

ENC Release Notes Version 6.5

April 2, 2025

ADDITIONS AND CORRECTIONS NEW IN VERSION 6.5

Module 6 - 4-pole Analysis

1. As some large models can take some time to run, ENC no longer runs each time data are changed or when ENC is opened. Now ENC will only run when the “RUN” button in the top menu is clicked.
2. Another muffler element (type 15) has been added. This is similar to type 10, but the perforated tube length in the expansion chamber is not optimally tuned and the input data include the lengths of inlet and outlet tubes protruding into the expansion chamber. Element type 15 allows TL and IL calculations for existing muffler designs as well as for mufflers that are short with respect to their diameter. For these short mufflers, their optimal tuning is generally for the perforated section to extend the full length of the expansion chamber.
3. To allow more flexibility with the calculation of IL, there is now a choice provided for the duct configuration upstream and downstream of the muffler. The upstream configuration can either be anechoic (corresponding impedance $\rho c/S$) or can be characterised by a user entered real and imaginary acoustic impedance. The downstream acoustic impedance can be chosen to be anechoic or calculated by ENC for an open tube in free space.
4. The 1/4-wave tube muffler element has been updated so it now allows the opening to be covered with a perforated sheet or a layer of porous acoustic material or both. ENC calculates the contribution of these additions to the 1/4-wave tube impedance and uses this to estimate the TL and IL.
5. The Helmholtz muffler element has been updated so it now allows the opening to be covered with a perforated sheet or a layer of porous acoustic material or both. ENC calculates the contribution of these additions to the Helmholtz resonator impedance and uses this to estimate the TL and IL.

Module 6 - Reactive Mufflers

6. The table below the graph on the existing page shows octave band data for IL for the case where the table below the graph is labelled “Octave Band Transmission Loss”. This has been fixed so that now TL data are displayed.

Module 6 - Dissipative Mufflers

7. Duct bend attenuation has been updated according to the 6th edition textbook.
8. Unlined straight duct attenuation is now a choice for the graph and the octave band values.

Module 7 - Move Machine

9. A new page has been added to module 7, titled "Move Machine". This page allows users to determine the effect on vibration velocity levels (at a location on the structure that is beneath a machine mounting point) of moving a machine from one location to another on a flexible support structure.

ADDITIONS AND CORRECTIONS NEW IN VERSION 6.4

10. Plots may be saved to the clipboard by double left clicking on the plot.

Module 6 - 4-pole Analysis

11. This is a new page added to Module 6. It allows the TL and IL to be calculated for complex muffler systems with and without single or multiple perforated tube elements. Octave band and 1/3-octave band values are provided as well as plots of TL or IL vs frequency. Muffler elements, which can be connected together to form a complete muffler system, can be selected from a list of figures and include the following:
 - (a) Straight duct
 - (b) Straight duct with a temperature gradient
 - (c) Sudden expansion
 - (d) Sudden contraction
 - (e) Sudden expansion with extension into expansion chamber
 - (f) Sudden contraction with extension into expansion chamber
 - (g) Quarter-wave tube
 - (h) Helmholtz resonator
 - (i) Double-tuned expansion chamber (DTEC)
 - (j) Concentric tube resonator (CTR)
 - (k) Cross flow expansion
 - (l) Cross-flow contraction
 - (m) 3-duct cross flow with closed ends
 - (n) 3-duct cross flow with open ends

Module 9

12. The problem with junction type 36 not accounting properly for the number of wall studs and the sound absorbing material in the wall cavity has been fixed. In addition, it has now been pointed out in the user manual that sound absorbing material not only adds damping to the acoustic space between the wall leaves, but is also adds damping to the panel leaf with which it is in contact and the subsystem loss factor for this panel must be increased slightly to account for that. Where the sound absorbing material is in contact with both leaves, the loss factor for both leaves should be increased. The increase is difficult to estimate as it depends on the type of contact. That is, is the material stuck to the leaf, is it compressed against the leaf and if so, by how much etc.? In addition, the extent of the increase in the loss factor of the leaf is greater for small original leaf loss factors. The amount to increase the loss factor may be estimated using measured data for the difference between TL without cavity absorption and the TL with cavity absorption. Panel loss factor can be increased until

the predicted difference is close to the measured difference.

