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“Safer” Cluster Munitions?

Assessing Claims of Technological Advancement and Minimized Humanitarian Harm

Norwegian People’s Aid

Norway
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About this briefing paper

This briefing paper by Norwegian People's Aid examines claims that recent technological advances in cluster munitions have minimized the humanitarian concerns that led to the negotiation and adoption of the Convention on Cluster Munitions in 2008. It presents the key findings and conclusions of a new independent technical study by Fenix Insight, commissioned by NPA, and also draws on an earlier technical study undertaken in 2007 by Norwegian People's Aid in cooperation with the Norwegian Defence Research Establishment and C King Associates.

The briefing paper identifies the questions that should be asked—and the evidence that should be required—when assessing claims of technological advancement and minimized humanitarian harm.

Read the briefing paper and the technical reports online

https://bit.ly/4gVaflQ

Norwegian People's Aid, "Safer" Cluster Munitions? Assessing Claims of Technological Advancement and Minimized Humanitarian Harm (2026).

https://bit.ly/4cz50qF

Fenix Insight, Study of the Contemporary Types of Cluster Munitions with Self-Destruct Mechanisms and Their Impact in the Field (2026), commissioned by NPA.

https://bit.ly/3Sx3Tkw

C King Associates, Norwegian Defence Research Estabishment and Norwegian People's Aid, M85 – An analysis of reliability (2007).

Acknowledgements

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Cover photographs

The photographs are courtesy of Fenix Insight and show from left to right the only three significant submunition designs with self-destruct mechanisms that have become available for service after the adoption of the Convention on Cluster Munitions in 2008: (1) a Russian unexploded 3B30 submunition recovered by Fenix Insight in Ukraine; (2) an inert US M80 submunition; and (3) an inert Israeli M99 submunition.

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The return of an old argument

The argument that technology can overcome the humanitarian problems associated with cluster munitions is not new. Cluster munitions with submunitions incorporating self-destruct (SD) mechanisms and, in some cases, self-neutralization (SN) or self-deactivation (SDA) mechanisms became increasingly prominent during the 1990s and 2000s. Their benefits and limitations were extensively considered during the diplomatic negotiations that led to the Convention on Cluster Munitions (CCM) in 2008. Ultimately, such features were not accepted as sufficient to prevent cluster munitions from inflicting unacceptable civilian harm.

A 2007 study by Norwegian People's Aid (NPA), the Norwegian Defence Research Establishment (FFI) and C King Associates provided important evidence for the negotiations on the CCM. The study examined the Israeli M85, then widely acknowledged as the best available SD submunition with the lowest possible failure rate. *M85 – An analysis of reliability* found a striking gap between claimed and operational performance: despite a claimed failure rate below one per cent, analysis of the use of M85 in Lebanon in 2006 indicated a failure rate of around ten per cent. The study explained in detail why testing conditions and methodologies produce results that differ substantially from operational performance. It also identified fundamental characteristics of cluster munitions, which create a post-conflict explosive hazard that is different in both kind and scale from that posed by unitary munitions.

Two decades later, the technology argument has returned. Some States and commentators assert that "significant advancements" since 2008, including "enhanced safety mechanisms and self-destruct features", now "minimize humanitarian concerns" associated with cluster munitions.

Such claims require evidence. NPA therefore commissioned Fenix Insight to examine what has actually changed since 2008, and what the available evidence tells us about the performance and humanitarian implications of contemporary cluster munitions technology. The new study revisits and builds on the earlier 2007 report on the M85 submunition.

An unexploded M85 submunition found inside a house in Cambodia in January 2026. Photo: Chakreya Bout, NPA Cambodia

Key findings, conclusions and recommendations from the Fenix Insight study

1 Very little is new

Fenix Insight identified more than **30 types** of submunitions incorporating SD mechanisms that are currently in, or available for, service, and none that rely on SN or SDA as a backup feature. The identified submunitions were manufactured by a total of **eleven countries** (China, India, Israel, France, Germany, North Korea, Poland, Russia, Slovakia, Spain and the United States). In some cases, particularly among States Parties to the CCM, the manufacturing State has ceased production and destroyed its own stocks, while the munitions may remain in the stockpiles of other countries.

