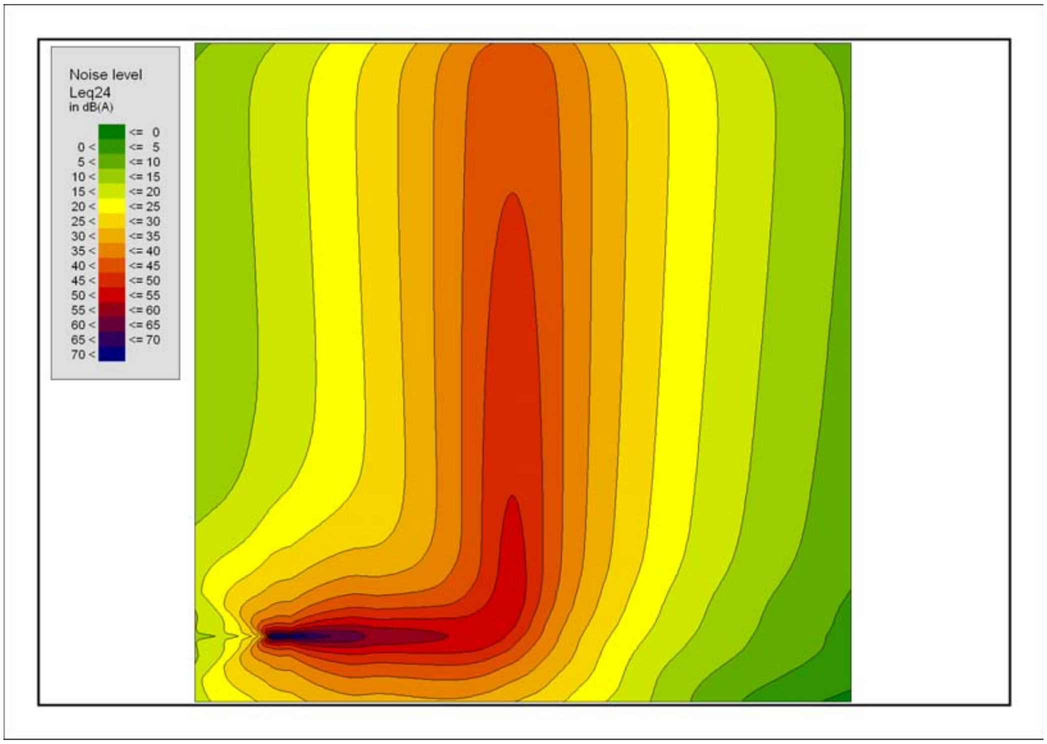
United Kingdom's reply and studies delivered on 12th of September 2008 are in the attached CD-Rom.

Annex 8

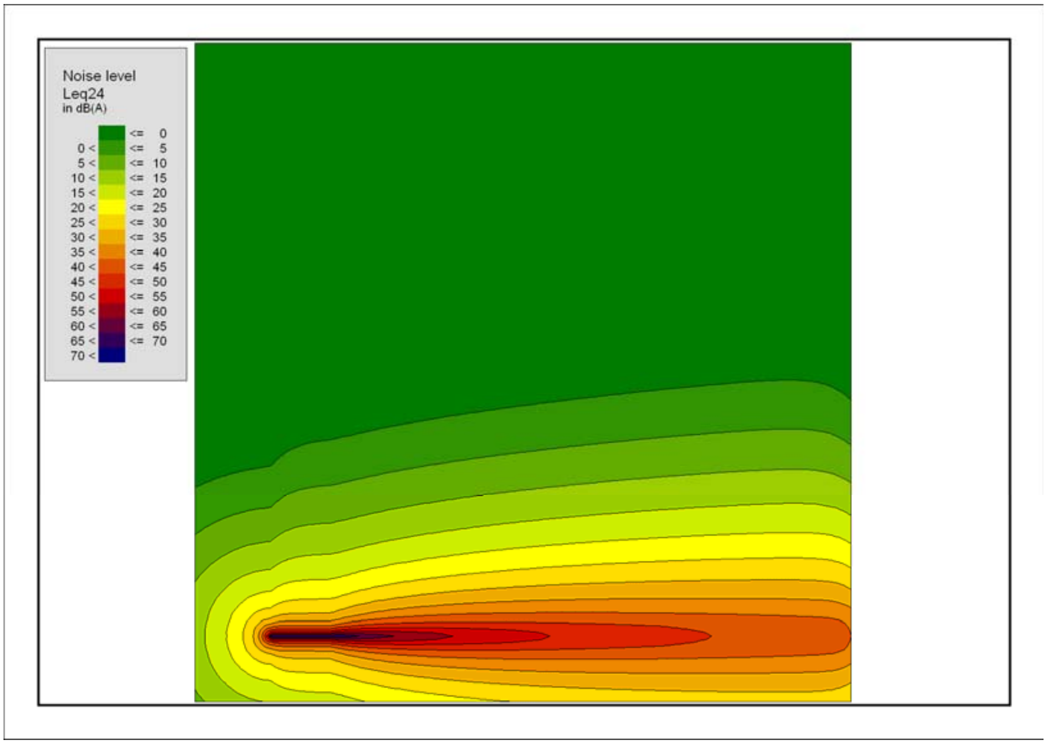
Aircraft noise calculations – Plots of the 5 dB noise contours using the interim method and the Austrian - German database suggested in the Commission Recommendation of the 6 August 2003.