13. Sound transmission loss values for partitions separating acoustic spaces now represent both resonant transmission and non-resonant transmission.
14. The module 9 part of the user manual has been updated with more detailed and clearer explanations, including explanations of the choice of radiation efficiency type used by ENC
15. Explanations are now provided for the treatment of stud properties for circular partitions separating acoustic spaces.
16. The problem of ENC not recognising some user entered values has been fixed.
17. Radiation efficiencies and radiated sound powers for panels are now written to the “fullSEA.OUT” file, which is a text file that can be opened in Notepad. The various cases considered include radiation into free space, 3-D spaces, narrow 2-D cavities and 1-D tubes for panels or partitions excited acoustically or mechanically.

ADDITIONS AND CORRECTIONS NEW IN VERSION 6.3

Constants pop-up

18. The error in the viscosity data has been corrected. All data shown in versions 5.7 to 6.2 must be multiplied by 10^{-10} .

Module 9

19. This module is no longer a beta version and this indication has been removed from the menu bar.

Module 9 - Coupling Loss Factor Input Data

20. Two additional data items have been added.
 - (a) A choice between rigid and pinned junctions. Previously only rigid junctions were allowed. The pinned junction option may be used in cases where rotational junction motion is unrestrained or not significant. The option only applies to structural junctions (but not junction types 10 and 11). In some cases the pinned condition is characterised by no transmission of energy and in those cases the ENC GUI shows a dash for both transmission coefficient and transmission loss (TL), although the TL in the text files will appear as a value of 500 rather than a dash.
 - (b) The ability to add the radius of gyration property to the added mass that may be included in a beam structure (junction types 1 to 8).

Note that if uploading any project files developed using version 6.2, it will be necessary to click on the run button, first on the “subsystem input data” page and then the “Coupling loss factor input data” page before doing so on the “SEA calculation results” page. Please also check that the frequency input data box has the same value on both pages.

ADDITIONS AND CORRECTIONS NEW IN VERSION 6.2

Module 3 - ENC 6th version

21. In the barrier popup menu, the ground height under the source is now set to be 0.0 m for all cases. All other heights must be entered relative to this.
22. In the pink ground effects box, the ground roughness is now a required input for calculating the combined ground and meteorological excess attenuation. However, the value is only used if the chosen “Method” option is “Spherical waves-circular propagation paths-logarithmic atmospheric sound speed profile”. The same comment applies in the barrier attenuation calculation page.
23. In the barrier (Ab) popup page, wind and temperature data have been greyed out for straight ray path selections for the ground reflection model, to indicate that the adjustment of source and receiver heights to account for the effect of curved sound rays is not done.
24. In the barrier (Ab) popup page, the same wave propagation types as used in the Ag calculations are now included .
25. In the barrier (Ab) popup page, the errors in attenuation at low frequencies for some barrier configurations has been fixed.
26. The ground effect popup page contains more useful information showing results of intermediate calculations.
27. Two additional choices allowing circular ray paths and two different calculation methods for the atmospheric sonic profile are now provided.
28. The calculation of the attenuation due to meteorological effects for a negative atmospheric sonic profile has been updated.
29. In the Ag popup window, a range of intermediate results are now available in the spherical wave calculation box. In addition, to account for spherical propagation paths, the term, $k(r_S + r_R - d_{SR})$ is replaced with $2\pi f \Delta t$ where Δt is the propagation time difference between the direct and reflected ray paths.

Module 3 - ISO9613

30. The excess attenuation, Aref, due to a reflecting surface (much closer to the source than the receiver - by at least a factor of 3) may now be included if desired. Users may choose a plane or cylindrical reflecting surface.
31. Errors in the calculation of the Amet excess attenuation and the overall Lp value for 8 kHz have been corrected.

