Review of advice to RAF aircrew for operating in extreme thermal environments

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Presentation Overview

1. Background on current advice to aircrew in extreme thermal environments
2. Review of UK aircrew “dress-to-survive” guidelines for cold-water immersion
3. Proposed revision of guidelines for cold-water immersion

The studies were conducted on behalf of RAF Centre of Aviation Medicine (RAF CAM)
RAF advice to aircrew for operating in thermal extremes

- Duty of care
  - AEA (MAA RA 2130 (3))
    - Cold protection for survival in cold water
  - Operations (MAA RA 2345 – fatigue)
    - Cold protection for survival on land
    - Restrictions in hot environments (GASOs)
    - Assess risk in cold and hot environments (JSP 539)

GASOs = Group Air Staff Orders, JSP = Joint Service Publication, MAA RA = Military Aviation Authority Regulatory Article
**RAF advice to aircrew for operating in thermal extremes**

| Regulation | Wearing and Carriage of Aircrew Equipment Assemblies (AEA) and Safety Equipment (SE)  
2130(3) Aviation Duty Holders and AM(MF) shall issue detailed orders covering the wearing and carriage of approved AEA and SE by aircrew, supernumerary crew and passengers in all aircraft under their AoR. |
| Acceptable Means of Compliance | For aircraft with a Release To Service (RTS), only AEA and SE approved in the Aircraft Document Set (ADS) should be worn or carried.  
For non-RTS aircraft, Aviation Duty Holders and AM (MF) Orders and/or Defence Contractor Flying Organizations’ Clearances should detail the AEA and SE to be worn and carried.  
Modification of Equipment. AEA and SE should not be modified in any way without approval of the relevant equipment authority.  
Where no equipment authority exists, approval should rest with the Aviation Duty Holder or AM (MF). |
| Guidance Material | Nil. |

No longer any guidance on ‘dress-to-survive’ advice for cold water immersion
RAF advice to aircrew for operating in thermal extremes

Advice to aircrew
Duty of care

AEA (MAA RA 2130 (3))
Cold protection for survival in cold water
Cold protection for survival on land

Operations (MAA RA 2345 – fatigue)
Restrictions in hot environments (GASOs)
Assess risk in cold and hot environments (JSP 539)

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RAF advice to aircrew for operating in thermal extremes

Previous guidelines based on ASIC standard:

- ‘Survival’ curves based on Wissler mathematical model and brief instructions
- A graph on how to account for water ingress into the immersion suit
- Similar model predictions for survival on land in tables and a Windchill chart
Review of guidance on AEA for cold-water immersion

Approach:

• Comparison of UK guidance against guidance provided to non-UK aircrew in other countries
• Comparison of UK Wissler model used to create the ‘survival’ curves with other models
• Benchmark existing/future AEA against existing thermal insulation data
Review of guidance on AEA for cold-water immersion

Benchmark against non-UK advice to aircrew:

- Requested information from TTCP participating countries and performed an open literature search on the internet e.g. dtic.mil
- ASIC standard and STANAG – same ‘survival’ curves as UK
- US Navy provide similar advice in tabular format (matrix table of clothing configurations and colour coding), don immersion suit ≤ 10 °C water temperature
- US Air Force has a similar document to JSP 539 for assessment of risk of cold injury but nothing for immersion
Review of guidance on AEA for cold-water immersion

Verification of Wissler model:

- Comparison against other models used: Cold Exposure Survival Model (CESM), NAVAIR Wissler model
- Limited data available – different approaches, not all information published
- CESM – UK Wissler model generally more conservative (cautious) results
- NAVAIR Wissler – UK Wissler model generally more conservative (cautious) results (different assumptions used in the measurement of thermal insulation and the model)
Review of guidance on AEA for cold-water immersion

Benchmark thermal insulation data:

- Only data available for non-Typhoon AEA were from 1980’s
- Typhoon AEA measured but modified method of calculating immersed thermal insulation from test results – lack of consistency between data
- Future Aircrew Clothing System (FACS) is to come into service and there is no immersed thermal insulation data
Proposed revision of cold-water immersion guidance

The proposed revision consisted of:

- De-emphasis of ‘survival’ times and ‘survival’ curves
- Colour coded zones for determining thermal insulation requirement
- Matrix style tables of AEA clothing configurations (platform specific)
- More explicit step-by-step instructions – more practical given the information available to Duty Holders
- Removal of ‘leakage’ advice
Proposed revision of cold-water immersion guidance

Revised ‘survival’ curves:

- Specific curve to account for maximum thermal insulation
- Colour coded zones
- Estimated rescue time NOT ‘Survival time’
- Accounts for GASO requirement to wear immersion suit

Example for AEA of all platforms except Typhoon
Proposed revision of cold-water immersion guidance

New table to represent AEA clothing and equipment:

Combination of clothing layers represented in a matrix table

<table>
<thead>
<tr>
<th></th>
<th>AEA items for Typhoon</th>
<th>Immerged thermal resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General coverall</td>
<td>Group</td>
</tr>
<tr>
<td>Without immersion suit</td>
<td>x1 - - x1</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>x1 - - x1</td>
<td>Any combination</td>
</tr>
<tr>
<td>With immersion suit</td>
<td>- - x1 - x1</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>- - x1 - x1</td>
<td>G</td>
</tr>
</tbody>
</table>

Example for Typhoon AEA
Proposed revision of cold-water immersion guidance

The limitations of the revision are:

- Lack of data for non-Typhoon AEA
- Historical inconsistencies in the method of calculating thermal insulation
- New AEA (FACS) to come into service without any thermal insulation data
- Lack of research quantifying impact of conditions outside of the assumptions (e.g. rough seas)
- No guidelines for dressing for abandonment on land in cold conditions
Summary

• A revision of ‘dress-to-survive’ guidance has been proposed focusing on improved ease of use and ensuring all aircrew platforms are addressed and the most up-to-date data is included

• The guidance can be further improved through:
  • Measurement of current and future AEA thermal insulation
  • Standardised approach to measurement and calculation of thermal insulation
  • Research to quantify the impact of rough seas and optimising AEA in terms of thermal burden
  • Inclusion of guidance for dressing for abandonment on land in cold conditions
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