



Defence
Safety Authority

DSA 03.OME Part 1: Defence Code of Practice (DCOP) 112

OME Vulnerability (Insensitive Munitions)



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Preface

Requests for Change

1. Proposed changes, recommendations, or amendments to DOSR Regulations and Guidance can be submitted to the DOSR Regulations and Publications Team:

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2. Any post and grammar change proposals can be approved or rejected by the DOSR without involvement of the associated Working Group.

3. Technical change proposals should be submitted to the associated Working Group for review and approval or rejection.

4. When incorporating changes, care is to be taken to maintain coherence across regulations.

5. Changes effecting Risk to Life will be published immediately. Other changes will be incorporated as part of routine reviews.

Review Process

6. The DOSR team will ensure OME Regulations remain fit for purpose by conducting regular reviews through the DOSR Governance Committees, consulting with MOD Stakeholders and other Defence Regulators as necessary on interfaces and where there may be overlaps of responsibility.

Further Advice and Feedback

7. For further information about any aspect of this document, or questions not answered within the subsequent sections, or to provide feedback on the content, contact the DOSR Regulations and Publications Team.

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DSA 02.OME Regulation 112

OME Vulnerability (Insensitive Munitions)

1. The Accountable Person shall ensure that the vulnerability of OME and the response to extreme but credible incidents is reduced to levels that are ALARP and Tolerable.

DSA 03.OME DCOP 112

Background

2. IM Policy has been developed to enhance the MOD's ability to demonstrate risks are As Low as Reasonably Practicable (ALARP) and Tolerable. The MOD's Insensitive Munitions (IM) policy sets out to progressively reduce over time the vulnerability of the UK stockpile as technology matures and procurement opportunities allow. It seeks to balance the technical costs and risks of improving the vulnerability of individual OME articles, against the improvements to safety that can be achieved at munition level, in the context of the entire munitions inventory.

3. NATO term defines IM as "A munition that reliably fulfils its performance, readiness and operational requirements on demand and that minimizes the probability of inadvertent initiation and severity of subsequent collateral damage to weapon platforms, logistic systems and personnel when subjected to specified accidental and combat threats".

4. IM policy is interpreted in the UK as the process for developing systems with improved vulnerability characteristics and is not used as a label for systems that meet AOP-39: Policy for Introduction and Assessment of Insensitive Munitions (IM), requirements. The covering STANAG for AOP-39 is STANAG-4439 - Policy for Introduction and Assessment of Insensitive Munitions (IM).

5. New munition acquisitions should be procured to comply with IM policy; this should be reflected at Outline Business Case (OBC) as a Key User Requirement. OME Project / Delivery Teams (PT/DTs) should remain proactive in the review of in-service munitions to identify IM improvement opportunities (e.g., re-stocking, mid-life update, re-provisioning, etc.) to achieve full or improved levels of IM compliance, to allow continual demonstration that OME risks are reduced to ALARP and Tolerable.

6. Improvement of IM characteristics offers the following benefits:

- a. The flexibility to concentrate assets and thus employ a smaller logistic 'footprint'.
- b. The retention of capability in face of attack and accidents.
- c. Reduced loss of people and assets following attack and accidents.
- d. A more favourable public perception of OME safety.
- e. Reduced demand for procedural risk mitigation measures (e.g., packaging and barriers).

- f. Reduced collateral damage in the event of an incident involving munitions (e.g., during storage and transportation).
- 7. Operational, transportation and storage benefits are realised through improved hazard classification (HC). The IM and HC testing burden can be minimised by combining IM and HC assessment requirements, providing the requirements of both IM testing and HC testing are met.
- 8. IM Cost Benefit Analysis (CBA) studies have shown a prevalence of high-risk situations during the operational phase of a munition's Manufacture to Target or Disposal Sequence (MTDS), i.e., OME is more likely to see an IM threat when deployed. The findings of these studies are backed up by statistics regarding Allied catastrophic munition related events.
- 9. IM compliance requirements should be considered when undertaking Urgent Capability Requirement (UCR) IM assessment – the delivery timescale for UCRs should not lead to a lowering of the priority placed on IM.