Module 7 - Single Isolator System

32. The x-axis now has vertical lines corresponding to integer increments on a log scale.

Module 9 - SEA

33. The software engine under pinning this module has been revised based on user feedback.

Module 9 - Subsystem Input Data

34. Option descriptions have been slightly clarified for line 20 and “sinusoidal” has been deleted from line 21 for corrugated plates.

Module 9 - Coupling Loss Factor Input Data

35. More groups have been added to junction types 4, 7, 8 and 24 to cover previously omitted wave type combinations.
36. Default values for the data at the bottom of the page have been set equal to zero, as this are the more commonly used values. Non-zero values are only used in special cases of a flexible connection between a subsystem and a junction.
37. The “Calculation method” options have been changed for a number of junction types and explained more fully in the user manual.
38. A moment arm input data option has been added for junction type #8.
39. The number of studs in a double wall can now be entered for junction type 36, as this has an effect on the calculation of the coupling loss factor between the two leaves making up the wall. Earlier versions of ENC assumed that the number of studs was 1.
40. As moments cannot be transmitted for junction types 10 and 12, data for rotational stiffness of the junction can no longer be entered.

Module 9 - SEA Calculation Results

41. The output data listed in the GUI is now available as a number of appropriately labelled text files. Text files have also been provided for TL and coupling loss factor (CLF) data for all junctions.
42. The word “joint” has been changed to “junction” in a number of places to avoid any confusion.
43. The number of iterations allowed to converge to a solution has been increased from 5 to 10.

ADDITIONS AND CORRECTIONS NEW IN VERSION 6.1

All Modules

44. All tables, figures and equations referred to in the textbook now have numbers corresponding to the 6th edition book, except in a few cases where the analysis was not included in the 6th edition. In those cases, the relevant textbook edition that contains the analysis is listed..

Module 1 - Fundamentals

45. A calculation of the isothermal speed of sound has been added.

Module 1 - Ear

46. The unwanted error message that appears on this page has now been removed.

Module 3 - ENC 4th version

47. This label has been changed to “**ENC 6th version**” to reflect the more extensive analysis which is now documented in the 6th edition textbook.
48. Reference to Table 9 in the Meteorological Effects part has been deleted as it has been omitted from the 6th edition textbook.

Module 3 - CONCAWE, Meteorological Effects

49. More decimal places are now available to properly define the value for ζ .

Module 5 - Single and Double Wall

50. The EN-12354 label has been changed to ISO12354 to reflect the more recent standard.

Module 6 - Pressure Drop and Flow Noise, Flow Generated Noise

51. The “Method” menu has been modified to be more concise and to reflect the content of the 6th edition textbook.

Module 6 - Pressure Drop and Flow Noise, Dynamic Pressure Loss

52. In the “Flow Through a Duct Element part, the “Method” menu has been modified to be more concise and to reflect the content of the 6th edition textbook.

Module 9 - SEA Subsystem Input Data

53. An additional external sound power input (achieved using a loudspeaker or equivalent) has been added for subsystem types 14 – 17.

Module 9 - SEA Coupling Loss Factor Input Data

54. More explanation has been added to the user manual regarding when coupling type 36 should not be used and the requirement to include coupling type 35 as well when it is used.

Module 9 - SEA Calculation Results

55. The error resulting in occasionally high coupling loss factors has been corrected.
56. The error causing abnormally high mode counts for 1/3-octave band data has been corrected.
57. The error data output has been slightly rearranged to be clearer.
58. The title, “ $p^2(\text{dB})$ ” has been changed to “ $L_p(\text{dB})$ ” to improve the clarity of what is meant.
59. An additional data box titled, “# iterations” has been added so users can iterate coupling loss factor calculations to attempt to obtain more accurate results.
60. More extensive explanations and guidance have been added to the user manual for Module 9.