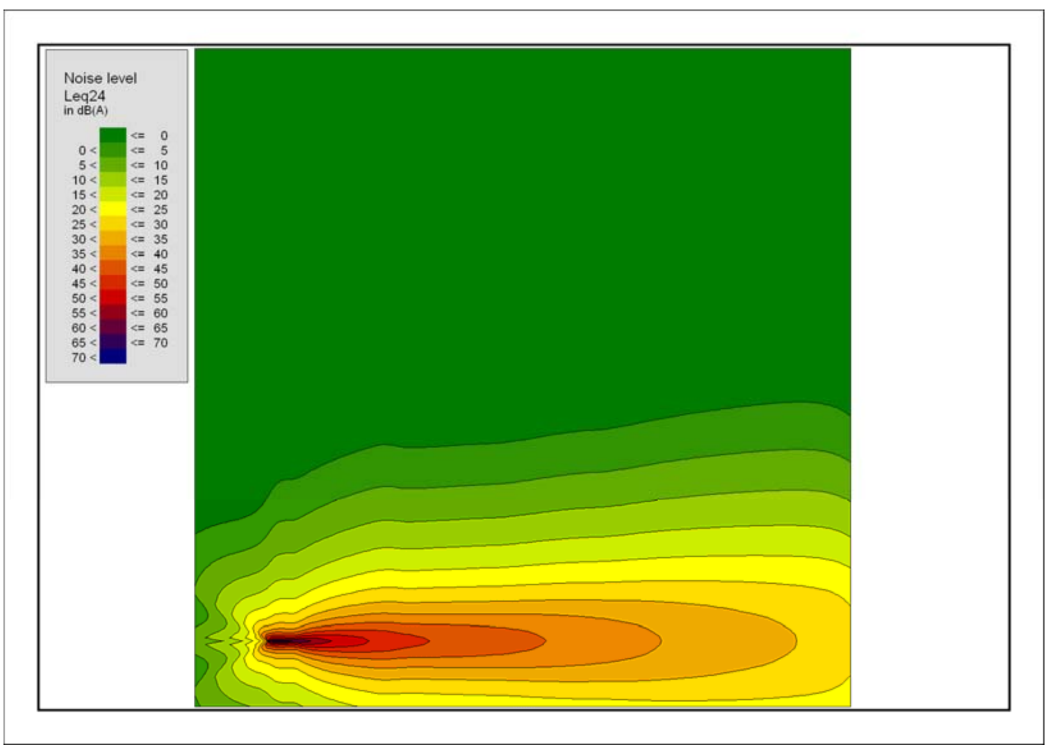
Specific configuration N. 1



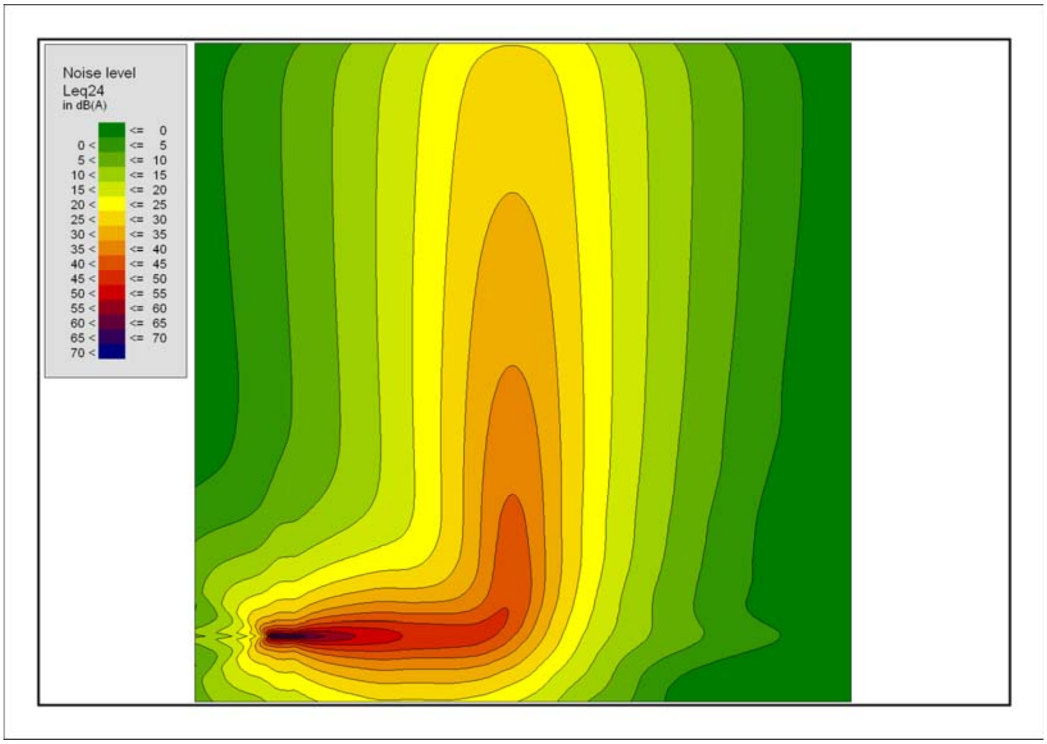
Specific configuration N. 2



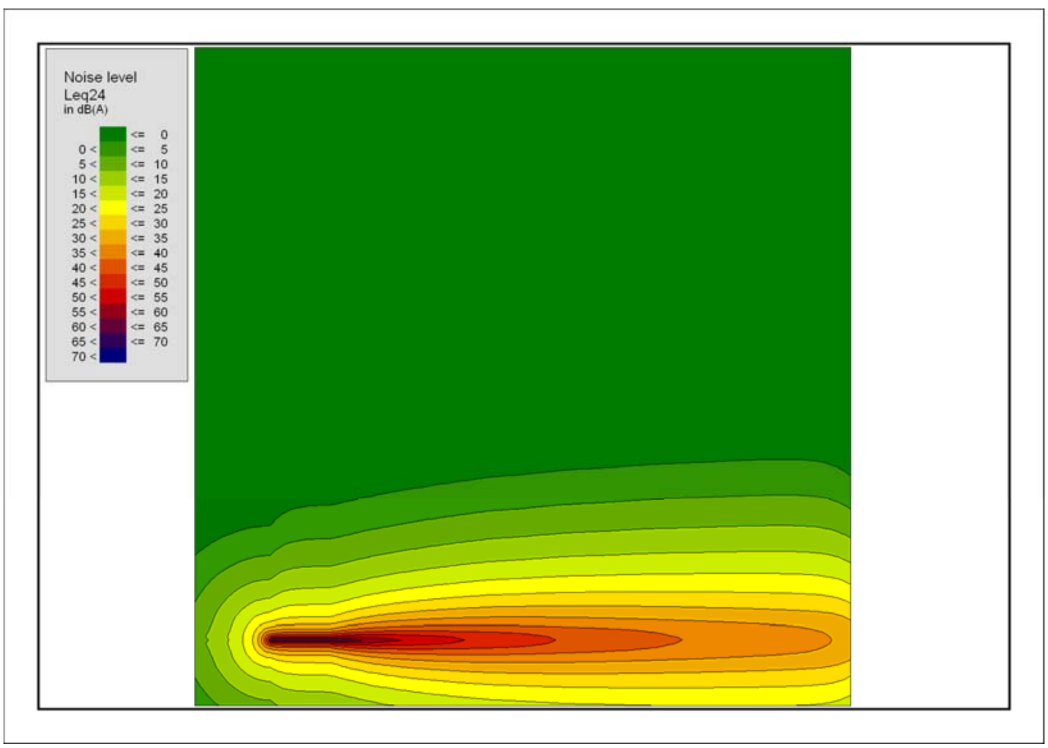
Specific configuration N. 3



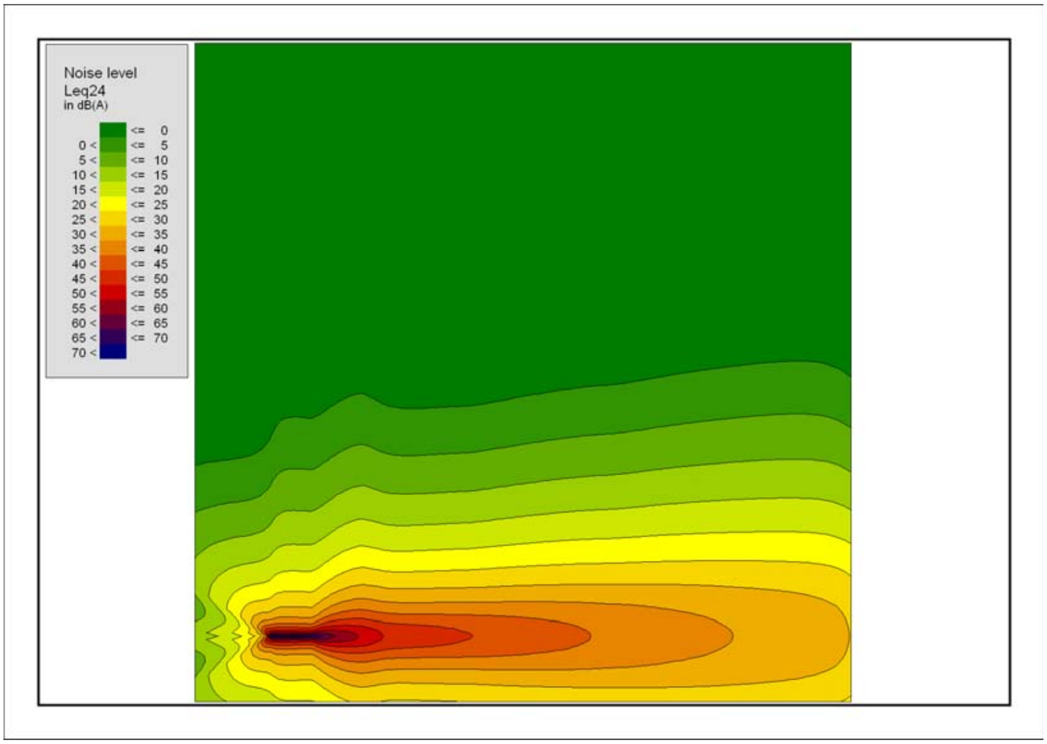
Specific configuration N. 4-7-10



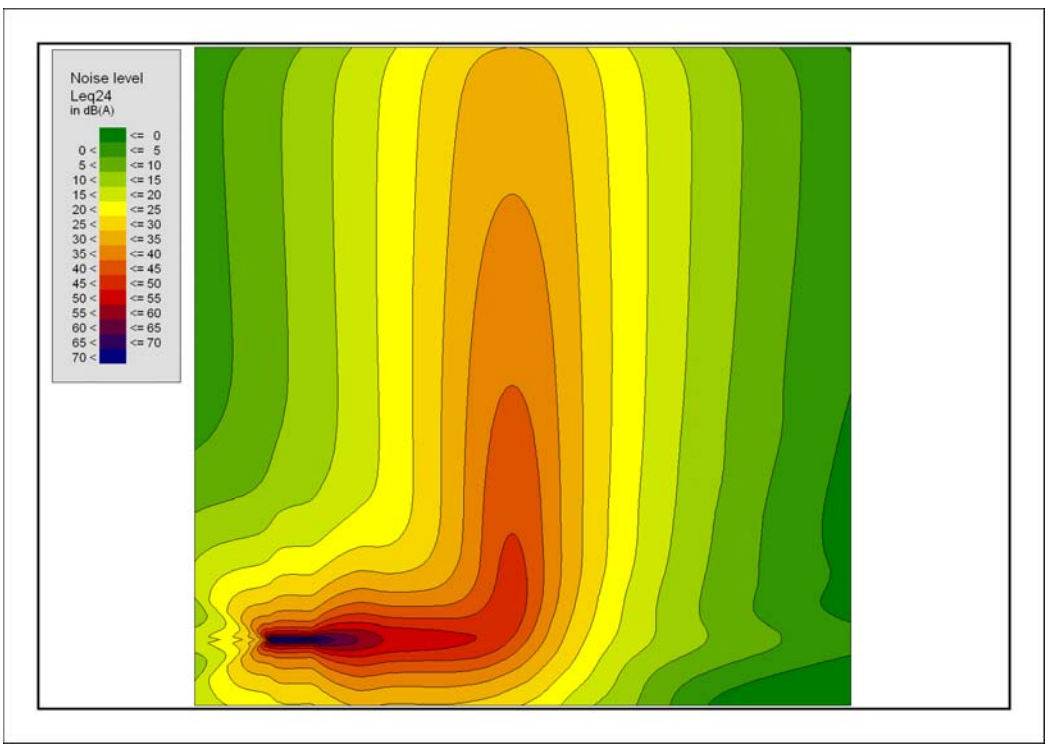
Specific configuration N. 5-8-11



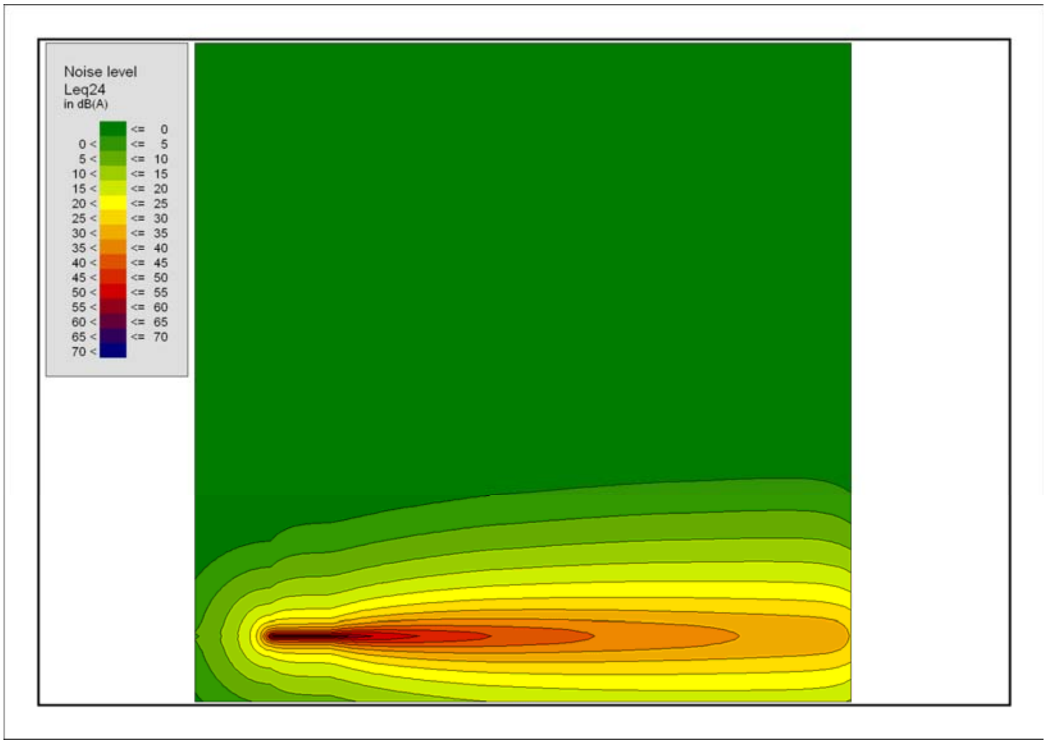
Specific configuration N. 6-9-12



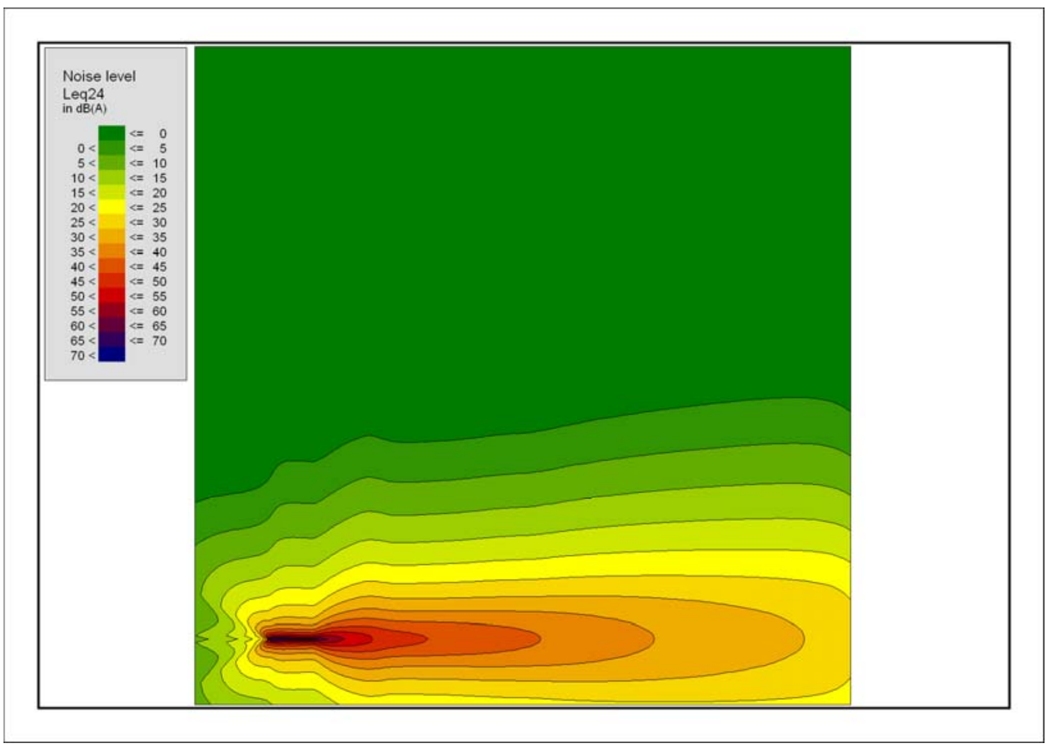
Specific configuration N. 13-16-19-22-25-28-31-34-37



