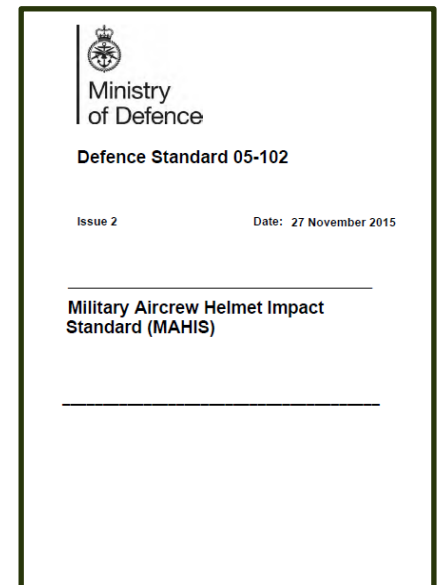


The Revision Of Military Aircrew Helmet Impact Standard (MAHIS) Def Stan 05-102 For The UK

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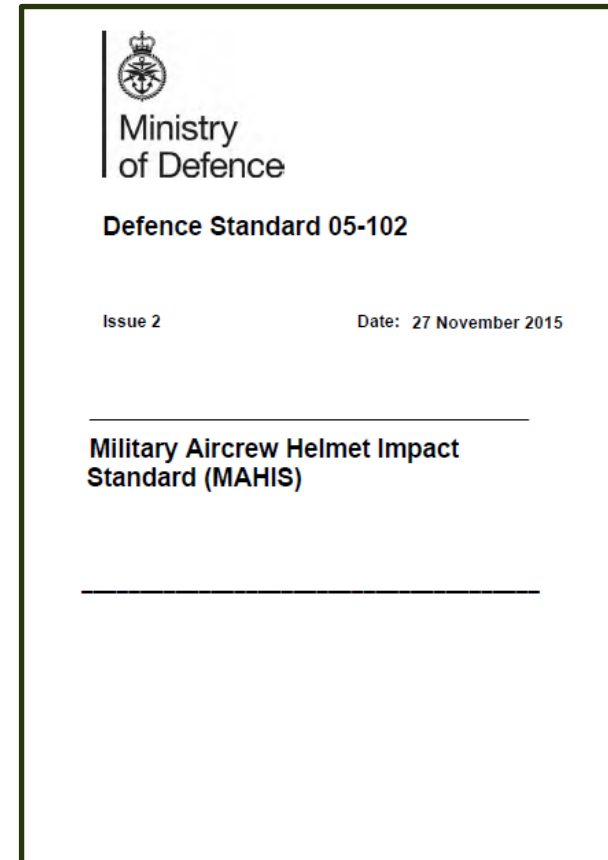
- What is Def Stan 05-102?
- Recent review and objectives
- Discussion of key changes and evidence
- Overview

What is Defence Standard 05-102?

- Def Stan 05-102 defines the shock attenuating performance of the helmet against different impact threats for UK military aircrew helmets
 - Type-E (ejection seats in fast jets)
 - Type-S (static seats in primarily helicopters & large fixed wing)
- It describes:
 - the required testing methodologies
 - the conditions for test and
 - the pass/fail criteria

Recent Revision

- In 2011 a review of the standard was requested by Cap Air
 - cross discipline working group set up
 - review of data undertaken
 - comparative assessment of US and UK helmets/standards undertaken (reported previously, Meeks and Logsdon (2013)¹)
- Review now concluded and revised standard published.
 - UK Defence Standard 05-102:2015 Issue 2



1. Assessing Impact Damage on UK and US Aircrew Helmets, Meeks and Logsdon, SAFE 2013

Working Group Key Objectives

- Establish whether there remains a need for a UK specific standard
- Review the threat to aircrew and ensure it is reflected within standard
- Ensure evidence for requirements are understood and documented
- Review and re-establish appropriate test methodologies (including the use of which headforms)
- Improve readability and clarity while removing ambiguity

The Review Process

- The review examined these key areas:
 - Protection requirement
 - Level of protection (max headform acceleration)
 - Extent of protection
 - Threat
 - Need for residual protection after initial impact
 - Characterising potential impactors
 - Environmental requirements
 - Test configurations

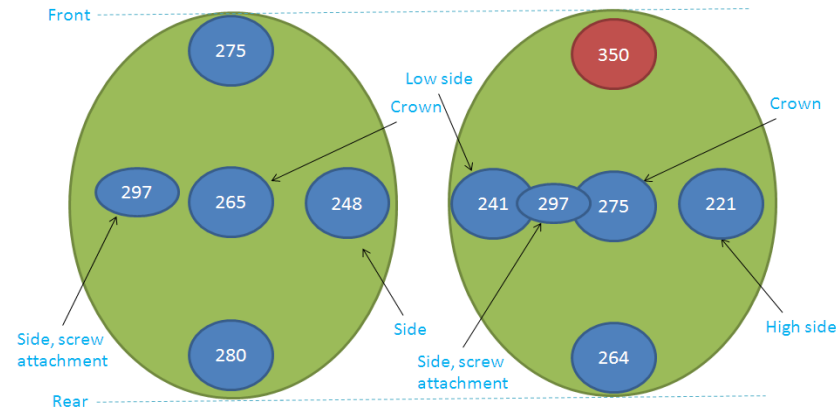


Protection

Headform Acceleration

- UK uses a 300G peak headform acceleration pass/fail limit
- Relevant accidents and incidents reviewed by RAF CAM
- Review of linear impacts and resulting head injuries conducted²
 - 300G remains limit to manage the risk of serious head injury

Conclusion - the current single pass/fail limit of 300G continued to be appropriate for MAHIS.