ADDITIONS AND CORRECTIONS NEW IN VERSION 6.0

Module 3 - ENC 4th version

61. The window that appears when clicking on A_g in the centre panel had an error which has now been fixed. The error resulted in negative values in some cases for $|R_s|$.
62. The maximum ground effect value has been limited to 30 dB (very unlikely to be reached).
63. It has been made clear in the user manual that in the A_g window, the calculations are for straight ray paths and do not take ray curvature into account.
64. Meteorological Effects are no longer calculated separately when the turbulence option for $|R_s|$ is selected in the A_g popup window, as the turbulence parameter accounts for meteorological effects, at least to the accuracy of the analysis in ENC.
65. Error messages are now produced if the x-coordinate of barrier B1 or B3 is greater than the x coordinate of the receiver or if the x coordinate of barrier B1 or B3 is less than the x coordinate of the source. This has also been added to Module 5 - outdoor barrier.

66. A 24 dB maximum overall attenuation limit has now been applied to all barrier attenuation calculations.
67. The problem of no ground reflection existing between the source and receiver when the ground slope and source / receiver heights are such that no ground reflected ray can reach the receiver now produces zero for the A_g value in the centre panel, rather than the “inf” value currently displayed. This means that the overall attenuation results will now be correct for these specific cases.
68. An error message will now be produced if the z-coordinate of the source is less than or equal to the z-coordinate of the ground beneath it and / or the z-coordinate of the receiver is less than or equal to the z-coordinate of the ground beneath it.
69. The z-coordinate of the ground beneath the source is now set = 0.0 and all other z-coordinates must be relative to this.

Module 3 - ISO9613

70. Only the “ISO9613” choice is now allowed for barrier attenuation calculations.
71. An error message will now be produced if the z-coordinate of the source is less than or equal to the z-coordinate of the ground beneath it and / or the z-coordinate of the receiver is less than or equal to the z-coordinate of the ground beneath it.
72. Only the point source option is allowed for barrier attenuation calculations.

Module 3 - CONCAWE

73. Only the point source option is allowed for barrier attenuation calculations.
74. Only the Maekawa method is allowed for barrier attenuation calculations.
75. An error message will now be produced if the z-coordinate of the source is less than or equal to the z-coordinate of the ground beneath it and / or the z-coordinate of the receiver is less than or equal to the z-coordinate of the ground beneath it.