The large majority of the more than 30 identified submunition types were produced before the adoption of the CCM in 2008. Fenix Insight concludes that they continue to suffer from inherent problems. **Only three significant new designs** are identified as having been made available since 2008: the Russian 3B30, US M80 and Israeli M99. It is uncertain if the M99 submunition is still in production. Fenix Insight observes that the limited number of new designs is itself significant. This matters because terms such as "advanced", "modern" and "new-generation" can create an impression that cluster munition technology has undergone a broad transformation since the CCM was negotiated. The limited number of significant new designs identified by Fenix Insight does not support that characterization.

2 The claims are unproven

Fenix Insight's analysis of the three most significant post-CCM submunition designs shows that the Russian 3B30 has demonstrated significant failures under operational conditions, while insufficient information is available to substantiate the claimed high reliability of the US M80 and Israeli M99.

The study concludes that there is no clear evidence that technological developments since 2008 have overcome the fundamental reliability and post-conflict concerns associated with earlier submunitions. It further concludes that efforts to mitigate harm through new SD systems developed since the adoption of the CCM are "currently unproven" and that more data is required. With past claims of reliability proven to be overstated, far more robust evidence is needed to substantiate manufacturers' claims of reliability.

See Table 1 below for a summary of the study's analysis of the three submunitions.

3 Testing cannot replicate operational realities

Like the 2007 M85 report, the Fenix Insight study emphasizes that test results are not a reliable predictor of how cluster munitions will perform in a combat situation. Controlled testing can replicate only a tiny proportion of the combinations of factors encountered during actual operation. The particular characteristics of cluster munitions and their submunitions can make the gap between test results and operational performance greater than for other types of ammunition.

The M85 report also showed that test results for submunitions with SD mechanisms may be particularly unrepresentative, because the hard, level and unvegetated ground conditions in many tests favour the functioning of the impact fuze, leaving the SD mechanism largely untested.

These limitations are directly relevant to recent claims of high reliability. For the US M80, for example, live testing reportedly produced an average reliability of 99.52 per cent, but precise details of the testing procedure and environment are not publicly available, and there has been no reported operational use to confirm its reliability in the field.

4 SD mechanisms have limits

The Fenix Insight study focuses primarily on SD mechanisms, since these are the key risk reduction mechanisms. The development of submunitions with SD mechanisms represents genuine efforts to reduce submunition failure rates and, consequently, the residual explosive hazard after use. Yet, as evidenced by the findings of the study, these SD mechanisms are also prone to failure. Building on the analysis in the 2007 M85 report, Fenix Insight explains in detail why both the primary fuze and the back-up SD mechanism can and do fail. Tracing the life cycle of a submunition, the study identifies major factors that contribute to failure at each stage—from design and manufacture through storage, maintenance, preparation and deployment, to the circumstances of the submunition's impact with the ground. Thus, while SD mechanisms can lower failure rates, their potential to do so is limited.

Fenix Insight highlights a further concern: when SD mechanisms fail, the submunition is left on the ground in a state of "significant uncertainty". In some cases, the SD mechanism creates a second, alternative pathway to initiation, increasing the risk of detonation when an unexploded submunition is disturbed and complicating post-conflict clearance. While there is little data on the proportions of SD and non-SD submunitions used in recent conflicts, the study is clear in its conclusion: both "continue to cause unacceptable harm to communities and clearance personnel".