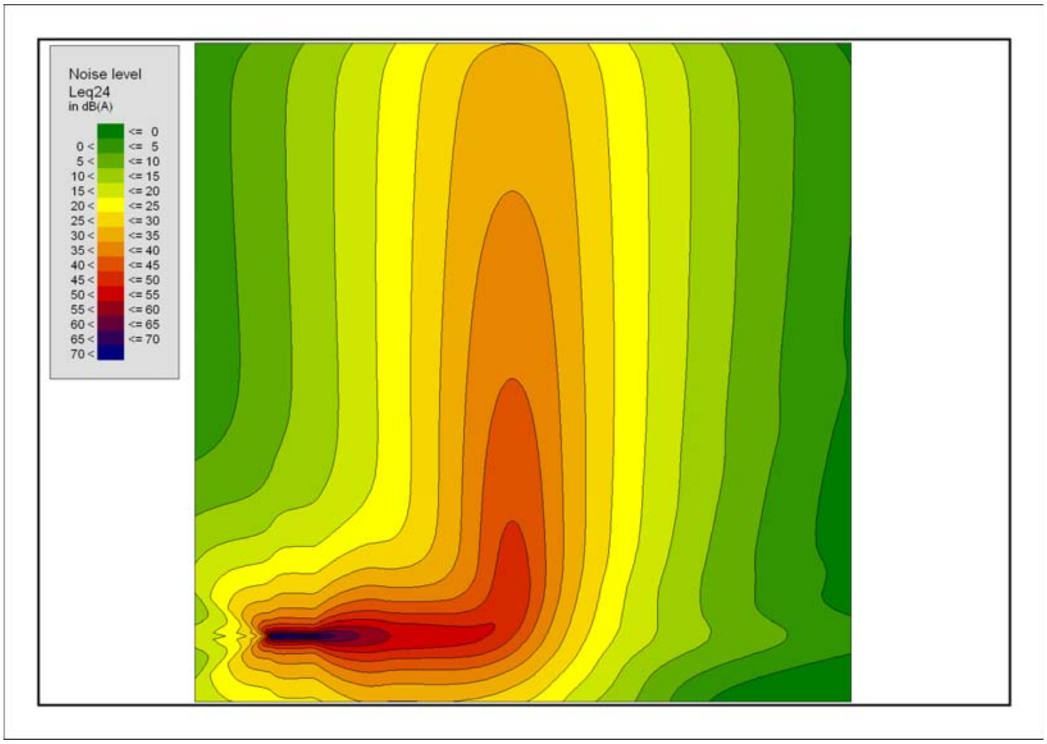
Specific configuration N. 14-17-20-23-26-29-32-35-38



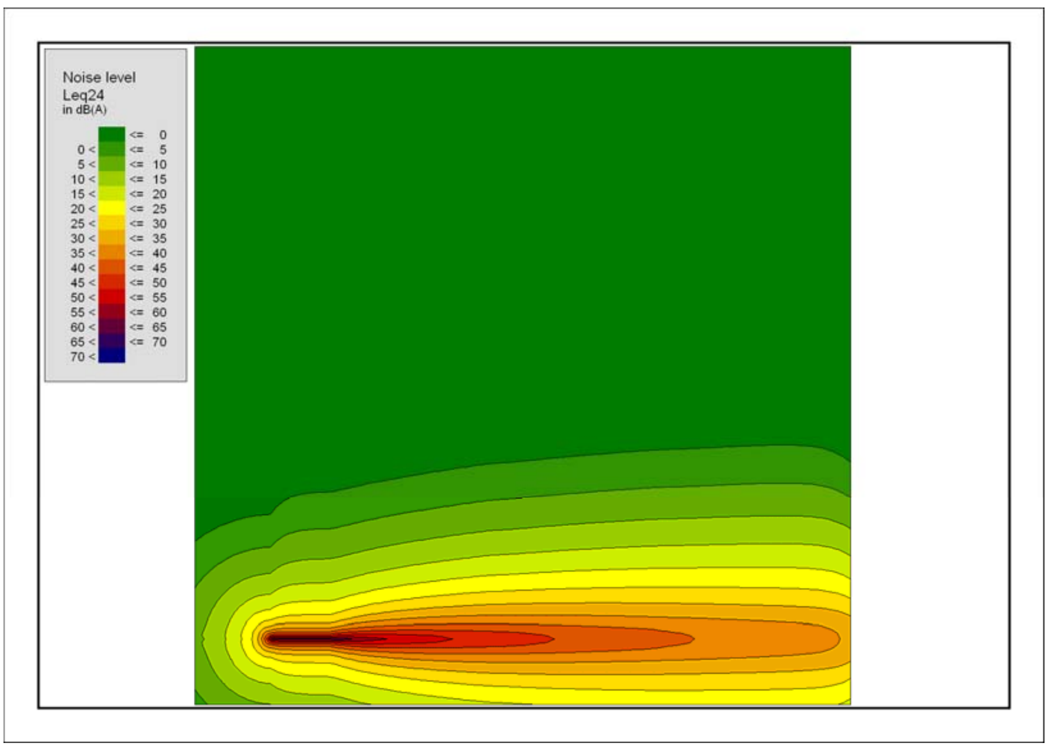
Specific configuration N. 15-18-21-24-27-30-33-36-39