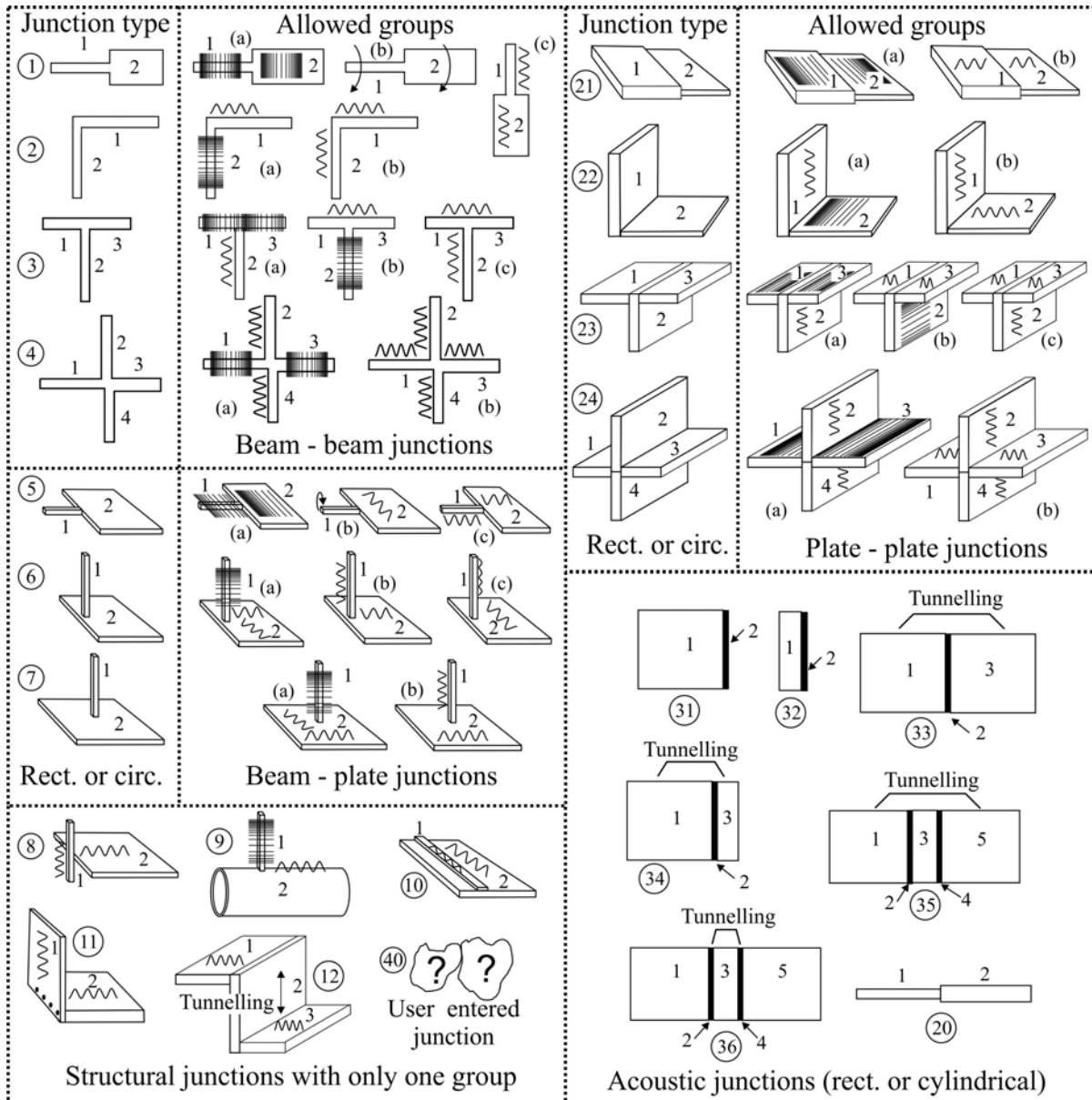
Module 5 - Outdoor barrier

76. Error messages are now produced if the x-coordinate of barrier B1 or B3 is greater than the x coordinate of the receiver or if the x coordinate of barrier B1 or B3 is less than the x coordinate of the source.

Module 9 - Statistical energy analysis (SEA)

77. This is an entirely new module that very much expands on the basic material in Chapter 11 of the 6th edition book, “Engineering Noise Control” by DA Bies, CH Hansen, CQ Howard and KL Hansen.
78. The version 6 user manual explains in detail the fundamental theory underlying SEA and the approximations that are made in the ENC software.
79. The SEA module can handle up to 50 subsystems and 50 junctions. There are 25 subsystem types (listed below) to choose from and 39 different junction types illustrated in the next page), with the ability for users to add their own subsystem types if desired. Subsystem types include corrugated and honeycomb sandwich plates, cylinders, rectangular and cylindrical spaces as well as rectangular and circular plates and partitions.

Beam, infinite - axial waves (#1)
Beam, semi-infinite - axial waves (#2)
Beam, infinite - torsional waves (#3)
Beam, semi-infinite - torsional waves (#4)
Beam, infinite - bending waves (#5)
Beam, semi-infinite - bending waves (#6)
Isotropic plate, infinite - in-plane compressional waves (#7)
Isotropic plate, semi-infinite - in-plane compressional waves (#8)
Isotropic plate, infinite - bending waves (#9)
Isotropic plate, semi-infinite - bending waves (#10)
Corrugated plate, infinite - in-plane compressional waves (#19)
Corrugated plate, semi-infinite - in-plane compressional waves (#20)
Corrugated plate, infinite - bending waves (#11)
Corrugated plate, semi-infinite in stiffest direction - bending waves (#21)
Corrugated plate, semi-infinite in least stiff direction - bending waves (#22)
Sandwich plate, infinite - in-plane compressional waves (#23)
Sandwich plate, semi-infinite - in-plane compressional waves (#24)
Sandwich plate, infinite - bending waves (#12)
Sandwich plate, semi-infinite - bending waves (#25)
Thin-walled circular-section cylinder - bending waves (#13)
1-D acoustic duct, infinite (#14)
1-D acoustic duct, semi-infinite (#15)
3-D acoustic space (#16)
Wall cavity space between 2 partitions (#17)
User entered subsystem (Total mass, impedance, loss factor, modal density and CLFs - structural systems only allowed) (#18)



80. This new module is currently included in the demo program and the ENC update to version 6.0. However, the SEA module is a beta version as it has not been fully tested yet. Users are asked to try it out and send any comments to colin.hansen@causalsystems.com.