In insensitive Munitions Compliance

- 10. AOP-39 gives guidance regarding design methodologies that may be employed to achieve IM through intrinsic compliance of the OME, or external mitigations. Management of risk to ALARP and tolerable is required, irrespective of whether full IM compliance has been achieved.
- 11. 'IM compliance' means that the OME in a particular configuration satisfies the criteria set out in AOP-39. These stimuli have been selected to encompass credible hazard mechanisms that may be induced in OME and are set out in Table 1.

Potential Threats	IM Response Requirement
Fast Heating (Magazine, Store, Aircraft or Vehicle fuel fire)	No response more severe than Type V (Burning)
Slow Heating (Fire in Adjacent Magazine, Store or Vehicle)	No response more severe than Type V (Burning)
Bullet Impact (Small Arms Attack)	No response more severe than Type V (Burning)
Fragment Impact (Fragmenting Munition Attack)	No response more severe than Type V (Burning)
Sympathetic Reaction (Most severe reaction of same munition in magazine, store, aircraft, or vehicle)	No propagation of reaction more severe than Type III (Explosion)
Shaped Charge Jet Impact (Shaped Charge Weapon Attack)	No response more severe than Type III (Explosion)

Table 1 - In insensitive Munitions Threats and Response Requirements

- 12. IM compliance may be achieved by a range of methods, as follows:
 - a. Use of low vulnerability energetic materials which are tolerant of shock, impact, and heat.
 - b. Munitions design and construction.
 - c. Built-in mitigation (stress raisers, fusible plugs, coatings, and liners, venting systems and bore mitigants).

- d. Passive mitigation barriers (screens or shielding to separate and protect individual or grouped munitions).
- e. Packaging, (to protect the store from the threat or to contain the effects of an event).

13. IM compliance is an achievable objective for most new munition designs, but older munitions may have limited design flexibility so full IM compliance may not be possible. There is a requirement to reduce risk to ALARP and Tolerable, which should follow a systems approach and may include the use of procedural and other mitigation techniques and special packaging.

14. A Threat Hazard Assessment (THA) may be carried out to determine potential threats to the munition throughout the MTDS, and to justify why any specific IM threat is deemed to be irrelevant. The purpose of the IM THA is to capture all credible mechanisms that might induce a response in the OME.

15. If a THA demonstrates that an IM stimulus is not applicable to a munition in a specific configuration, the IMAP can assess the munition to be exempt from assessment of that stimuli, in that configuration.

Insensitive Munitions Assessment Panel (IMAP)

Role of the IMAP

16. The IMAP's role is to act on behalf of the National Authority for IM signatures of OME. IMAP is required to:

- a. Provide an assessment of the Final IM signature of OME design standards in various configurations.
- b. Provide an assessment of the Target IM signature of OME design standards in various configurations.
- c. Provide guidance to the AP on the following:
 - (1) Ensuring that the approach to IM assessment and the body of evidence to be provided is adequate to conduct an IM assessment.
 - (2) IM trial plans and results.
 - (3) Assessment of IM compliance and potential insertion of IM technologies throughout the CADMID cycle.

The IM Assessment Methodology

17. In assessing the IM status of OME, the IMAP will consider how the following factors affect the response to defined stimuli, as defined in AOP-39. These responses will be tabulated as an IM signature (where 'Y' indicates IM compliance and 'N' indicates IM non-compliance):

Response Type	Response Descriptor	Fast Heating	Slow Heating	Bullet Impact	Fragment Impact	Sympathetic Reaction	Shaped Charge Jet Impact
Type VI	No Reaction	pass	pass	pass	pass	pass	pass
Type V	Burning	pass	pass	pass	pass	pass	pass
Type IV	Deflagration	fail	fail	fail	fail	pass	pass
Type III	Explosion	fail	fail	fail	fail	pass	pass
Type II	Partial detonation	fail	fail	fail	fail	fail	fail
Type I	Detonation	fail	fail	fail	fail	fail	fail

Table 2: IM compliant signature matrix to threats as defined in AOP-39.

18. Factors affecting responses to defined stimuli are as follows:

- a. The explosiveness and sensitiveness of the energetic materials used in the OME.
- b. The design of the OME.
- c. Sub-component interactions.
- d. Tactical packaging.
- e. Logistic packaging.
- f. Storage and transport configuration.
- g. The operational environment.