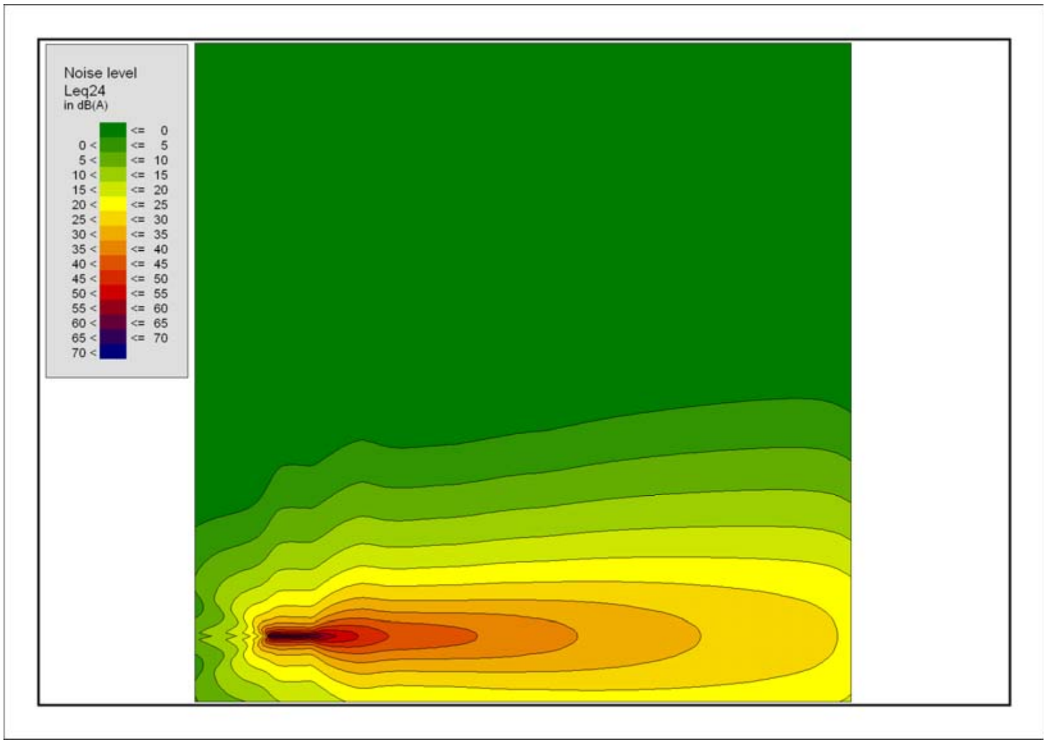
Specific configuration N. 40-43



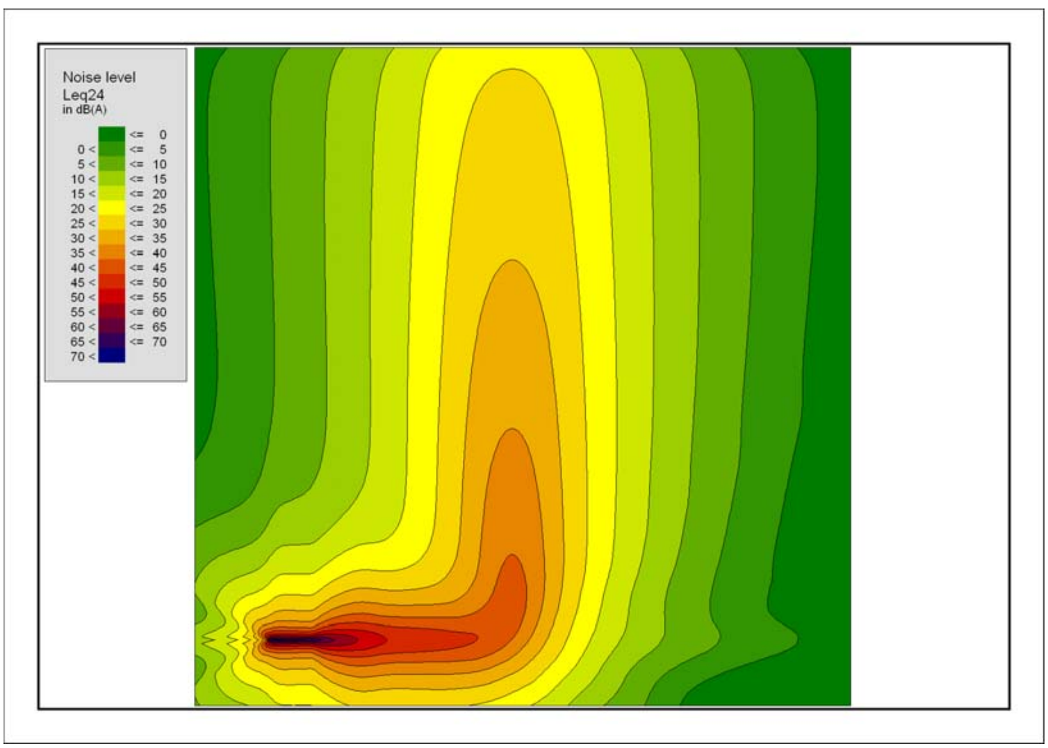
Specific configuration N. 41-44



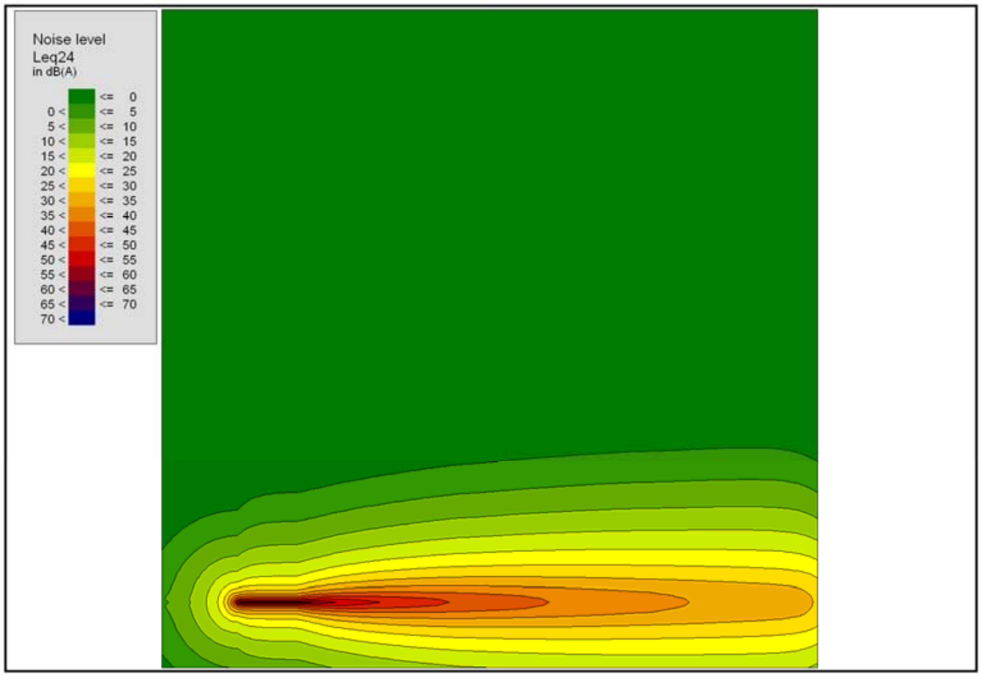
Specific configuration N. 42-45



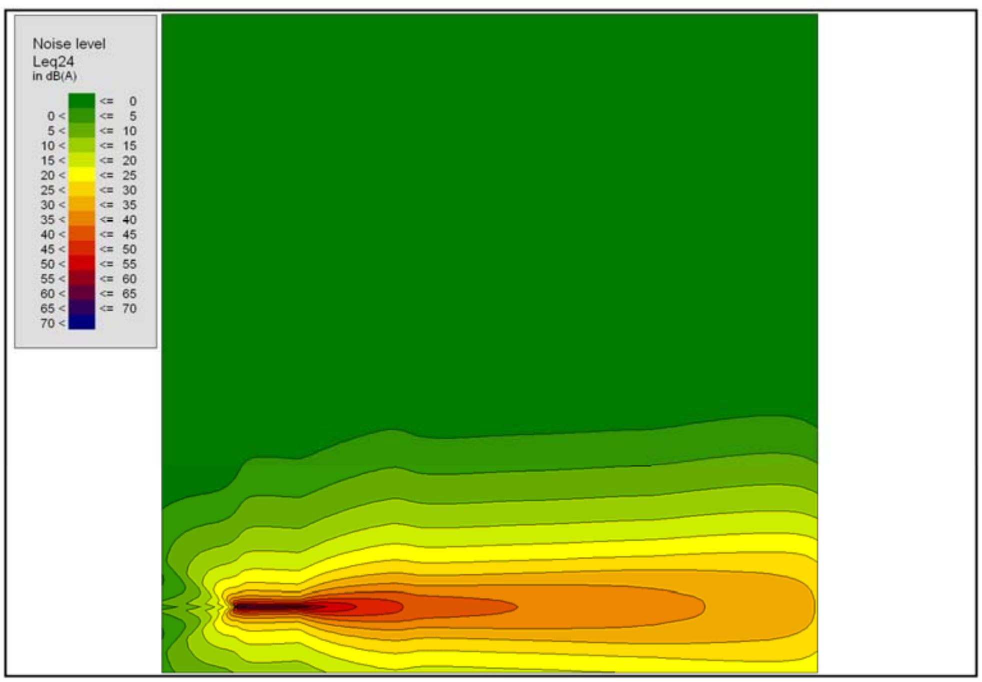
Specific configuration N. 46-49



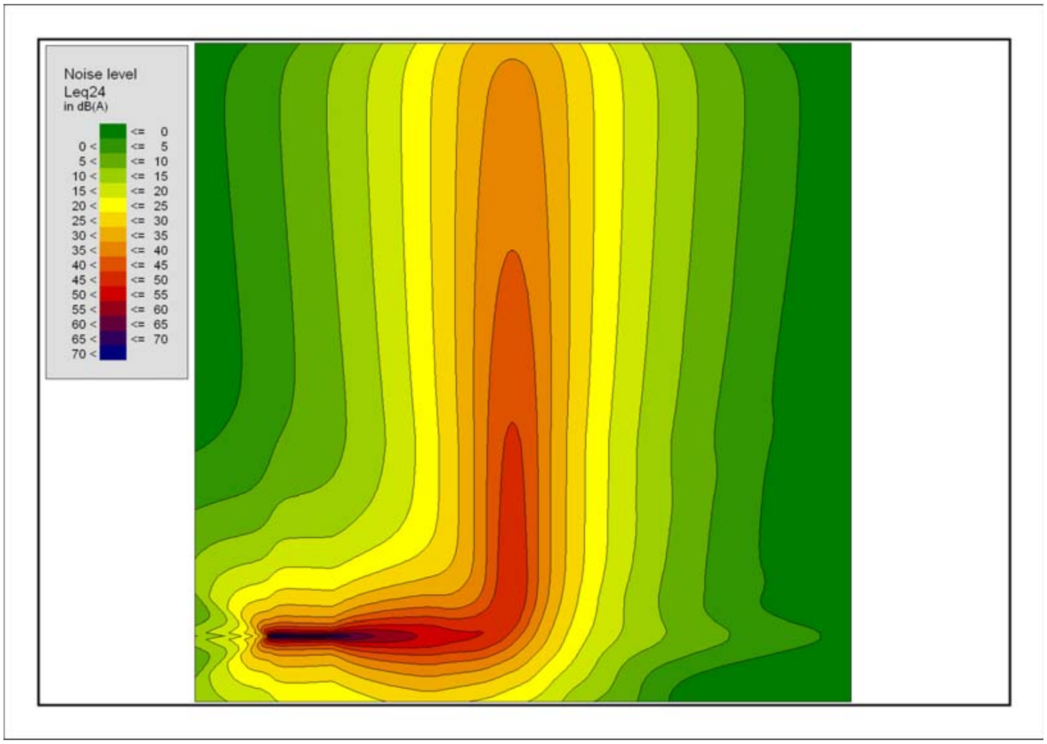
Specific configuration N. 47-50



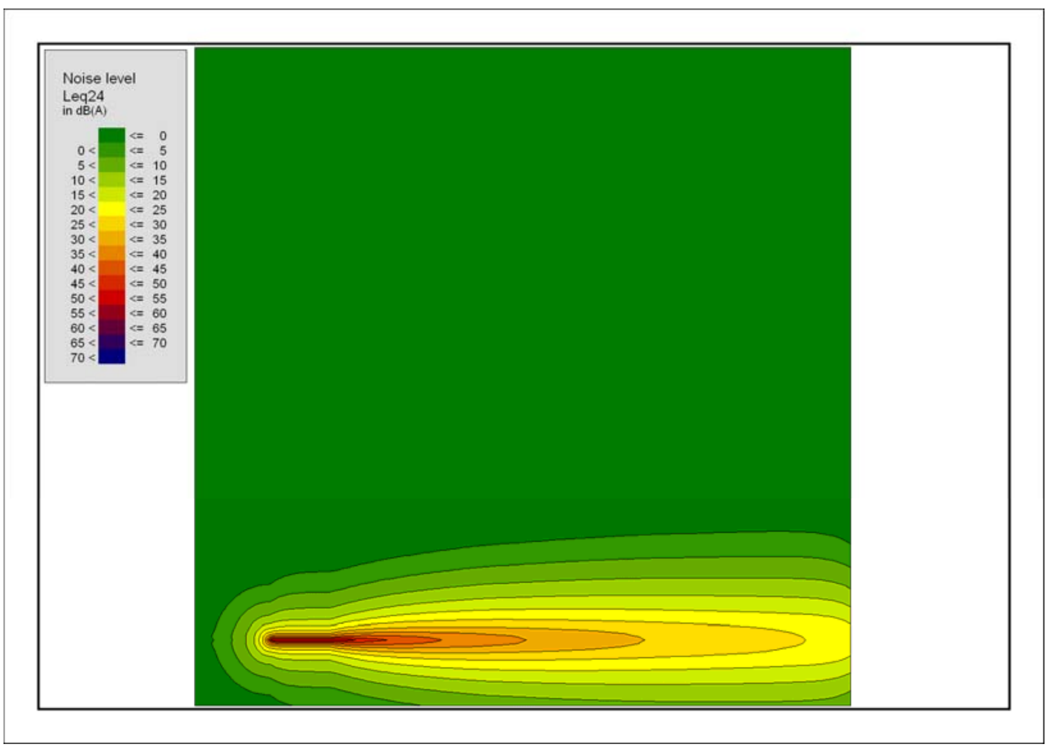
Specific configuration N. 48-51



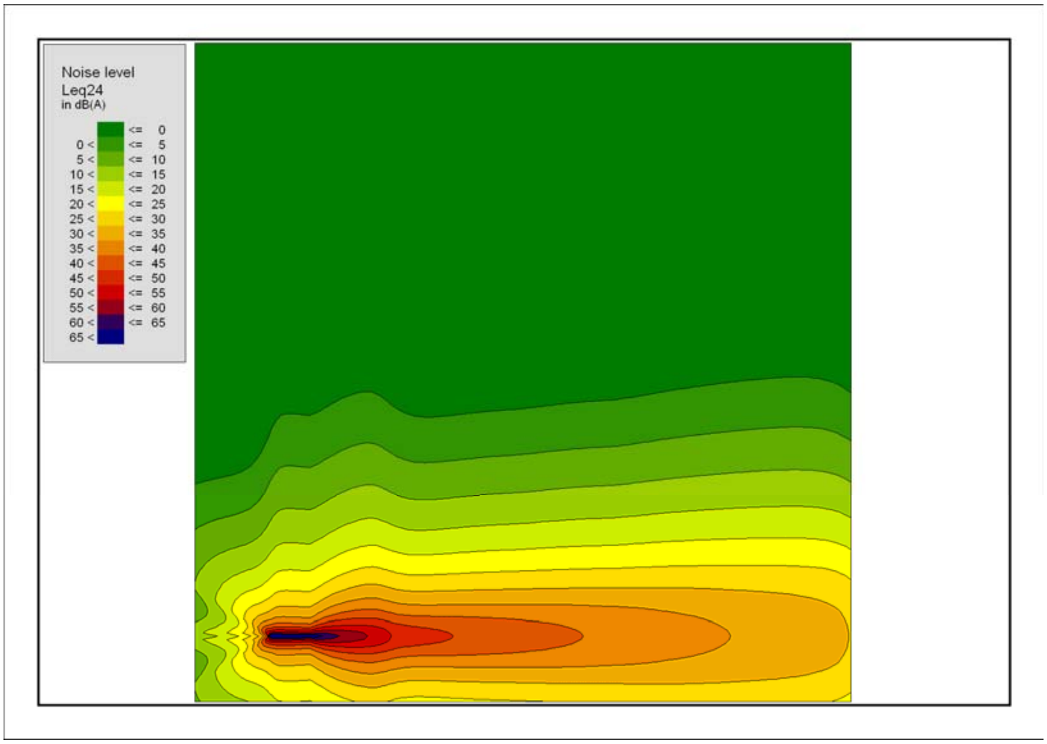
Specific configuration N. 52



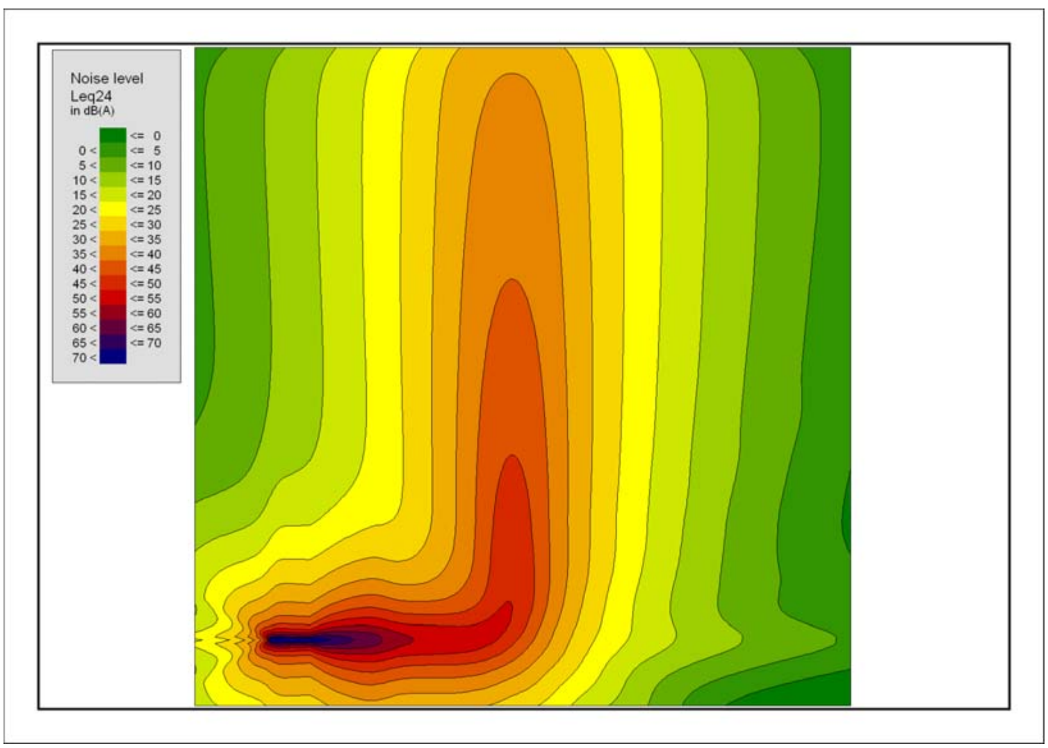
Specific configuration N. 53



