

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 enhance the safety and security of the Netherlands both at home and abroad. We also use our accumulated knowledge for businesses, industries and foreign governments.

Do you have a specific question or an issue you want investigated? The TNO Infodesk is the central gateway to the knowledge and expertise at TNO and it serves as an oracle for companies. You can contact the Infodesk on +31 15 269 6969. You can also raise your question by sending an e-mail to: infodesk@tno.nl

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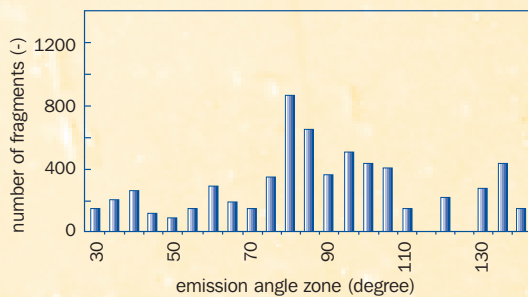
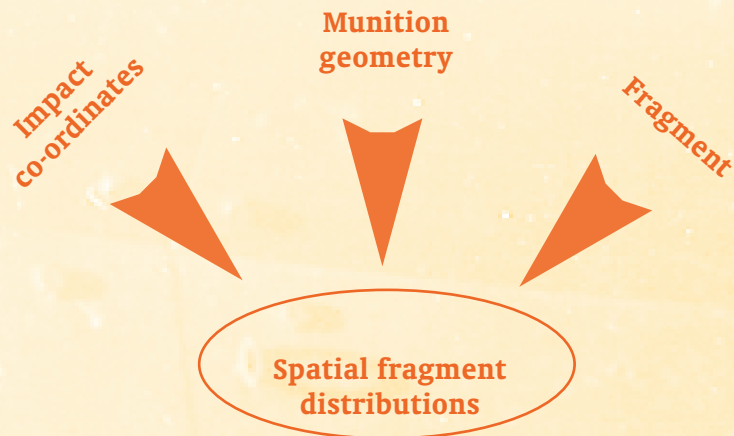


Fragment Cloud Analysis Method

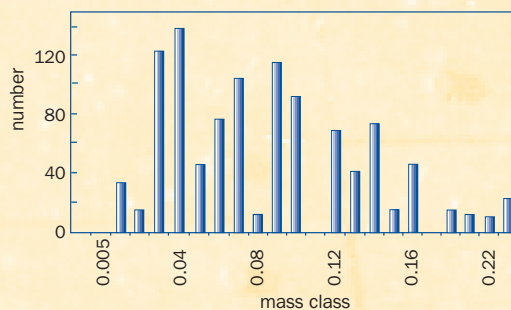
TNO | Knowledge for business



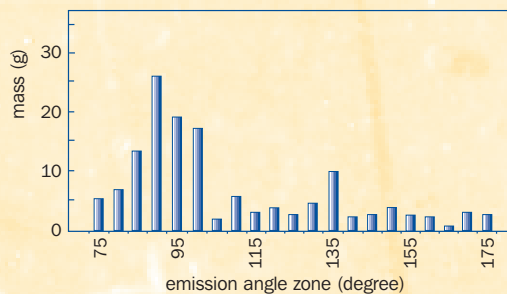
Diagnostics by cardboard soft recovery



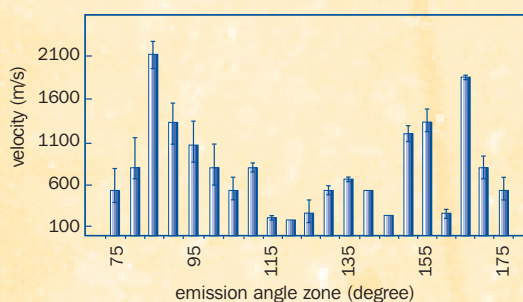
Spatial fragment distribution.