ADDITIONS AND CORRECTIONS NEW IN VERSION 5.7

Module 1 - Fundamentals and Weighting

81. The band frequency limits have been updated to the values for the more commonly used Base-10 filters

Module 3 - ENC 4th version (barrier calculations)

82. The sudden step change to zero dB attenuation at numerically large negative Fresnel numbers has been fixed so the change is gradual.

Module 5 - Outdoor barrier

83. The sudden step change to zero dB attenuation at numerically large negative Fresnel numbers has been fixed so the change is gradual.

Module 5 - Composite/Flanking

84. A constants button has been added to the slit attenuation calculation section to allow calculations for any gas and temperature.

ADDITIONS AND CORRECTIONS NEW IN VERSION 5.6

Constants set-up

85. The errors in the reference gas viscosity and Sutherlands constant for all gases except air have been fixed so that these numbers reflect the chosen gas.
86. The reference temperature, T0 can no longer be changed by the user as this was causing problems with viscosity calculations.

Module 2 - Sound Power (surface vibration measurements)

87. A sliding switch has been added that allows users to choose the type of excitation that the radiating panel is subjected to. If "Mech." is selected, then excitation is assumed to be mechanical and the panel behaves in resonant response. If "Acoustic" is selected, then excitation is assumed to be from an incident sound field and the panel behaves in forced response.

Module 3 - Sound propagation

88. In the CONCAWE and ISO9613-2 pages, the source, receiver and barrier coordinate values are now all coordinates referenced to a specified origin location which is not necessarily the ground. All values in the source, receiver and barrier boxes must be coordinates relative to the same origin location and when a barrier exists, the x-coordinate must be zero on the barrier face nearest the source. The height value used in previous ENC versions are now z-coordinates.

89. The calculation of barrier attenuation now allows for a barrier to be located on sloping ground between the source and receiver for all propagation models. Previously, the calculations required that the ground beneath the source, receiver and barrier had the same vertical coordinates (namely, zero), although approximate results could be obtained by adding the ground vertical coordinate at each location to the height of the source, barrier or receiver, respectively. Now any coordinates are acceptable for the ground level at the base of the source, barrier and receiver.
90. Ground effects, even in the absence of a barrier can take into account sloping ground (that is, different z-coordinates for the ground under the source and the ground under the receiver).
91. The calculation of diffraction path lengths around the ends of a finite-length barrier have been updated to remove small errors and to allow ground reflection around the end between the two diffraction edges.
92. The use of curved ray paths to modify source and receiver locations is only used for the single diffracted path over the top of the barrier and only for the ENC 4th version and CONCAWE options (not the ISO option).
93. The limitation of a maximum barrier attenuation of 24 dB is only applied to the non-reflected path over the barrier top. No limit is applied to the other paths, as this can lead to unexpected results.
94. Double barriers are now treated more accurately as two diffraction edges rather than using a simple additive correction.
95. Meteorological effects are no longer included as an addition to the barrier attenuation for any barrier attenuation results. Inclusion of these effects led to some errors, especially for the CONCAWE model.
96. The ground effect is now not automatically disallowed in the ENC 4th version and CONCAWE propagation models when the barrier option is chosen. This is because it was not appropriate for cases where there was line of sight between the source and receiver. Now users will need to untick the ground effect box when there is no line of sight. A warning message appears if both boxes are ticked for these two models.
97. For the ISO9613 model, if the barrier box is ticked, the ground effect box is automatically ticked. This is because, the ISO barrier model subtracts the ground effect from the barrier calculations, but the ISO model requires that it be included in the overall propagation model when a barrier calculation is included.
98. The Ar(dB) and Amid(dB) labels in the ISO ground effect popup page have been interchanged so they are now correct.
99. Sloping ground is now allowed in the ground effect and meteorological effects calculations.
100. The CONCAWE and ISO9613 options for barrier calculations are not included on the ENC 4th version page as these entire models are treated on separate pages.