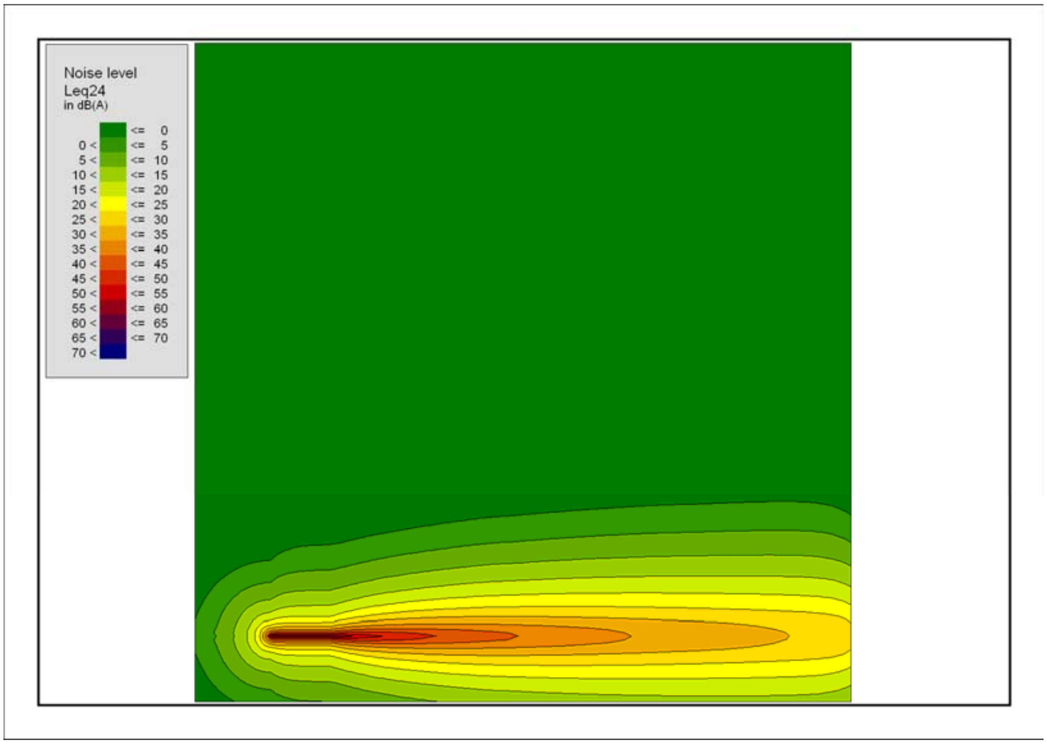
Specific configuration N. 54



Specific configuration N. 55

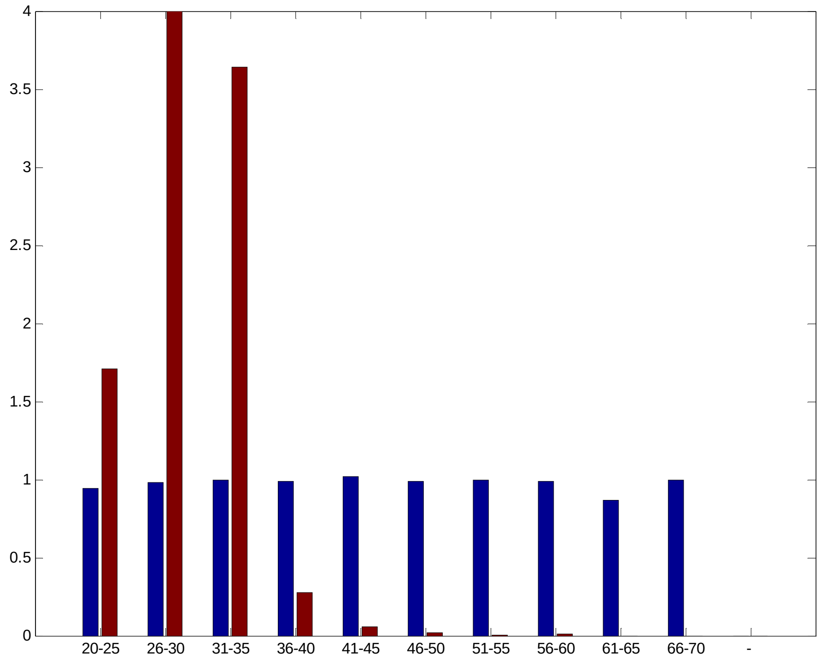


Specific configuration N. 56

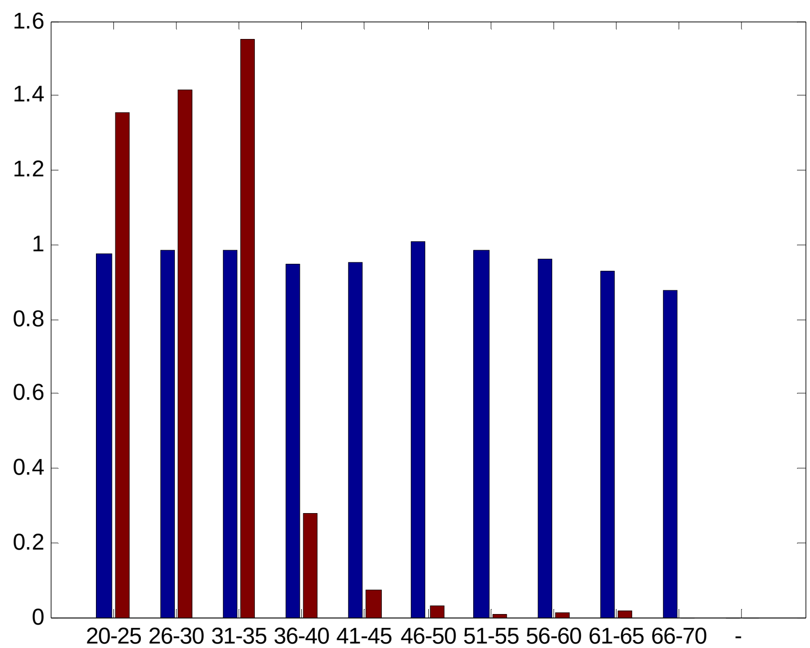


Specific configuration N. 57

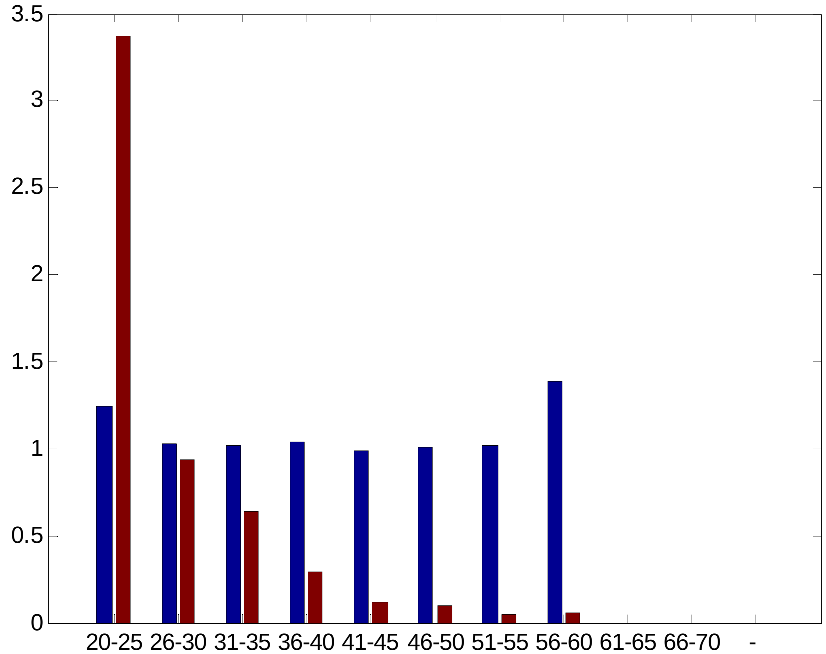
The following pictures present the area difference factor between 1) a software implementation using interim method and the Austrian – German database and 2) a software implementation using interim method and the Austrian – German database (BLUE BARS), and 3) a software implementation using interim method and the INM database (RED BARS).