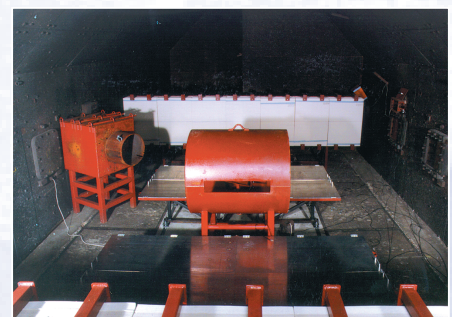
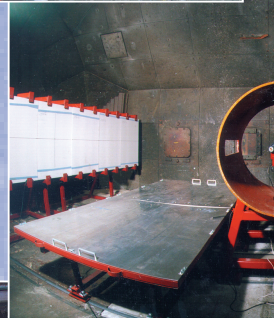
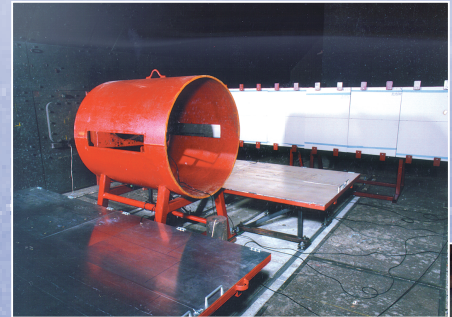
Fragment mass distribution.



Spatial fragment mass distribution.



Spatial fragment velocity distribution



Diagnostics by X-ray shadowgraphs

Co-ordinates of X-ray film and X-ray pulsers. Shadowgraphs of fragments

Timing of consecutive flash radiographs

Spatial fragment velocity distributions

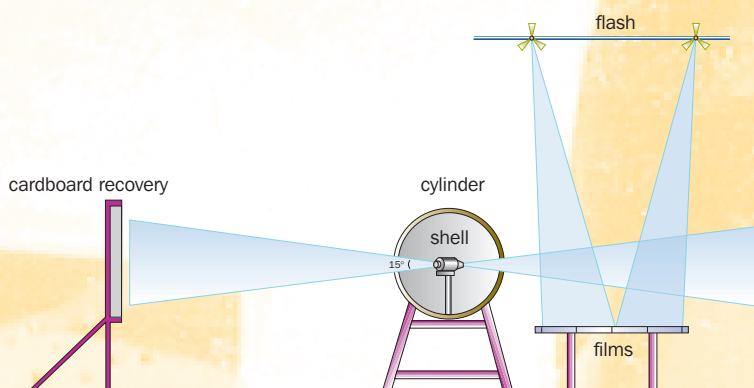


To measure the fragmentation characteristics of fragmenting munition, TNO Defence, Security and Safety has developed a standardised experimental technique: the Fragment Cloud Analysis Method (FCAM). Rotational symmetric fragmenting munition is placed inside a protective cylinder with two windows, allowing determination of the dynamics of the spatial fragment mass distribution.

Fragment recognition enables correlation between two consecutive shadowgraphs of the fragment cloud.

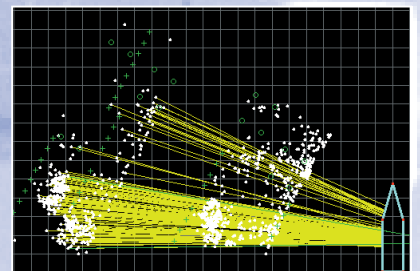
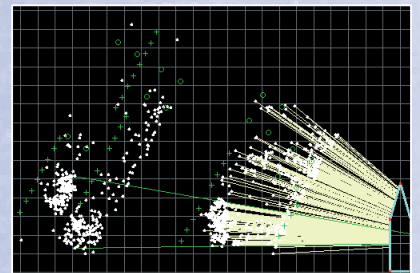
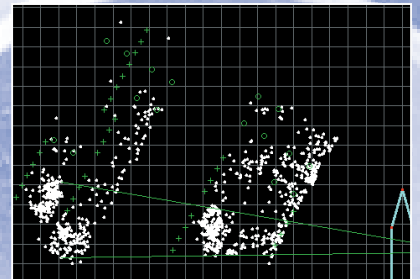
Advantages and Possibilities

- Well-conditioned static fragmentation experiment (conducted indoors).
- Fragmentation bodies with calibres of up to 155mm.
- Method applicable for spall characterization.
- Alternative for arena tests.
- Dynamical experiment feasible for calibres up to 40mm.
- Simultaneous determination of spatial mass and velocity distribution.
- Data can be transformed into many formats (like JMEM).
- Additional fragment perforation measurement can be performed simultaneously.



Resulting data suitable for:

- Evaluation by comparison of different types of munition.
- Evaluation of munition performance by computer simulations (data is input for computer models).
- Lethality calculations (lethal area) .



Consecutive digitized computer processed shadowgraphs.