5 No unexploded submunition can be considered "safe"

Fenix Insight also discusses the advantages and disadvantages of self-neutralization (SN) and self-deactivation (SDA) mechanisms. Even where such mechanisms function correctly, the main explosive charge remains in place. They also usually give no external indication of the condition of the device, which creates uncertainty. The residual risk from an unexploded submunition can consequently be almost impossible to gauge accurately, including for specialists. Fenix Insight therefore emphasizes that, so long as energetic material remains, no unexploded munition can be considered "safe". It must be treated as hazardous and should not be touched. Its presence can therefore continue to deny access to land, housing and critical infrastructure even where it causes no casualties.

The 2007 M85 study addressed a related issue, cautioning against categorizing unexploded submunitions as either "hazardous" or "non-hazardous" based on whether they are armed or unarmed. Revisiting the M85 in its new analysis, Fenix Insight reiterates that while this submunition is designed to "fail-safe" if it does not fully arm, testing proved conclusively that an unarmed or failed fuze can arm and fire accidentally through common actions, such as impact, movement and vibration. Arming is not a simple on-off process. All unexploded submunitions present a hazard to deminers and to civilian populations exposed to them.

6 The fundamental characteristics of cluster munitions remain unchanged

More broadly, the analysis in the Fenix Insight study confirms that the fundamental characteristics of cluster munition technology persist in newer designs. Understanding these fundamental characteristics is crucial because the debate over the post-conflict humanitarian consequences of cluster munitions cannot be reduced to a question of achieving a nominal failure rate.

NPA's summary of the fundamental characteristics of cluster munitions is illustrated in Figure 1 below. They include the large numbers of submunitions that are ejected from a carrier and dispersed over an area; the small size and weight of the submunitions; the resulting design compromises, primarily very small, vulnerable components, which make them prone to failure; their greater vulnerability to varying operational and environmental factors; and greater fuzing sensitivity. Some of the reasons why submunitions fail are unique to cluster munition technology and cannot be overcome through more advanced submunitions. These include damage caused to submunitions during ejection and descent from the carrier or by fragmentation from other submunition detonations before impact. Submunitions can also fail if they don't impact at the intended angle.

Together, these fundamental characteristics create a humanitarian problem that is different in both kind and scale from that associated with unitary munitions. They can result in very large numbers of unexploded submunitions; a greater probability that civilians will encounter and handle them; and a greater likelihood that the unexploded submunitions will detonate when disturbed. Any technological improvements to individual types of cluster munitions and submunitions therefore need to be assessed against this wider picture.

Improved reliability would, in any event, address only the post-conflict hazard from unexploded submunitions—not the humanitarian concerns arising from the area effects of functioning cluster munitions at the time of use.

7 An extremely dangerous perception

Fenix Insight cautions that the perception that newer SD systems make cluster munitions safe and acceptable is "extremely dangerous." This warning is particularly relevant as claims about technological advances and minimized humanitarian harm increasingly enter policy debates on cluster munitions.

Fenix Insight recommends that the findings of the study be communicated to policymakers and decision-makers engaged in discussions concerning cluster munitions, their military utility and their humanitarian consequences. It also recommends that claims concerning new or technologically advanced cluster munitions be subjected to careful scrutiny before they inform policy or procurement decisions.

NPA Deputy Team Leader Sakda Leuamnard photographed on 15 May 2025, using a GPS device to record the coordinates of unexploded submunitions in Phornuan village, Paksong district, Saravane province, Lao PDR. Each sign indicates one identified unexploded submunition. Photo: NPA Lao PDR.