2. S. E. Day and C. Meeks, "Briefing note on pass/fail criteria applicable to MAHIS," QinetiQ, QINETIQ/12/00811/1.0, October 2012.

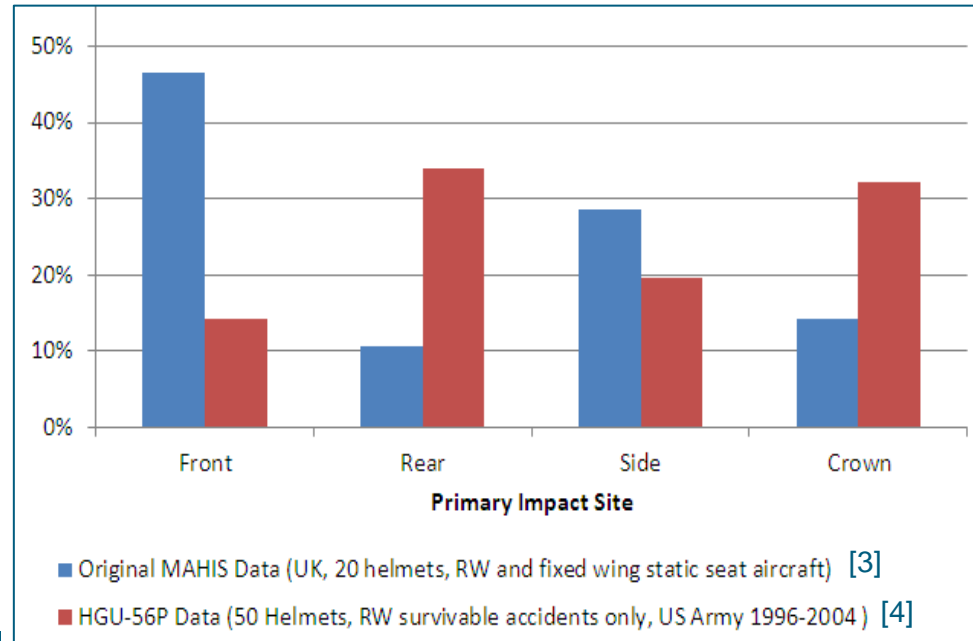
Protection

Protection Extent

- Threat analysis undertaken for Type-E & S
- There are specific threats
 - (i.e. on ejection)
- There is also potential for impact any point on helmet

Conclusion - protection maintained across whole shell

Rotary Wing Helmet Impact Sites



3. A. Foreman, S. E. Day and M. E. Lewis, "The development of a Military Aircrew Helmet Impact Standard - MAHIS," Journal of Defence Science, Vol 10, No 2, May 2005

4. M. Adams, "A Review of the US Army Helmet Impact Standards," Army Air Corps.

The Threat

Number of Impacts

- Difficult to determine, post accident, number of impacts in any given place
 - Visual damage from large impact similar to two small impacts
- There are known conditions for impact in specific places (i.e. back of head in windblast during ejection)
 - Following this there remains potential for further impact
- Accident evidence has shown significant numbers of survivable accidents where helmets has shown 2 or more impacts, but unable to conclusively rule out any multiple hits

Conclusion – Maintain a double impact requirement in standard



The Threat

Types of Impact

- It is common in helmet impact standards that anvils of different shapes are used to represent threats
- Studies have shown that impacts occur on objects that are not flat during a crash involving aircrew
- Accident damage replication undertaken in UK have shown better replication through the use of a hemispherical rather than flat anvil in some cases

Conclusion – maintain both the flat and hemi anvils



The Threat

Impact	Anvil Face	Impact Velocity (m/s)	
		Type E	Type S
1	Flat	6.0	7.0
	Hemispherical	6.0	7.0
2	Flat	4.3	5.0
	Hemispherical	4.3	5.0

Extract from Def Stan 05-102:2015 Issue 2

Impact Velocities

- Consideration was given to:
 - the database of survivable accident and incidents
 - damage replication studies
 - the performance of current in-service helmets
- Available evidence did not allow for any change in the impact velocities in the previous standard
 - However, no justification for velocity difference between anvils

Conclusion – impact velocities should be harmonised across anvils

Summary Of Other Key Changes

- Environmental testing aligned with aircraft RTS
- Penetration test removed due to lack of credible threat and inclusion of hemi anvil
- More precise definition of configuration for test
 - An as worn configuration at the point of impact

Testing Facilities/Equipment

- Inclusion of both twin wire and monorail frictionless guided free fall testing systems
- Updated set of headforms

Def Stan 05-102:2015 Issue 2

300G pass/fail criteria across whole helmet

Two impacts at same location

Flat and hemispherical impacts

Environmental test:

Hot: $+60 \pm 5^{\circ}\text{C}$, Cold: $-25 \pm 5^{\circ}\text{C}$

Immersion test removed

Explicit guidelines on helmet configurations for impact test, to minimise differing interpretations which may influence the test result

Remove the penetration test due to a lack of credible threat and the presence of the hemispherical impact test

Harmonise impact velocities on flat and hemi anvils:

Type-E helmet - 6m/s and 4.3m/s

Type-S helmet - 7m/s and 5.0m/s

Use of either twin wire or monorail frictionless guided free fall systems

Use of ISO headform sizes C, E, J, M, O

Conclusion Slide

- Scope of the standard remains limited to impact protection and remains a UK requirement
- All available evidence has been reviewed to ensure the standard remains current
- Changes have been made in light of available evidence
- Testing methods and requirements have been updated
- Readability and clarity has been improved

[dstl]