The +$G_z$ette

Submissions from the International Acceleration Research Workshop Community
May 2008

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Workshop website:

www.flightmed.com.au/workshop.html

Where and When

This is the 22nd anniversary of the International Acceleration Research Workshop conceived by Dr. Russell R. Burton. This year's workshop will be held again during the Aerospace Medical Association Annual Scientific Meeting in Boston.

The workshop will take place at:

Fairfax A Room

Sheraton Hotel

Thursday, 15 May 2008

12:00 – 14:00 PM

Everyone is welcome

This year's International Acceleration Research Workshop is generously sponsored by:

wyle laboratories

Chairman of IARW 2008

and Editor of +$G_z$ette:

David G. Newman,
MB, BS, DAvMed, PhD, MRAeS, FAICD, AFAIM

2008 International Acceleration Research Workshop

Agenda

- **Welcome**
- **Introductions**
- **Discussion of newsletter articles and/or Laboratory/National Reports**
- **Special Announcements**
  - **Centrifuge manufacturers**
  - **TNO Presentation**
  - **Nic Green (Andy Prior)**
  - **IARW Website**
- **Other presentations or discussions of acceleration research related topics**
- **Chair selection 2009**

Chemical-Biological Ensemble with Anti-Exposure Protection Centrifuge Evaluation

Conducted by NAVAIR Human Systems Department at
Brooks City-Base San Antonio, TX
August – September 2007

Barry S. Shender, Ph.D.
Carla Mattingly

An evaluation of the Chemical Protective Undergarment (CPU) under the CWU-62B/P anti-exposure (A-E) coverall and the JPACE A-E Risk-Reduction chemical protective coverall (JARR) was conducted at the human centrifuge facility at Brooks City-Base in San Antonio, TX, to determine compatibility with the standard CSU-13B/P anti-G suit (AGS). Five assemblies were tested:

1. Baseline: CWU-62B/P with MCP (heavyweight Multi-Climate Protection top and drawer) and CWU-27/P flight suit
2. JARR: JARR with MCP
3. JARR-M: JARR with MCP and MOPP IV
4. CPU: CPU under CWU-62B/P and CWU-27/P flight suit
5. CPU-M: CPU with MOPP IV

MOPP IV condition included A/P22P-14 CB Mask (AR-5), JB2GU CB Gloves, CMU-24/P CB Overvest, and CB sock (CPU only; JARR includes CB socks).

Common items worn during each trial included briefs, HGU-55/P helmet, PCU-56/P parachute harness, CMU-33/P survival vest, safety boots, and AGS.

Eight subjects were exposed to +Gz rapid onset runs (ROR; 6 G/s up to a maximum of +9Gz for 15s), gradual onset run (0.1 G/s up to a maximum of +9Gz), and two types of simulated aerial combat maneuver profiles (6 G/s up to a maximum of +9 Gz) during approximately 60 minute trials. ROR G-tolerance with and without performance of anti-G straining maneuvers was determined. Objective measures included +Gz level, mean anti-G suit pressure (AGSP) at G plateau, AGSP inflation rate (time to 90% AGSP at G plateau), time to complete anti-G suit filling from beginning of G plateau, heart rate, and extent and persistence of loss of peripheral and central vision. Subjective measures of comfort and workload (NASA Task Load Index) were also assessed.

Not every subject was available to wear all five assemblies during the four weeks of testing in August and September 2007. One subject dropped out after one trial; his data were not included in the analysis. A total of five trials with each CPU and JARR configuration (with and without MOPP IV) and three baseline trials were conducted. While there were subject differences, results of ANOVA tests of objective data and Kruskal-Wallis tests of subjective measures detected no statistically significant differences in physiologic or most of the subjective responses between the assemblies. There was statistically significant less subjective workload recorded when the baseline assembly was worn compared to CPU and JARR ensembles. There were a

number of subjective comments noting the increased fatigue associated with wearing MOPP IV and varying levels of discomfort associated with parts of the assemblies.

Since the test assemblies did not impede the function of the AGS, there is no objective reason to limit the use of these configurations during test flights of high performance aircraft.

ASMA High G Workshop 2008

UK Update

Introduction

The UK conducts acceleration research at the Qinetiq centrifuge facility at Farnborough, and in 2 dedicated Hawk fast jet aircraft operated by the Royal Air Force Centre of Aviation Medicine (RAF CAM) at Boscombe Down. Aircrew training is also conducted on the Farnborough centrifuge – all fast jet aircrew undergo centrifuge training prior to flying the Tucano, and all Typhoon aircrew undergo centrifuge training/conversion to Typhoon life support equipment prior to starting the Typhoon operational conversion unit.