Table 1: Significant new SD submunition designs since 2008

Submunition	Manufacturing state	Summary of Fenix Insight's technical assessment
M99 	Israel	• The M99 is billed as an "Advanced Submunition". It followed the M85, apparently acknowledging that the M85 did not meet the claimed one per cent failure rate during operational use. The M99 is believed to incorporate the most comprehensive backup fuzing of any submunition and is therefore perceived to be the new benchmark in reliability. • There is very little information available regarding the design, or evidence from testing and operational use, to substantiate the claimed high degree of reliability for the M99. It has seen very little operational use, but even the one known deployment led to a documented case of a failed submunition. • Regardless of its fuzing systems, the fundamental characteristics of the M99, such as its use in multiples, deployment from a carrier and the incorporation of numerous small components, have been proven to result in high failure rates among other submunitions. • It is unclear whether the M99 is still in production. Fenix Insight recommends seeking clarification as to whether the Israeli production of the M99 has ceased, establishing whether the reported US acquisition of M999 cluster munitions with M99 submunitions is proceeding and, if so, whether this involves new production or existing stock.
M80 	United States	• The M80 aimed to significantly improve reliability by incorporating an electronic SD delay, mainly operating independently of the primary impact fuze. • There is very little information available regarding the design, or evidence from testing and operational use, to substantiate its claimed high degree of reliability. There has been no reported operational use of the M80. • Many of the fundamental features of the submunition suggest that real-world performance is likely to fall far short of test results. Analysis of the fuzing system identifies the potential for both mechanical and electrical points of failure.
3B30 	Russia	• The 3B30 is a complex submunition, with characteristics that make both the primary and backup SD fuzing vulnerable to a variety of failure pathways. • Operational use in Syria and Ukraine has led to large numbers of failures, suggesting a high failure rate. • When the 3B30 remains unexploded, the SD system becomes a liability, easily activated accidentally and with no visible sign that it has been initiated.