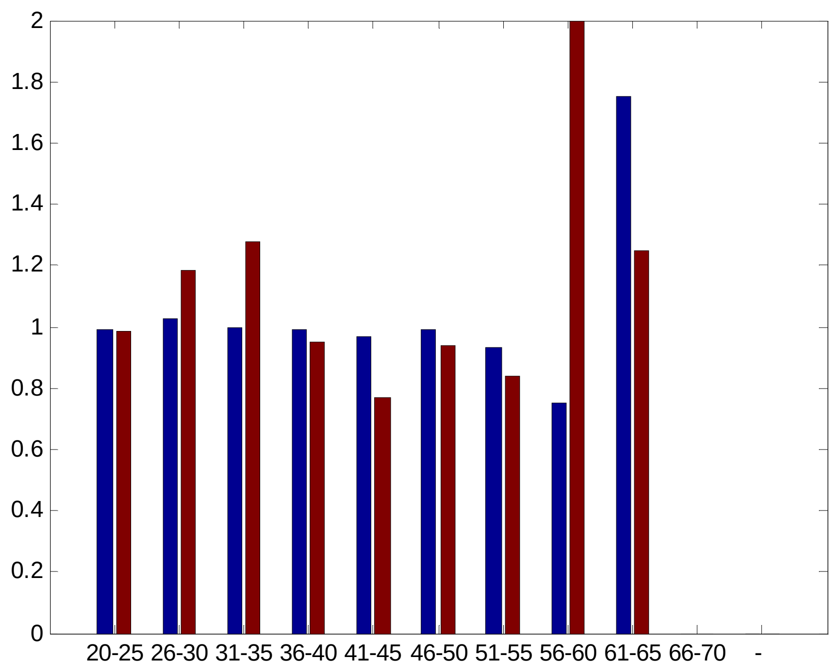
Specific configuration N. 1



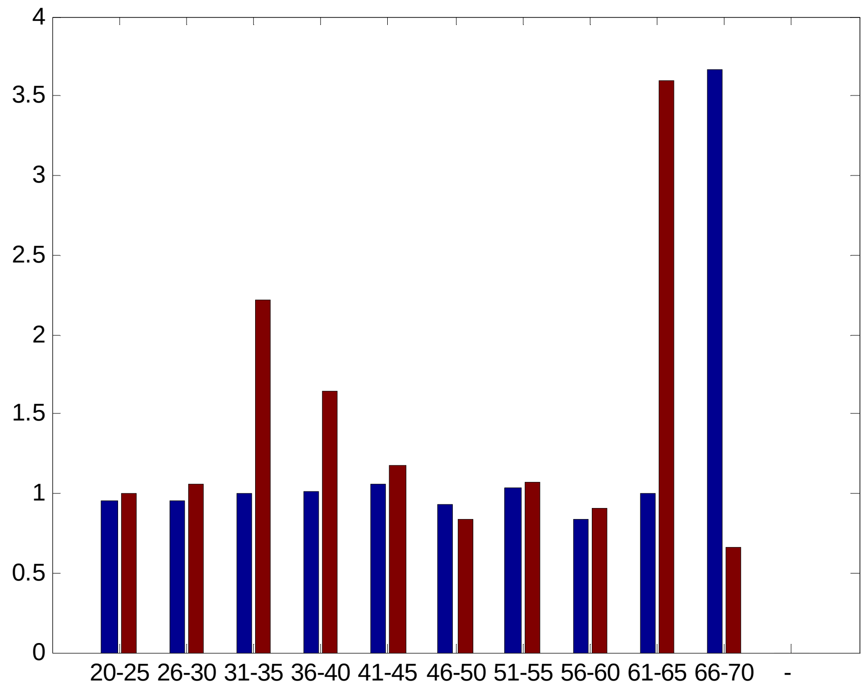
Specific configuration N. 2



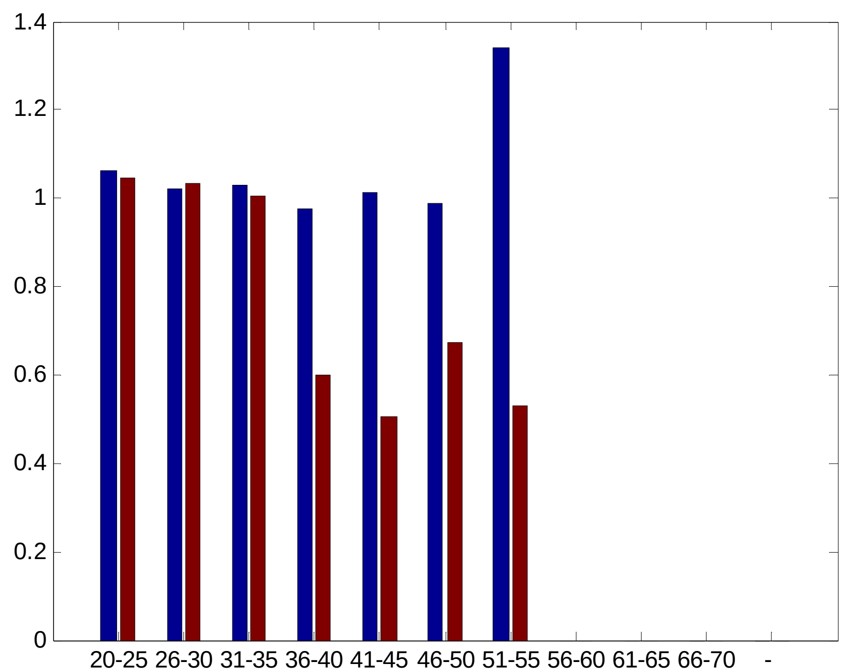
Specific configuration N. 3



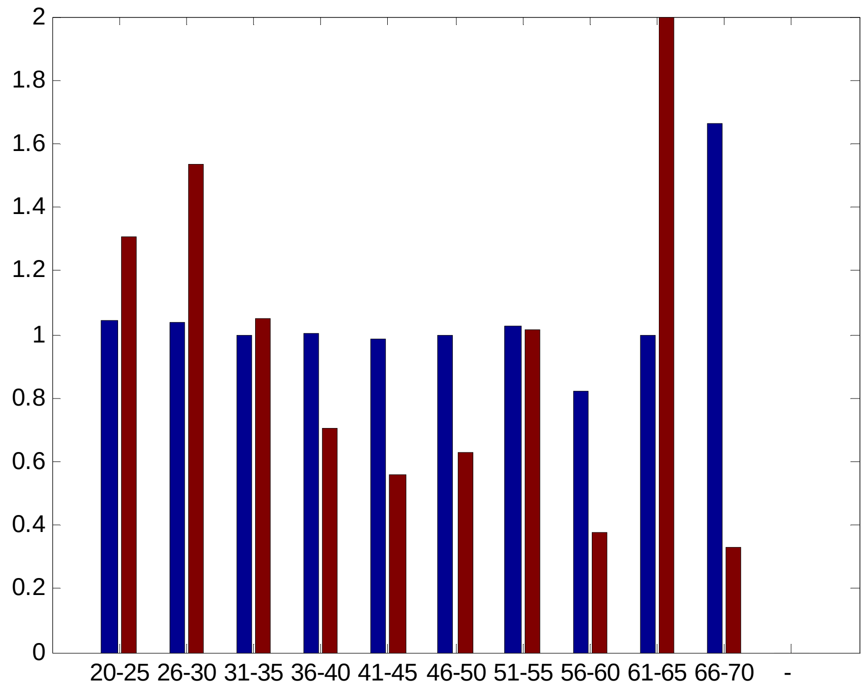
Specific configuration N. 4-7-10



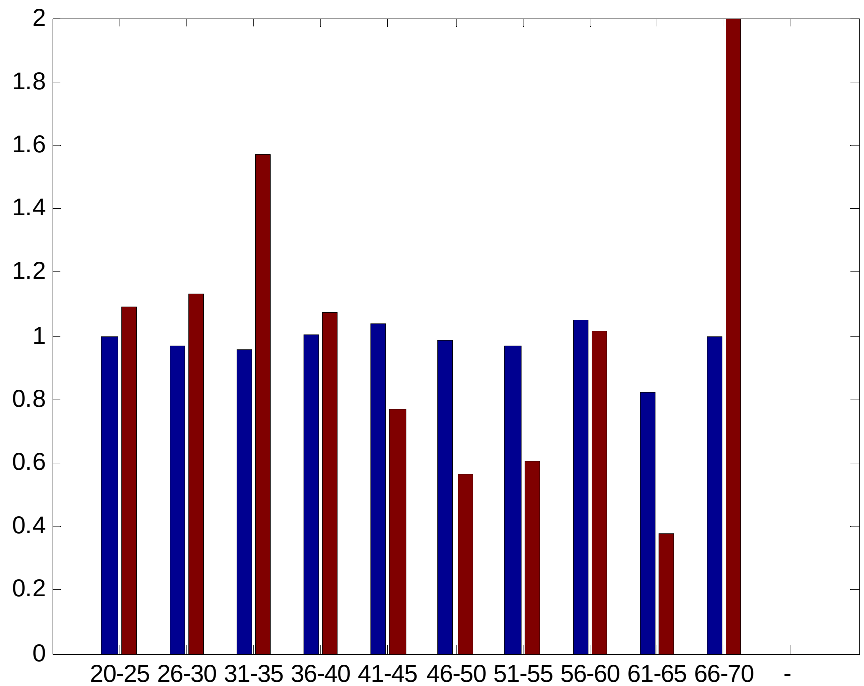
Specific configuration N. 5-8-11



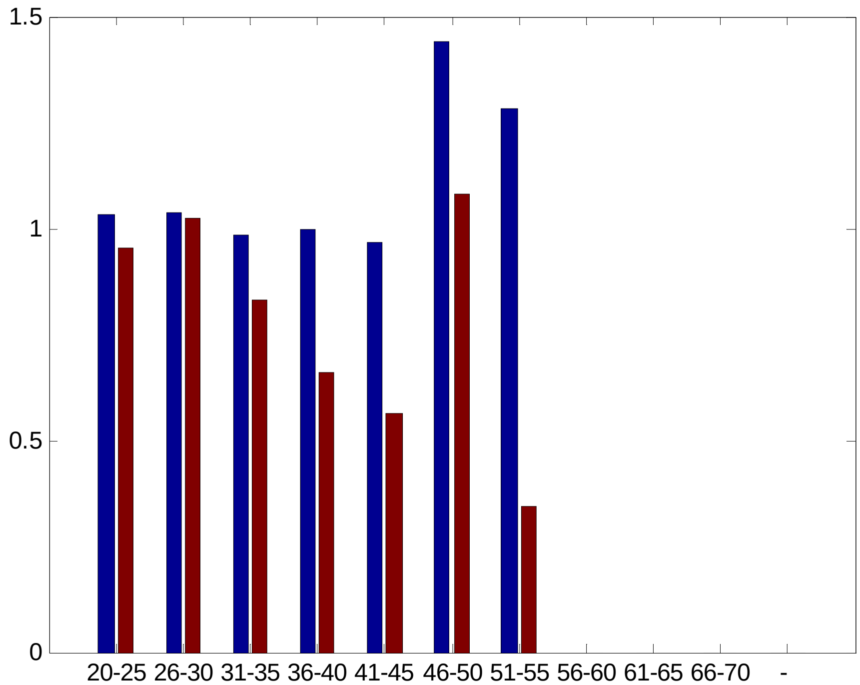
Specific configuration N. 6-9-12



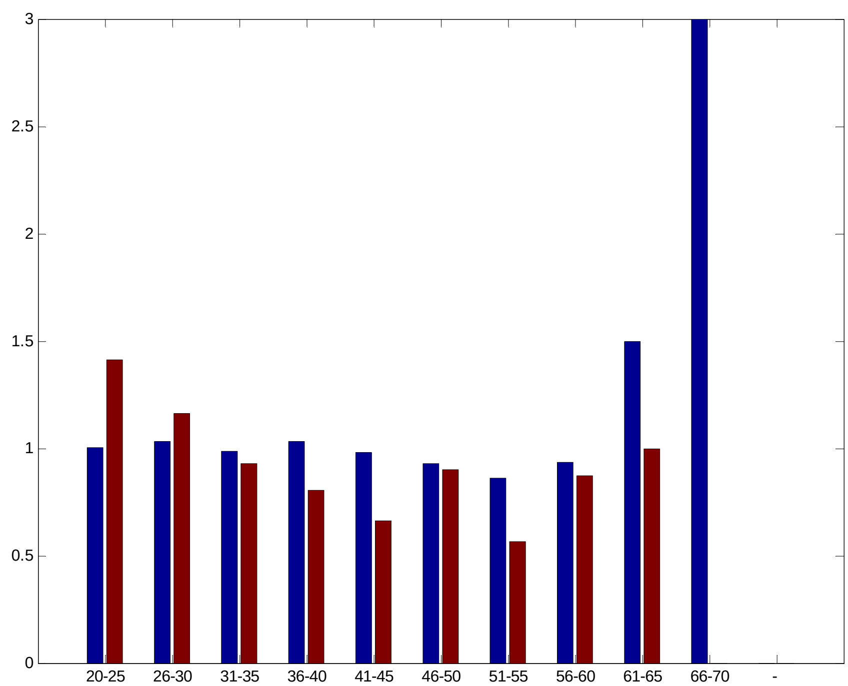
Specific configuration N. 13-16-19-22-25-28-31-34-37