Review of Proposed Assessment Methodology

19. The following should be provided to the IMAP during an IM signature submission:

- a. Brief description of OME, including design and construction sub-components, energetic materials, outputs from Threat Hazard Assessment, MTDS.
- b. Pre-existing information, including IM signature of similar designs, modelling and analysis, energetic materials characterisation, laboratory scale test results, small-scale and component level test results.
- c. Proposed IM proving methodologies, including evidence to be gathered from read across, EM characterisation, laboratory, and small-scale testing, modelling and analysis, sub-component level testing, full-scale testing proposed.

20. The IMAP will confirm that:

- a. The methodology and body of evidence proposed will allow a robust IM assessment suitable for the stage in the acquisition cycle which the munition has reached.
- b. Test procedures, configurations, instrumentation, and facilities meet the requirements and objectives of the test.

Assessment of Full-Scale Test Results

21. To categorise the results of IM full-scale tests, the IMAP require the information listed above and all available trials evidence. The relevant test AOPs identify the minimum data to be recorded, as follows:

- a. AOP-39 - Policy for Introduction and Assessment of Insensitive Munitions (IM). Covering STANAG: STANAG-4439 - Policy for Introduction and Assessment of Insensitive Munitions (IM).

- b. AOP-4240 - Fast Heating Munition Test Procedures.

(1) It should be noted that there is an opportunity to link IM tests to Hazard Classification tests: UN Test Series 6(c) - Bonfire Test (UN Manual of Tests and Criteria) is a comparable test to the Fast-Heating test but has a requirement for witness screens. It is a requirement in UN Test Series 6(c) that the article under test to be tested in the conformation as presented for transport.

- c. AOP-4382 - Slow Heating Test Procedures for Munitions.

- d. AOP-4241 - Bullet Impact Munition Test Procedures

- e. AOP-4496 - Fragment Impact Test Procedures for Munitions

- f. AOP-4396 - Sympathetic Reaction Test Procedures for Munitions.

(1) It should be noted that there is an opportunity to link IM tests to Hazard Classification tests: UN Test Series 6(b) – Stack Test (UN Manual of Tests and Criteria) is a comparable test to the Sympathetic Reaction test. It is a requirement in UN Test Series 6(b) that the article under test to be tested in the conformation as presented for transport.

- g. AOP-4526 - Shaped Charge Jet Munition Test Procedure

Submission for Endorsement of IM Compliance

22. Where OME has failed to achieve IM compliance, the IMAP can advise the Accountable Person (AP) with an opinion on the way forward. Implementation of IM Policy

Process for applying IM Policy to New Procurement

23. This procedure breaks down into four successive stages which may be adapted to the type of procurement and of OME considered:

- a. The DT/PT incorporates the UK IM Policy in the initial User Requirement Document as a Key User Requirement.
- b. The DT/PT, in consultation with IMAP, identifies a Target IM Signature for the OME.
 - (1) This requires an analysis of the risks to the OME throughout the MTDS, based on the threats listed in AOP-39, alongside a review of the current IM technology available. The Target IM Signature can serve as a basis for contractual requirements.
 - (2) The submission should show the signature derived from the IM assessment and justify any modifications due to consideration of the current IM technology. The risk assessment conducted for the expected responses to the AOP-39 threats, potential MTDS and mitigation measures where anticipated risk levels are not Tolerable or ALARP should be included.
- c. The DT/PT, in consultation with stakeholders and FLC/ODH, identify an achievable Contractual IM Signature, based on the Target Signature, whilst considering external influences, e.g., cost, time, capability requirements, etc. Any change from the Target IM Signature should be agreed by all stakeholders.
 - (1) After acceptance from stakeholders and FLC/ODH, a Contractual IM Signature should be incorporated into the contract at Full Business Case (FBC).
- d. The DT/PT, in consultation with IMAP, review the Contractual IM Signature throughout the CADMID cycle to identify potential for insertion of IM technologies and therefore potential improvement of IM signature.
 - (1) The AP should develop a strategy for achieving compliance with the Contractual IM Requirement. This strategy should ensure that IM requirements are being addressed and managed properly, the hazards associated with areas of deviation from UK IM Policy are captured and mitigated in logs and safety cases and that risk owners are engaged throughout the life cycle, and accept any residual risks associated with that deviation from UK IM Policy.