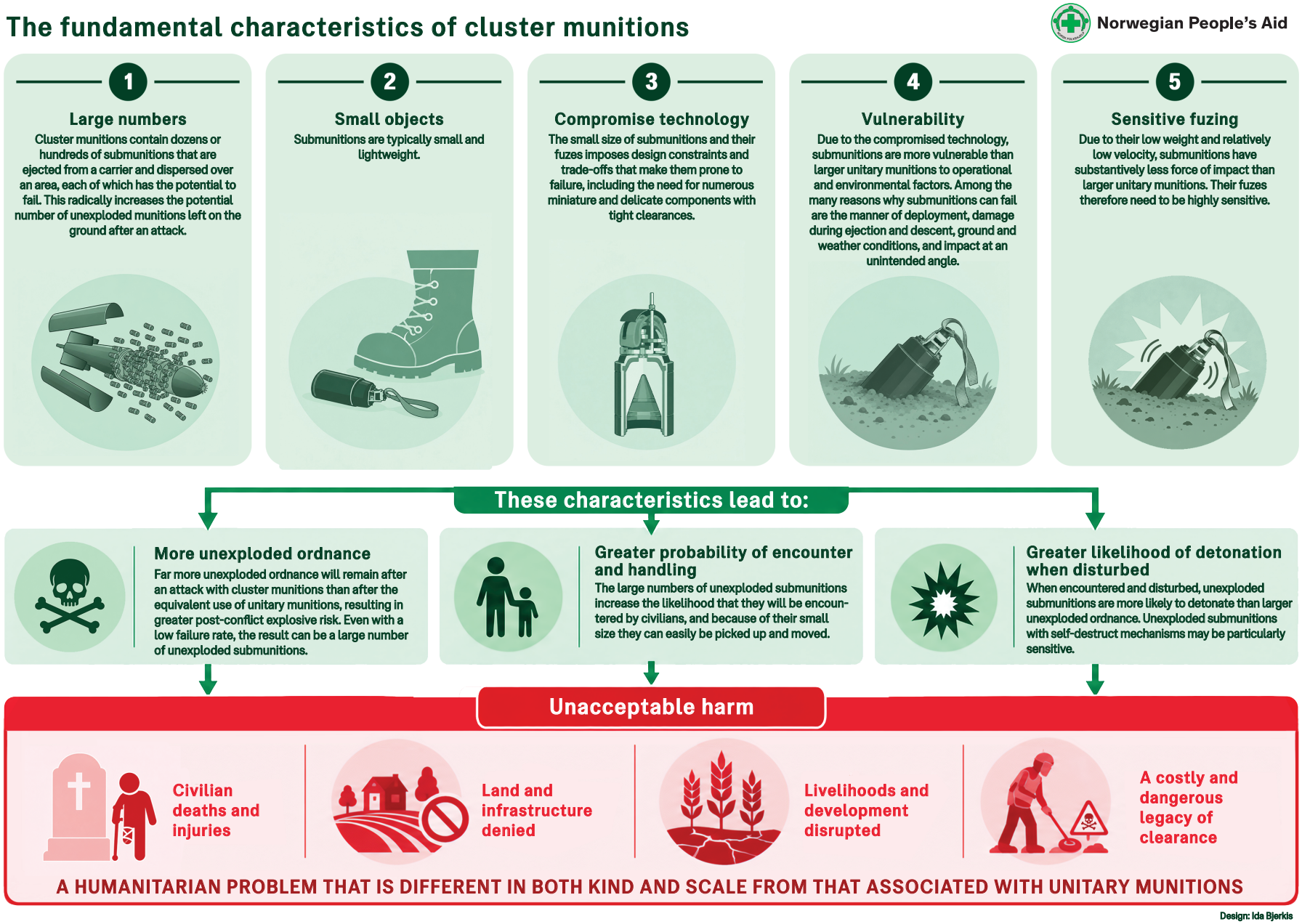

Figure 1: The fundamental characteristics of cluster munitions

Fact Box 1: Submunitions are compromise technology

- NPA uses the term **"compromise technology"** to describe the design constraints and trade-offs inherent in producing small, lightweight submunitions for dispersal by cluster munitions. As the Fenix Insight study explains, many submunitions share similar characteristics, largely dictated by their limited size and weight, that make them particularly prone to failure.
- Submunition fuzes are typically small and contain numerous miniature and delicate components, with tight clearances, which make them vulnerable to a range of operational and environmental factors. Any pathway interference or distortion of a critical component is likely to prevent the system from operating as intended. Components can, for instance, be damaged during ejection or descent from the cluster munition carrier, or by fragments from detonations of other submunitions.
- Their small size and low weight also affect how submunitions interact with the environment. Anything that cushions the impact of a submunition can increase the likelihood of failure. As Fenix Insight explains, a submunition weighing 200 grams may be slowed significantly as it passes through the leaves and small twigs of a tree canopy, whereas a 20 kg artillery projectile (weighing 100 times as much) would be barely affected.
- There is a further trade-off. Because the components are small and light and impact velocities relatively low, the fuze must be capable of functioning in response to comparatively low forces. If the fuze fails to function as intended, the unexploded submunition may therefore remain highly sensitive to subsequent movement or shock, increasing the risk of detonation when it is disturbed.