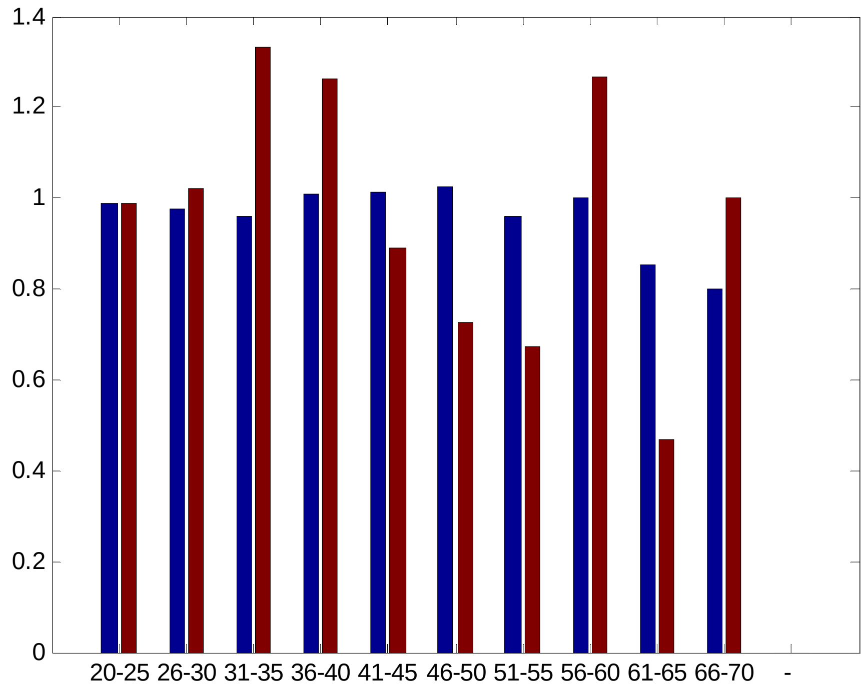
Specific configuration N. 14-17-20-23-26-29-32-35-38



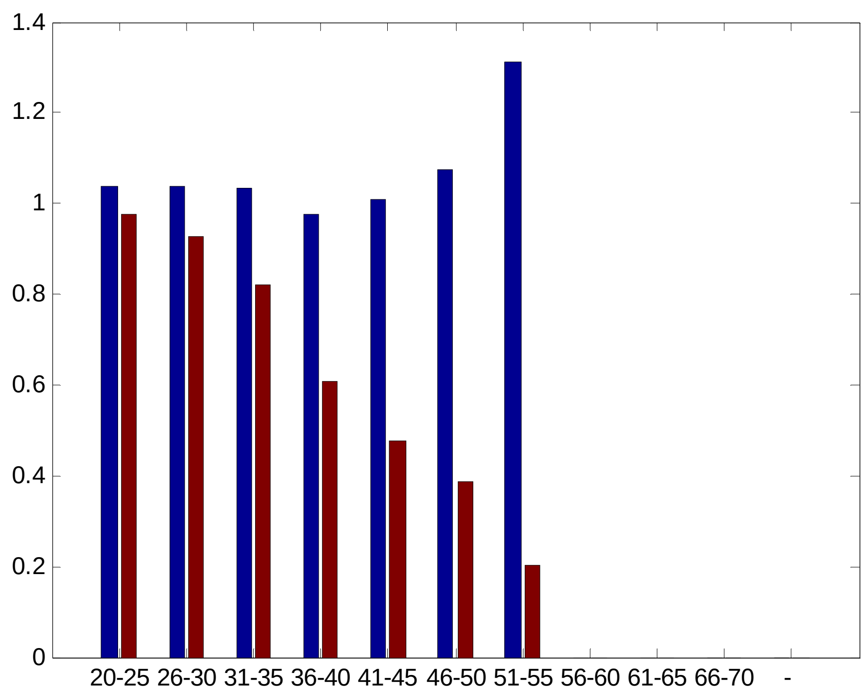
Specific configuration N. 15-18-21-24-27-30-33-36-39