101. In the barrier calculations, only the ISO9613 method is allowed for the ISO9613 model calculations and only the Maekawa method is allowed for the CONCAWE model calculations. Any attempts to choose different barrier calculation methods for these two models are ignored. This avoids considerable confusion.
102. The ground effect options for the ground effect calculations with and without a barrier have now been made consistent.

Module 5 - Outdoor barrier

103. All relevant changes made for the barrier calculations in Module 3, ENC 4th version page have also been made in Module 5. This includes deleting the ISO9613 and CONCAWE methods as these are dealt with separately in Module 3 together with other propagation effects. The calculations in this module give the same results as obtained using the ENC 4th version page in Module 3.

Module 6 - Reactive mufflers

104. The confusing message about the duct diameter being different to the inlet duct diameter when the Helmholtz or 1/4-wave resonator options are chosen has been removed for non-circular ducts. For a non-circular duct the attached duct diameter that should be entered is the distance from the mouth of the resonator to the opposite wall of the duct.

Module 6 - Lined duct

105. The incorrect symbol for temperature in the popup window that appears when the green “Flow resistivity” button is clicked has been fixed.

Module 8 - Control Valves - gas

106. The option of selecting a multi-hole trim has been added.

ADDITIONS AND CORRECTIONS NEW IN VERSION 5.5

Module 3 - Sound propagation

107. The calculation of barrier attenuation requires that the ground under the source, receiver and barrier all have the same height coordinate. To avoid errors, this has now been set to 0.0 and cannot be changed by the user. A future version of ENC will allow the ground height to be different under the source, barrier and receiver and will allow the ground to slope between them.

Module 4 - Panel absorbers

108. The equation in the analytical method for radiation efficiency has been updated for excitation by an incident sound field. The previous ENC version used the equation for point force excitation.

Module 6 - Pressure loss, flow through a straight duct

109. The value for f_m from Equation (8.244) is now made more accurate by iterating using Equation (8.243).

Module 8 - Control valves – liquid

110. A new page based on the 2015 IEC standard has been added.

Module 8 - Pipe flow noise (turbulent flow - Baumann/Coney)

111. The upper frequency limit over which the results are valid has been extended.

Module 8 - Wind Turbines

112. This category has now been checked and added to the Gas and Steam Turbine page. Although this page was added in version 5.4, it was not mentioned in the 5.4 release notes, as it was not yet completed and checked.

ADDITIONS AND CORRECTIONS NEW IN VERSION 5.4

Module 2 - Rayleigh Integral

113. This is a new page in this module. It uses 1/3-octave or octave band average RMS surface velocity measurements to calculate the sound pressure level at a location in the far field of a vibrating structure consisting of a continuous surface and assuming that radiation from the back-side of the surface will not contribute to the sound pressure at the receiver location. The surface is divided into a number of elements, N , and the 1/3-octave or octave band surface velocity is averaged over the element. If the elements are sufficiently small, 1 velocity measurement for each element may be adequate. The radiating surface must be in a large baffle or part of the surface of an enclosure.

Module 3 - Sound Propagation

114. The problem with errors in the barrier attenuation arising when a non-zero location is used for the base of a barrier has been fixed temporarily by not allowing non zero height locations for the ground under the barrier, source or receiver. For now, these different ground heights can be taken into account approximately by adding the ground height of the source and receiver to their respective heights. The origin of the coordinate system will be at the base of the barrier, in its centre, where it touches the ground. The ability to include non-zero ground heights for the source and receiver will be included in a later version of ENC.
115. The negative barrier attenuations obtained in some cases when the barrier does not interrupt the line-of-sight between the source and receiver has been fixed.

Module 5 (old Module 4) - Double Wall

116. The TL at point B and at frequencies between