Typhoon aircraft

Centrifuge and flight assessments of life support equipment for the Typhoon aircraft continue. Full coverage anti-G trousers and positive pressure breathing for G protection (PBG) are now in service in Typhoon. Work has been completed on flight clearance of zipped full coverage anti-G trousers (FAGT), using a modified run-off of the zip closure, following a previous zip failure during a flight test in a Hawk aircraft. Long term assessment of the Typhoon Helmet Equipment Assembly continues, for durability, comfort and longevity. A similar assessment has been carried out for the Typhoon ADOM oxygen mask.

Joint Strike Fighter aircraft

A flight assessment of the JSF Bifurcated visor helmet mounted display system has been completed, with participation from 7 experienced US and UK aircrew. Comfort and stability of the helmet were assessed under flight conditions in the Hawk aircraft, including 1 vs 1 air combat, and exposure up to +9Gz. Flight testing of the Generation II helmet is anticipated in 2008.

STING

A flight evaluation of the STING anti-G ensemble and breathing regulator/PBG system has been completed in the RAF CAM Hawk aircraft (under an ASIC Test Project Agreement). A report in is preparation.

In-flight urination
A flight trial of a selection of in-flight urination devices is underway in the RAF CAM Hawks, including the AMXD pump system, the current in-service pack and the Travel John pack.

5 bladder anti-G trousers
A centrifuge and limited flight assessment of new monofilament 5 bladder anti-G trousers has been conducted. These have shown that performance is similar to legacy garments (Mk2 and Mk4) and a service trial is now planned. It is anticipated that these garments will replace the Mk10 anti-G garment which was previously found to provide sub-optimal G protection.

The Effect of Pressure Breathing and Chest Counter-pressure Garment Inflation on Apical Lung Expansion during Sustained +Gz Acceleration
A novel imaging technique called electrical impedance tomography (EIT) has been investigated for measurements of apical lung volume at accelerations up to +9Gz (60mmHg PBG) to investigate the effect of chest counter-pressure in reducing lung distension. Nine subjects were exposed to accelerations up to +9Gz under 3 experimental conditions: no PBG, and PBG with and without chest counter-pressure. Apical lung volume was measured using EIT and whole lung volume with spirometry. Significant reduction in regional and overall lung volume was found with increasing +Gz acceleration. PBG increased overall and regional lung volume, but the presence or absence of chest counter-pressure did not influence the magnitude of this increase.

Mask tensioning study
A small study was completed to determine the feasibility of using smart materials to automatically tension an aircrew mask during PBG and pressure breathing for altitude protection. A concept demonstrator was produced, which provided effective mask sealing. However, the thermal properties of the material are not presently compatible with operational use of the concept.

Acceleration Research Report from the Swedish Defence Research Agency

Acceleration Physiology

Ola Eiken, Britta Levin and Mikael Grönkvist

Research projects concerning acceleration physiology and spatial disorientation have been undertaken both at the Dynamic Flight Simulator (DFS) and at the centrifuge at the Karolinska Institute. Projects/problems that have been dealt with during the past year are:

• Problems at high G loads
- Cardiovascular effects of wearing a pre-inflated full coverage anti-G suit during 8 hours; effects of fluid intake (see Grönkvist et al., abstract 512)
- Work of breathing during pressure breathing at high G-loads; effects of the counter-pressure jerkin.
- Mechanisms underlying the G-protection afforded by the anti-G suit abdominal bladder.
- Pressure habituation of peripheral blood vessels – relations to G-induced arm pain and relaxed G-tolerance, and to the release of vasoactive substances at high G-loads / high intravascular pressures.
- Determination of G-tolerance in closed- vs open-loop systems.

• Spatial disorientation and motion sickness
- The significance of somatosensation for spatial orientation during centrifugation.
- Visual sensations of roll rotation during complex vestibular stimulation (Tribukait & Eiken. ASEM 79: 479-87, 2008).
- Effects of different anti-emetic drugs on motion sickness induced autonomic dysfunction (Nobel et al., abstract 17).

In addition to these research projects our group has taken part in an aircraft accident investigation, reconstructing, in the DFS, the events of an accidental ejection from a fighter aircraft.