

TEST & EVALUATION of BIO-DETECTORS



TNO innovation
for life

BIO-DETECTION

The military threat coming from bacteria, viruses and toxins is of great concern. Bio-detectors and samplers are being applied to timely determine the presence of such biological agents on-site. Users often have difficulties in defining how well this equipment must function. Procurement agencies are not always able to adequately appreciate claims of performance by suppliers. Industry often has difficulties in providing evidence of adequate performance. TNO offers to assist end-users, buyers, manufacturers and other stake-holders in defining

validating the performance of detector systems against these specifications.

The TNO products provide:

- consultancy on defining requirements
- support in procurement processes
- laboratory equipment testing and evaluation against requirements
- advice for equipment improvement.
- operational advise on implementation

The laboratory capabilities include a bio-aerosol test chamber and supportive microbiology facilities up to Biological Safety Level 3 (BSL 3)

CONSULTANCY

TNO offers technical and conceptual support in design, procurement and development of bio-detection systems and samplers. TNO knows how to derive and implement user needs, based on the requested capabilities and prerequisites (requirements). Consultancy also includes translation of anticipated scenario's into functional requirements for detection systems.

TNO offers a model-based approach to address optimization of detector settings. This helps to tune detector output with the user decision making based upon it. TNO also provides support to procurement processes, e.g. by expert judgement of programs of requirements and industry responses thereto.

EXPERIMENTAL TESTING

To what extent a detector or sampler complies with pre-set requirements can (best) be verified by experiments. TNO offers a product using an in-house laboratory facility consisting of a 12 m³ Dycor® bio-aerosol test chamber, which allows both dynamic and static exposure of equipment to biological agents at BSL 1. This product serves to evaluate the performance of bio-aerosol detection or sampling systems against non-pathogenic simulant agents.

For non-aerosol tests, TNO has facilities to evaluate equipment challenged with viable material up to BSL 3. This product serves a complementary role, to confirm the performance of bioaerosol detectors against premixed samples of live pathogenic agents. It also allows to evaluate systems with non-aerosol inlets. Both products can be combined, by splitting samples and subsequently challenging the detection equipment at BSL 1 and at BSL 2/3.

As a crucial final step in the detector evaluation process, TNO can offer access to field trials, due to TNO's strategic collaborations with reputable (inter-) national partners.

EVALUATION CONCEPT

The bio-detector evaluation concept offered by TNO complies to that, being developed in the European Defence Agency project 'T&E Bio-DIM'. This concept is based on three stages:

- source of the agent
- pathway between source and target/receiver
- the target/receiver of exposure.

Biological test event



SOURCE

TNO can test biological detectors using internationally accepted biological agent simulants or other BSL 1 agents in the controlled atmosphere of the bio-aerosol test chamber. Among these simulants are:

- Spores of *Bacillus atrophaeus*: simulant for *Bacillus anthracis*
- *Erwinia herbicola*: simulant for e.g. *Yersinia pestis*, *Francisella tularensis* and *Brucella*.
- MS2 and Baculo CpGV: simulants for viruses
- Ovalbumin: simulant for toxins, including ricin and botulinum.

The aerosol challenge can be generated from both dry material or suspensions in relevant size ranges. Relevant interfering agents can be mixed with the aerosol to investigate the selectivity of equipment. A variety of pre-testing growth conditions of micro-organisms is possible.

PATHWAY

For experimental simulation of the pathway between source and receiver TNO applies the aerosol test chamber. In here, the aerosol challenge, the temperature and the humidity are being varied, controlled and registered during exposure experiments. This offers high reproducibility of the challenge-level.

TARGET/RECEIVER

In the detection evaluation paradigm, the target/ receiver, being the detector or sampler under evaluation, is placed inside the BAT chamber. Alternatively, it can be set to sample from outside the chamber.

EVALUATION OUTPUTS

The most straightforward read-out is the detector's Limit of Detection. If assessed along a range of bio-agents, this provides information on sensitivity and detection-spectrum. However it does not provide information on the reliability of the detector signal, which to many users is

indispensable. Therefore, TNO offers a product, the so-called Receiver Operator Characteristic (ROC) curve, in which other operationally relevant parameters such as response time, sensitivity, false alarm rate are also determined.



Furthermore, TNO experts, operating and evaluating detection equipment at some stage of development, can give conceptual and technical advice to developers and suppliers, which may improve equipment design or efficacy. TNO experts may also advise users with regard to optimal implementation and application of detection systems (such as instruction of use, location, network set-up), for which purpose TNO products such as operational modelling of dispersion and detector architectures are available.

TNO

The 3300 TNO professionals put their knowledge and experience to work in creating smart solutions to complex issues. These innovations help to sustainably strengthen industrial competitiveness and social wellbeing. We are partnered by some 3000 companies and organisations, including SMEs, in the Netherlands and around the world. For more information:

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