

Methods of determining the impact of noise from vehicles and munitions

Study into the transfer and impact of noise

Noise is produced when weapons, munitions and vehicles are deployed. TNO investigates the transfer of noise and its impact on the environment, and gives advice on noise-reduction measures.



The firing of munitions, the use of explosives and the use of heavy vehicles are all examples of Defence activities that generate noise. This noise can be aggravating, annoying and sometimes even disturbing for artillery personnel and drivers alike as well as for people living in the neighbourhood of a barracks or artillery range and also for animals in the surroundings.

TNO has developed methods to measure the intensity of the noise at the source (a weapon or vehicle, for instance) and is able to calculate the transfer of the noise from its source to the environment and its subsequent impact.

Noise transfer across large distances

The intensity of the noise transfer in the

atmosphere is closely related to the weather conditions and the state of the soil. Each soil type and weather condition has its own acoustic properties that can make the noise either stronger or weaker. Following precise and extensive research, TNO has developed validated calculation models to measure the transfer of noise across large distances.

Sound that crosses both land and water is difficult to measure; the two surfaces affect the transfer of noise differently. The meteorological situation can vary significantly and thus allow other influences to be exerted on the noise. TNO's calculation models, however, are able to define the weather conditions in detail and therefore very precisely measure the noise transfer. Since these models can be linked to weather

prediction models, the noise impact can be forecast up to 48 hours in advance.

Noise and weapons

For artillery fire three kinds of noise can be measured:

1. muzzle noise that is created by the explosive combustion of the charge of a projectile that is fired;
2. projectile noise that is created when the projectile travels faster than the speed of sound (comparable with a jet fighter that breaks the sound barrier);
3. detonation noise that occurs when the projectile has a detonating charge and explodes.

TNO has studied methods to measure and determine the strength of the source of this noise as well as calculation methods to determine the impact of the noise. Special research has been performed on heavy artillery, which produces low-frequency noise that carries over large distances and is difficult to reduce. TNO has been working with the American Defence Ministry to study the measures that have the best chance of reducing the noise made by these weapons.

Noise and vehicles

A Leopard tank and other heavy vehicles produce a lot of engine noise. The strength of the noise for vehicles is normally measured at the source, but using an array of microphones TNO has been able to study the direction the noise takes, and investigate, for instance, how special noise mufflers on the Leopard tank can help reduce the noise.

Noise and firing ranges

Shooting practice using rifles and pistols takes place in the Netherlands on shielded firing ranges with concrete shields above the firing area. This ensures that the bullets are contained within the firing range and do not ricochet off into the surroundings. TNO studies the impact of the noise of these ranges on, for instance, the residential area in their vicinity and advises on measures that can be taken to reduce this impact.

Noise and vibrations of buildings

Explosions cause waves of noise that flow not only through the atmosphere but also through the ground. These waves can cause buildings to vibrate and, consequently, result in constructional damage. TNO performs measurements for buildings to determine the likelihood of any damage.

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Weather conditions and soil composition affect the noise transfer. TNO's calculation models take these into account.



TNO calculation methods determine the noise transfer over both land and water, enabling the impact of the noise to be predicted up to 48 hours in advance, taking into account the weather forecasts.



TNO uses an array of microphones to identify precisely from which side of the Leopard tank the noise originates.

TNO Defence, Security and Safety

'TNO Defence, Security and Safety' is the title under which TNO operates as a strategic partner for the Dutch Ministry of Defence and makes innovative contributions to enhancing the security of the Netherlands both at home and abroad. We also use our accumulated knowledge for foreign governments and for defence-related industries.

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