Fact Box 2: A low failure rate can mean large numbers

- Arguments that the humanitarian concerns associated with cluster munitions should be viewed in the context that "all weapons have a failure rate and leave behind unexploded ordnance" overlook a fundamental difference: **scale.** The large numbers of submunitions dispersed by cluster munitions radically increase the potential number of unexploded munitions left behind after an attack. The post-conflict problem created by cluster munitions is therefore very different from that created by unitary munitions.
- The effect of scale can be illustrated by applying the same hypothetical failure rate to similar unitary munitions and cluster munitions. For example, the Russian 9M218 122 mm rocket carries 45 3B30 submunitions. If a full salvo of 40 such rockets were fired, a hypothetical failure rate of 10 per cent would leave **180** unexploded submunitions. If 40 equivalent unitary rockets were subject to the same failure rate, **four** unexploded rockets would remain.
- The difference in scale becomes even more striking for cluster munitions that contain larger numbers of submunitions. Consider the hypothetical use of 20 US Army Tactical Missile System (ATACMS) missiles in an attack. ATACMS missiles can be equipped with either unitary warheads or warheads containing submunitions. The M39 ATACMS missile, for example, carries 950 M74 submunitions. At a hypothetical failure rate of 10 per cent, 20 unitary ATACMS missiles would leave **2** unexploded munitions. By contrast, 20 M39 ATACMS missiles would disperse 19,000 submunitions, leaving **1,900** unexploded submunitions at the same hypothetical failure rate.
- When greater numbers of weapons are used over the course of a conflict, the difference in scale is greater still. Consider the hypothetical use of a total of 100,000 Israeli M395 155 mm artillery projectiles each carrying 63 M85 submunitions. These would disperse a total of 6.3 million submunitions, of which **630,000** would remain unexploded at a hypothetical failure rate of 10 per cent. The equivalent use of unitary 155 mm projectiles would leave **10,000** unexploded munitions.
- The effect of scale remains significant even at very low failure rates. If a one per cent failure rate were achievable in practice, large numbers of unexploded submunitions would still result. Applied to the example above, a one per cent failure rate would leave **63,000** unexploded M85 submunitions, compared with **1,000** unexploded munitions from the equivalent use of unitary projectiles.
- UN estimates indicated that up to four million submunitions were dispersed over South Lebanon during the 2006 conflict. At a hypothetical failure rate of only one per cent, approximately **40,000** unexploded submunitions would still have remained. In reality, the failure rates were significantly higher.

Assessing the claims

The humanitarian concerns that led States to adopt the Convention on Cluster Munitions (CCM) remain as compelling today as they were in 2008. Where claims of technological advances or improved reliability are invoked as justification for a policy or procurement decision concerning cluster munitions, they should therefore be subjected to careful scrutiny.

To help policymakers, decision-makers, the media and civil society representatives assess such claims, NPA has developed the following recommendations.

1. **Ask what, precisely, is new**
   General references to "advanced", "modern" or "new-generation" cluster munitions or "enhanced" safety mechanisms are insufficient. Those making such claims should identify the specific cluster munition and submunition concerned, the technological development said to distinguish it from earlier systems, when it was introduced, and which reliability or humanitarian concern it is intended to address.

2. **Demand the evidence**
   Those making the claim should provide sufficient evidence for it to be independently and meaningfully assessed. Headline performance figures—such as claims of failure rates below one per cent—should not be accepted without the information necessary to assess them. This should include test methodologies, sample sizes, test conditions, environmental and terrain conditions, delivery parameters and complete results. Particular attention should be paid to what the claimed failure rate actually measures, including how extensively and under what conditions any incorporated SD mechanism or other safety feature was tested.

3. **Do not equate test results with operational performance**
   Controlled testing cannot reproduce the full range of conditions encountered during storage, deployment and actual use. Assessments should therefore consider not only how a submunition is designed to function or how it performs under controlled test conditions, but what evidence exists of its reliability under operational conditions. Evidence from actual use in combat should be given particular weight.

4. **Seek independent technical assessment**
   Policymakers and others who do not have the specialist expertise required to evaluate complex technical claims should seek advice from independent technical experts and humanitarian mine action operators with experience of cluster munitions and unexploded ordnance. Such expertise can help determine whether a State or manufacturer's claims are supported by the available technical, testing and operational evidence.

5. **Assess the humanitarian claim, not only the technical claim**
   Evidence that a particular technological development improves reliability should not in itself be treated as evidence that the humanitarian concerns associated with cluster munitions as a whole have been meaningfully reduced or minimized. The assessment must consider the fundamental characteristics of cluster munitions that underpin their pattern of humanitarian harm. This includes what a claimed failure rate means in terms of the actual number of unexploded submunitions left behind, the nature of the residual explosive hazard, and the humanitarian consequences arising from the area effects of cluster munitions at the time of use.

Abbreviations

CCM Convention on Cluster Munitions
SD Self-destruct mechanism
SN Self-neutralization mechanism
SDA Self-deactivation mechanism

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