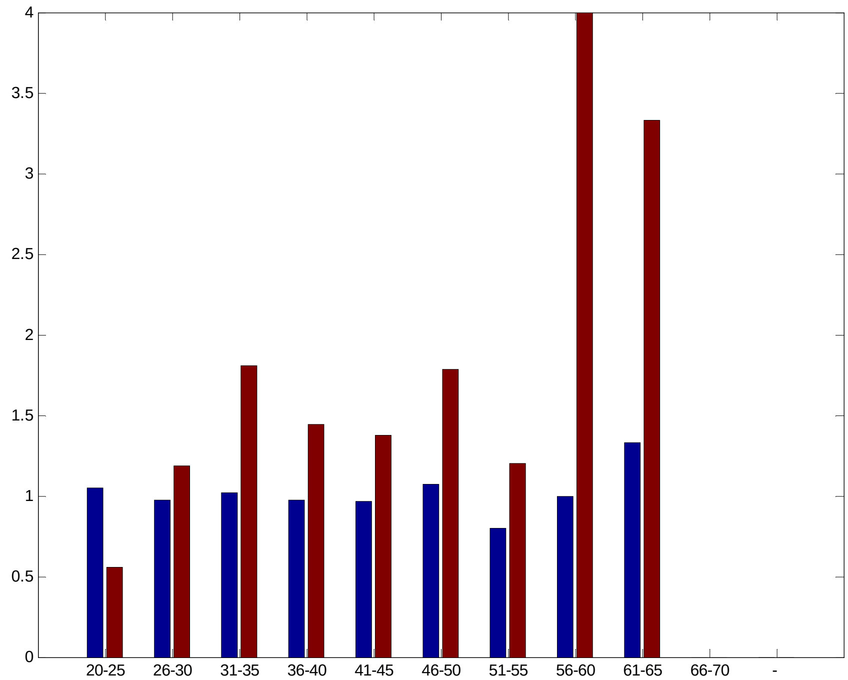
Specific configuration N. 40-43



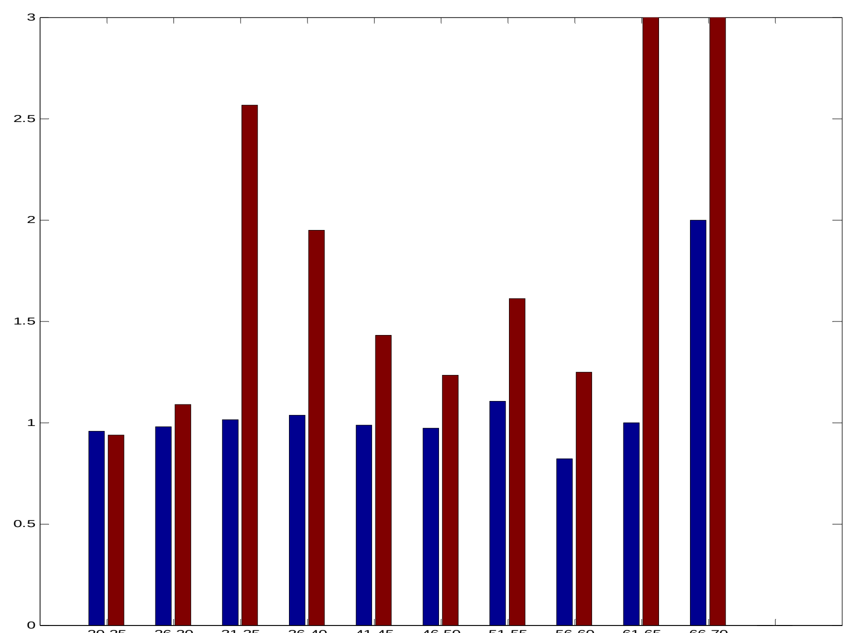
Specific configuration N. 41-44



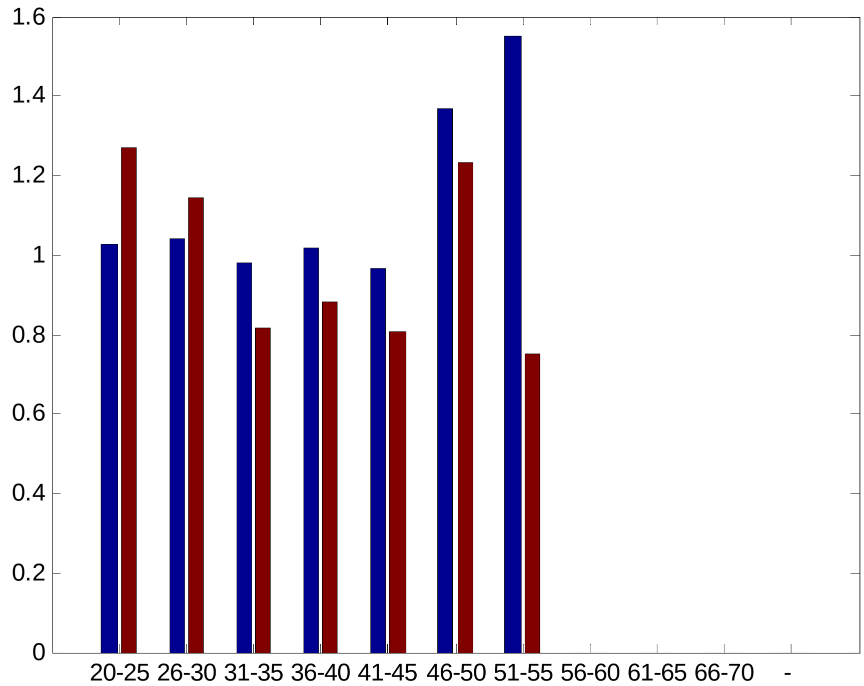
Specific configuration N. 42-45



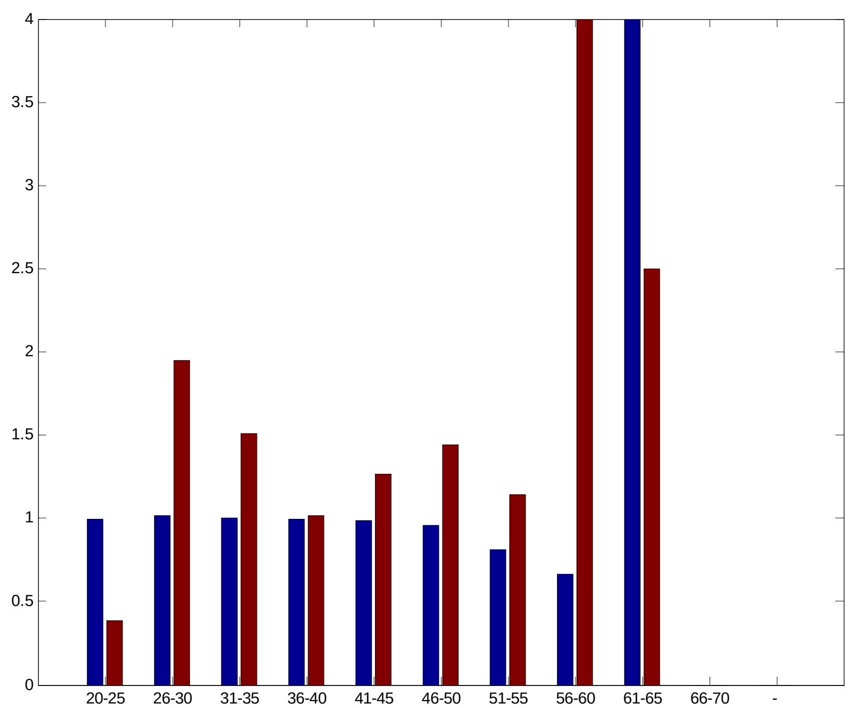
Specific configuration N. 46-49



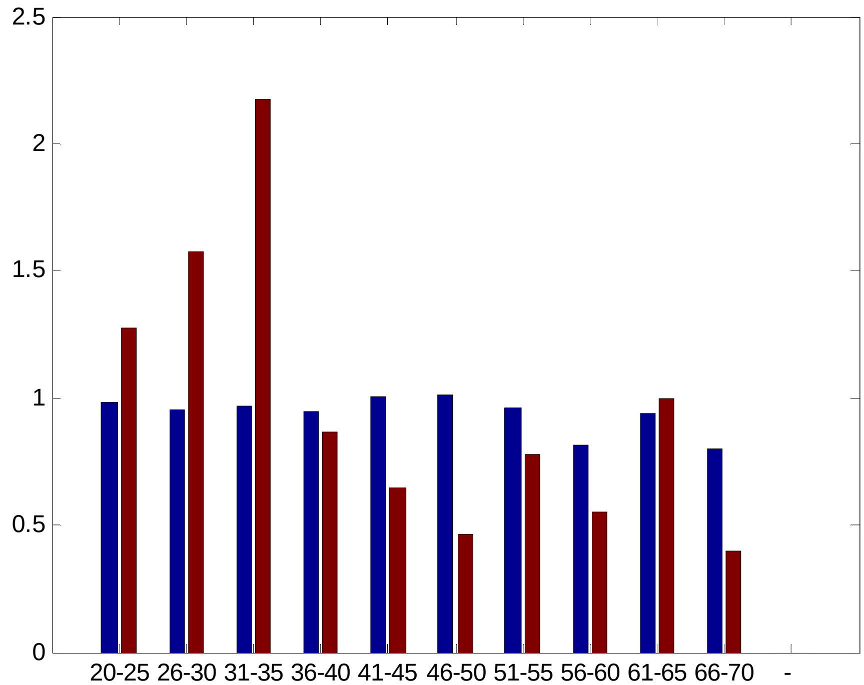
Specific configuration N. 47-50



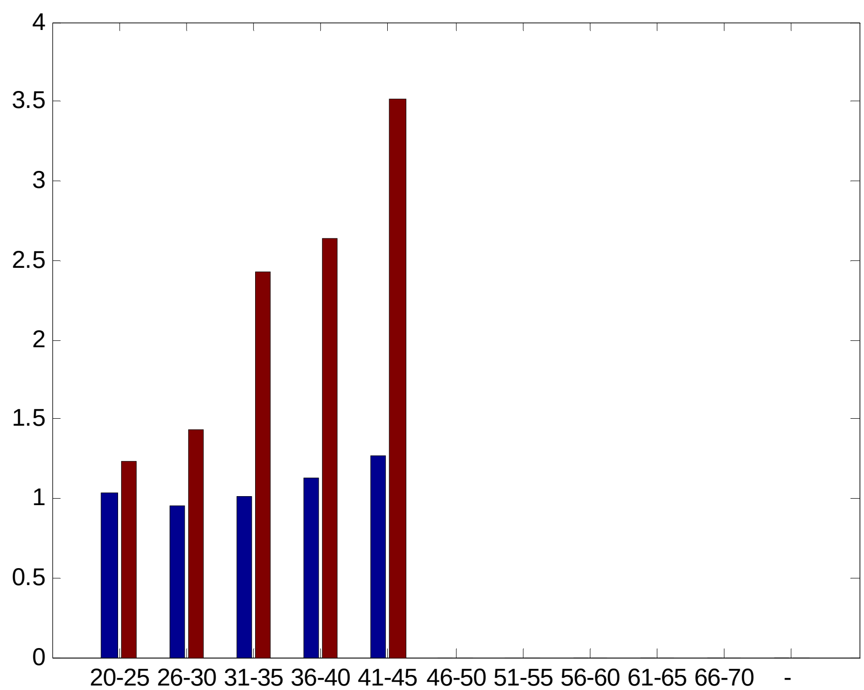
Specific configuration N. 48-51



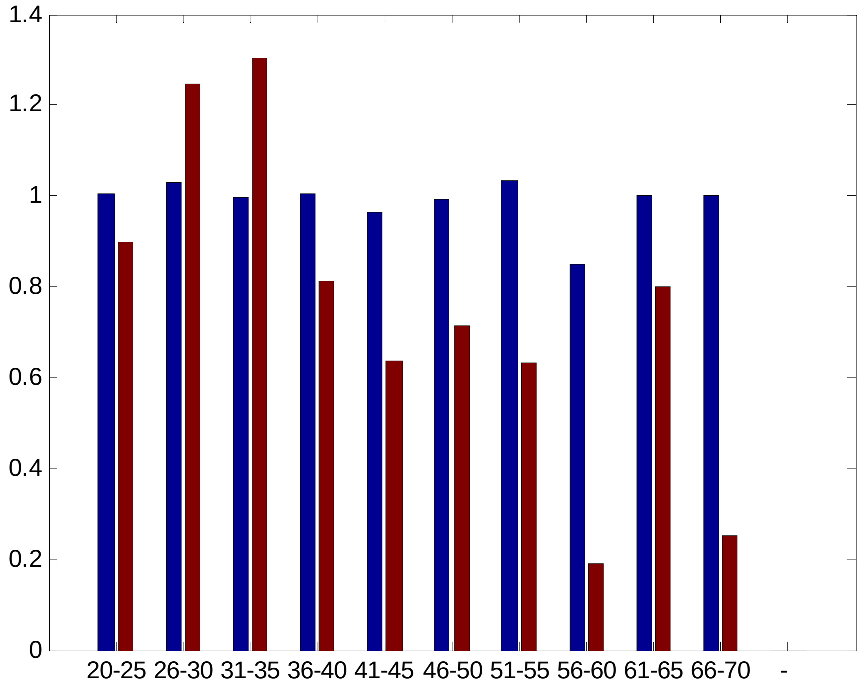
Specific configuration N. 52



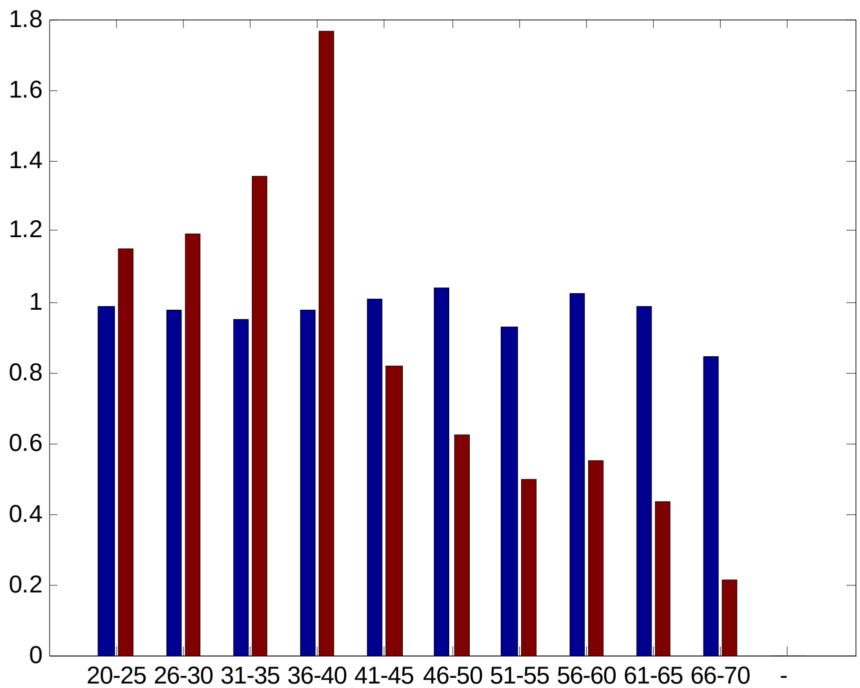
Specific configuration N. 53



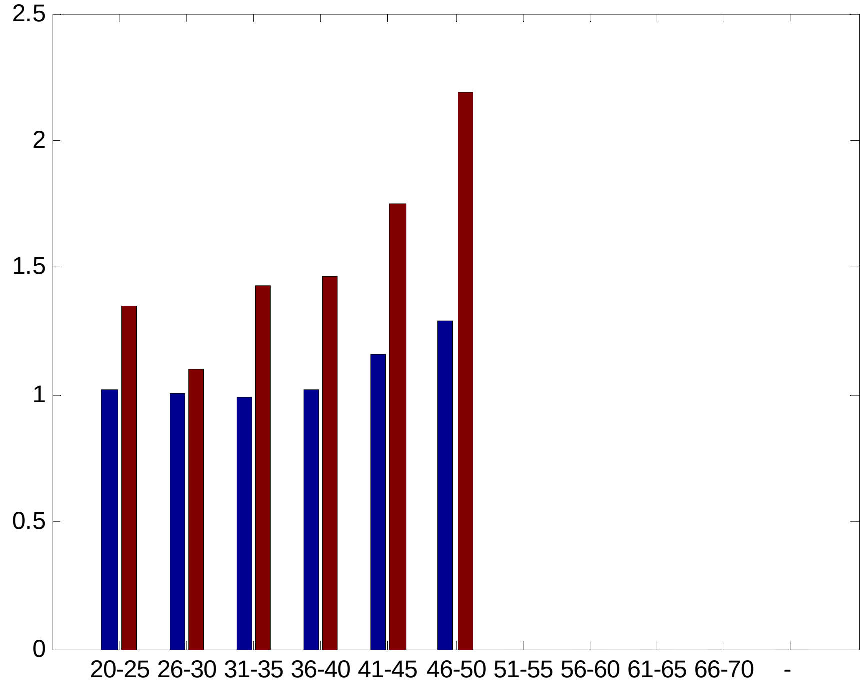
Specific configuration N. 54



Specific configuration N. 55



Specific configuration N. 56



Specific configuration N. 57