Mid-Life Update and Replenishment of Munitions

24. The mid-life update (MLU) of OME often involves replacement of energetic components (warhead, propulsion, fuze etc), packaging and configuration changes. This presents an opportunity to improve the IM Signature of that OME, should current risks and the current IM technology indicate that this is desirable. Therefore, opportunities for improving the systems IMAP assessment should be considered at this point.

25. This is particularly important if no IM specification was required at the time of the OME's initial procurement. If the OME currently in service does not have an IM signature validated by the IMAP, an additional stage should be incorporated at MLU to produce an IM signature in accordance with STANAG-4439.

26. When the MLU Target and Contractual IM signatures are established, the IMAP should be tasked to consider the evidence to ensure that there is no degradation of the levels of response relative to the IM signature of the OME to be updated.

27. The IM Signature of OME at replenishment should be considered; there may be a possibility of increasing the level of IM compliance by upgrade or replacement particularly if IM technology has advanced to a point where a significant risk presented by the OME could be mitigated or eliminated by adoption of that technology.

28. The IMAP may be consulted regarding the desirability of upgrade or replacement instead of like-for-like replenishment. If the IMAP advises that a significant risk could be mitigated or reduced, this should be considered as part of the safety and engineering risk management process.

IM Signatures

29. The IM assessment process culminates in the generation of the IM signature for a munition of a specified build standard in a specified configuration. For a complex munition with several components containing Energetic Materials, there may be multiple IM signatures for the various components in various configurations. The format of the IM signature is detailed in AOP-39.

30. OME Safety Review Panel (OSRP) submissions should include an IMAP assessed IM signature.

Agreement of IM Compliance

31. Attaining agreement of the level of IM Compliance should provide an audit trail demonstrating that the reasons for procuring a solution have been identified, assessed, and justified and that any deviation from MOD Policy has been communicated and accepted across DE&S and FLC/ODH.

32. This is important during MLU and replenishment activity, if improving the IM signature is possible but efforts are disproportionate due to time, cost, or performance reasons.

33. The IMAP submission should demonstrate that the risks associated with the OME have been identified and are reduced to ALARP and Tolerable. In drafting the submission, the AP should:

- a. Specify the shortcoming(s) against the MOD's IM policy.
- b. Identify the reason(s) for non-compliance.
- c. State the results of any cost benefit analysis.
- d. Assess the safety implications for the system, the munition, and its environment throughout its life cycle.
- e. Identify the operational impact, including any special handling or operating procedures and any mitigation measures required to reduce the risks associated with IM non-compliance to ALARP and tolerable.

f. Include the Platform PT / DTs and the Users in the risk management process and provide supporting evidence that they have implemented the mitigations and can operate the weapon system within the constraints imposed by the mitigations.

g. Identify future opportunities or a planned timescale for improving the shortcoming(s) against the MOD's IM Policy.

34. Agreements of IM Compliance should be recorded in the OME Safety Case and will be reviewed as part of the evidence provided for review by the OME Safety Review Panel (OSRP).

35. The AP is responsible for producing the submission for agreement of level of IM Compliance. In preparing the submission, the AP should consult with stakeholders, to ensure they are aware of the risks related to the OME and concur with any proposed mitigation actions. This could be undertaken through the Safety and Environmental Panel. The submission should include evidence of engagement and agreement to related risks and mitigations. The need for agreement of level of IM Compliance could arise throughout the OME MTDS.

Urgent Capability Requirement (UCR) OME

36. IMAP can support procurement of UCR's through the provision of IM assessments, made on readily available information. Where no information is provided and no demonstrable attempt is made to provide evidence, IMAP are unable to support.

37. If possible, the IMAP submission should be provided prior to system acceptance. Advice surrounding IM assessment of UCR OME should be sought from the relevant Independent Safety Advisor and IMAP.

38. The IM policy should be applied to UCR OME that is retained in service after the UCR has ceased, as part of the normal process of justifying, endorsing, and fulfilling the core capability requirement.

39. Where UCR OME has an FLC agreement of IM Compliance, but on re-provisioning, has had changes to its design or sub-assemblies, a submission for re-agreement of IM compliance should be made to the FLC detailing:

- a. The changes to the munition.
- b. A statement that the overall risk has not increased (or has decreased).
- c. Request that the FLC note the addition of the new munitions to the current agreement of IM Compliance for the duration of the UCR.