NorFLAG 4.0

Acoustic Performance Estimation Software
(Updated from NorFLAG version 3.0)

Do you need to estimate the acoustic performance of constructions combining different material layers such as porous materials (e.g. mineral wool), solid and perforated plates (slotted, with circular holes, microperforated)? NorFLAG does the job of calculating the absorption coefficient, the impedance and the sound reduction index for constructions combining such different material layers. NorFLAG also calculates the attenuation of noise in ducts, e.g. air-conditioning ducts, lined with the chosen layers.

Calculations may be performed at single frequencies or as mean values in one-third-octave bands, for free and diffuse field sound incidence. For exported data (MS-Excel or ASCII) values in octave-bands are presented. One may estimate the absorption coefficient measured in a standard reverberation room according to ISO 354. These absorption coefficients may be directly exported to the software NorRT60 that calculates the reverberation time in rooms.

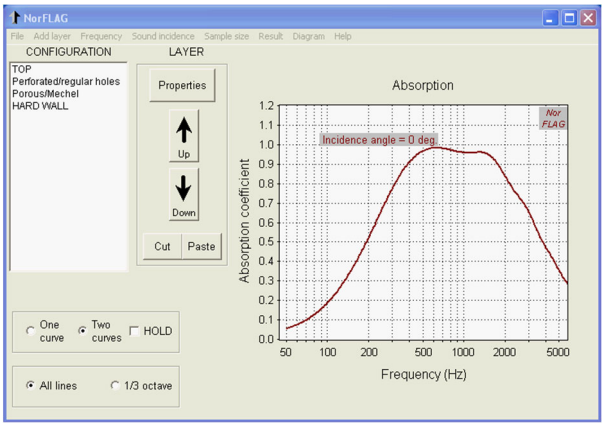
For its calculations, NorFLAG uses, except when handling flexible plates, a transfer matrix method with only two physical variables: sound pressure and particle velocity. This implies that porous materials are treated as equivalent fluids, which will not completely represent certain foam materials. The software will, however, give a proper model in a vast number of cases and certainly be useful both for acoustic consultants and for students in acoustics as well. Please note that NorFlag software is updated version of the former WinFlag software being commented on below.

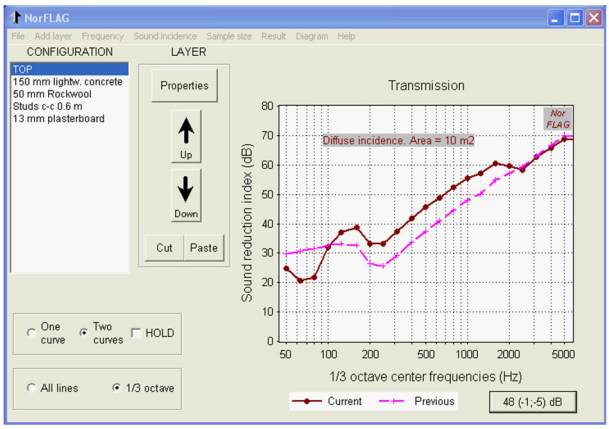
“These programs (WinFlag and WinRT60) are exceptionally user-friendly and will be useful tools in any acoustic engineer’s toolbox” - Carl Hopkins, University of Liverpool, UK

My every day work is to compare, evaluate, optimize and calculate acoustic materials.
One of the most efficient tools to do this, besides doing the measurements, is using WinFlag to predict, verify or recalculate materials, material designs and “measurement” results.
- Jan Borgers

“I have to say I love this program. It is a matter of seconds to design an absorber panel for a specific frequency, and adjust its Q. Compared to similar software it is more straightforward, quicker, and looks overall more professional.”
- Thalis Menexelis, Athen, Greece

"The manual and program looks very intuitive and good with references for the models. I think this program is a useful tool for acoustics consultants and even producers of absorbers."
- Anders Buen, Brekke & Strand Akustikk AS, Norway





- Calculates the absorption coefficient with a choice of 22 different types of layers, including 7 different models of porous materials. The absorption coefficient may be calculated, with some exceptions, for any combination or any number of these layers limited to a total of 20 layers. A 23th type of layer, the infinitely hard wall, i.e. a rigid backing, may be included in the case of absorbers placed against a hard wall in a room.
- Absorption coefficients obtained in a standard reverberation room (the commonly used product data after ISO 354) may be estimated, as well as the weighted sound absorption coefficient α_W according to ISO 11654.

- The sound reduction index in dB (sound transmission loss) is simultaneously calculated for all combinations not including the infinitely hard wall. The weighted sound reduction index R_w (C; Ctr) according to ISO 717 Part 1 is also calculated when applying a diffuse field option and calculating results in one-third-octave band.
- To simulate structural connections in double lightweight walls, such as studs or point-like connections ("ties"), two additional types of layers named *Structural bridges,* is introduced. These bridges may either be infinitely stiff or given a certain flexibility to simulate e.g. flexible steel studs in double-leaf walls.
- The acoustic impedance is also simultaneously calculated in all cases when an angle of sound incidence is specified.
- All data mentioned above may be calculated for a given angle of incidence or in a diffuse field. For the effect of structural connections, however, only diffuse field calculations are applicable.
- Calculations are performed at single frequencies or as mean values in one-third-octave bands. There is also an option for exporting calculated results as mean values in octave bands.
- As an add-on to the software the attenuation of noise in ducts, e.g. air-conditioning ducts, lined with the chosen layer configuration may be calculated.
- A report window in Rich Text Format (.rtf file) is implemented where specifications, tables of results and diagrams may easily be imported.
- Results, together with specifications for the combination of layers, may be exported to a plain text file (ASCII), alternatively to a Microsoft Excel file.
- A chosen combination of layers, a configuration, may be saved to a file and later imported for additional calculations. The same applies to single layers, which enables the user to build up a library of material layers.

New features in NorFLAG version 4.0 (upgrade from version 3.0)

- Similar to the general model for a perforated plate with rectangular slots (or slits), the model for perforated plate with circular holes is exchanged with a general one covering all sizes of perforations, from micro-perforations to common large holes. However, the special model for micro-perforated plates with holes is kept such that one may compare results using these two different models.
- Predicted result for the absorption coefficient measured in a standard reverberation chamber often shows too high coefficients in the lower frequency range, especially for relatively thick porous materials, also with an airspace backing. The normal procedure is to integrate over the whole angle of incidence, zero to ninety degrees. Reducing the angle of incidence upwards to approximately 80 degrees may in such cases give a better fit to the measured data. When predicting results for reverberation room measurements, one is offered a choice of the upward integration angle.
- The one-parameter model of porous material by Wilson is substituted by a newer one having three parameters. In addition to the resistivity of the material, the porosity and the tortuosity shall be specified.
- A graph presenting the flow resistivity for mineral and glass fibre materials used in Norway is presented in the manual for the software. However, a simplified model is now included to calculate the resistivity (kPa·s/m2) either of glass or mineral fibre materials when the fibre diameter and the material density are known. Additionally, the resistivity (kPa·s/m^2) of sintered metal fibre material may also be calculated when the fibre diameter and the porosity are known.
- To obtain a high absorption coefficient for a perforated panel absorber it must normally be combined with a porous layer or a fabric placed close to the holes or slots, this to give the necessary resistance component. In the case of using a wire mesh cloth in such cases, a model is included under the "Help" menu to calculate the resistance (Pa·s/m) of such a cloth.
- When calculating the attenuation in ducts the result was formerly given by dB/m. Now one may calculate the attenuation in dB specifying the length of the duct silencer.
- A number of five new Annexes are added to illustrate calculated and predicted data concerning absorption coefficients and transmission loss, also including data for some new types of materials.