
INTRODUCTION. New night vision goggles and helmet mounted display systems are increasing the weight of pilot helmets, and could result in an increased injury risk if worn in emergency aircraft ejections. Human and manikin impact tests were performed with various helmet mounted systems in order to determine aircraft ejection effects on human dynamic response of increasing the helmet weight.

METHODS. Impact tests were conducted on ten human subjects and an ADAM manikin. Subjects were divided into two groups: 1) ADAM manikin were performed at levels up to 10 G for humans and 20 G for the manikin, with weights ranging from 4.5 to 7.0 lbs. RESULTS. Increasing the helmet weight resulted in increasing compression, shear, and bending forces on the human subjects' necks. The manikin tests showed the same trend for compression forces, although at levels higher than expected at impacts greater than 10 G.

CONCLUSIONS. Increasing helmet weight generates significant linear increases in compression, shear, and bending forces on the neck during impact tests of +Gz and instrumented manikins. Manikin tests for helmet weight up to 20 lbs. showed significant linear increases in compression, shear, and bending forces on the manikin, with weights ranging from 4.5 to 7.0 lbs.

HUMAN AND MANIKIN HEAD/NECK RESPONSE TO +Gz ACCELERATION WHEN DETERMINED BY HELMETS OF VARIOUS WEIGHTS. J.L. Buhrman, C. Perry, and J.R. Suhrman. U.S. Army Aeromedical Research Laboratory, Wright-Patterson AFB, Ohio 45433.

INTRODUCTION. Recent attempts to improve helmet mounted night vision devices and helmet mounted displays have raised questions about the safety of such systems during emergency escape in ejection seat equipped aircraft. On the one hand, "safe-to-fly" determinations must be made to allow operational testing with prototypes. On the other, specifications must be written for full scale development. METHODS. A working group was convened to consider this issue. This group reviewed accident statistics, reports from the literature, and in-house laboratory data. Mass properties of standard flight helmets (HGU-55/P and HGU-26/P) and helmet mounted display (HMD) equipped helmets were compared with brine solutions and other responses to +Gz acceleration pulses of ±Gz. RESULTS. Severe neck injuries are relatively rare in conventional data, but there are many variables that it is difficult to assign cause and effect related to helmet mass properties. Laboratory studies of helmet dynamics and related biodynamic responses relating compression force at the occipital condyles to the impact phase of ejection indicate that these forces exceed NEQL safe exposure guidelines (250 lbs.) untreated by the time of the test. Some subjects experienced increased compression forces greater than 100 lbs. without injury. It remains unclear how conservative. CONCLUSIONS. Helmets, weighing less than 5.0 lbs. and having a center-of-gravity centrally located and orthogonal to the origin of the anatomical axis of the head, will not induce severe neck injuries during an impact phase of ejection more often than current operational helmets.
COMPARISON OF UPPER BODY STRENGTH IN A STANDARD EVA FOOT RESTRAINT WITH A RIGID EVA ENCLOSURE IN A NEUTRAL BUOYANCY SETTING. M. Barnett*, Department of Aerospace Medicine, Wright State University, Dayton, OH 45403

INTRODUCTION: A rigid EVA enclosure with full length anthropomorphic arms and a closed mechanical restraint system offers several theoretical advancements over current EVA systems. To assess human factors aspects of such an enclosure, a mockup was constructed for neutral buoyancy testing. Upper body strength, an important contributor to performance and control, was assessed for subjects in the simulated EVA enclosure and compared to that in a simulated EVA foot restraint. METHODS: Using an underwater load cell in a standardized position for force measurement, exertions consisting of 16 separate exertions were assessed using a 11 male subjects. Variables examined were environment (enclosure vs. foot restraint), restraint with the opposite hand (yes or no), direction of exertion (forward or backward) and right or left exertions (p<0.01). RESULTS: ANOVA revealed a global enhancement of strength for exertions performed in the enclosure (p<0.01). Use of the opposite hand for restraint enhanced strength (p<0.001) for all except left forward and backward exertions. Hand used for a given exertion did not influence strength. Significant first order interactions (p=0.05) were noted between environment and direction, environment and opposite hand use, and direction and opposite hand use. CONCLUSION: A rigid enclosure offers a strength advantage over a standard EVA foot restraint. Overall strength in the enclosure without opposite hand use was greater than that in the foot restraint with opposite hand use. Thus, the enclosure allows a greater force exertion while sparing the opposite hand from fatigue induced by grasping.

FACTORS AFFECTING CREW MEMBER COMMUNICATION IN SPACE. A. Kelly, Hi-Tech Incorporated, San Francisco, CA 94107 and N. Kane*, University of California, San Francisco, CA 94143.

INTRODUCTION. In order to maintain crew compatibility and performance during future long-duration space missions, it is important to understand how various factors related to the space environment may influence crew member interactions. METHODS. Fifty-four American, European, and Soviet astronauts and cosmonauts who had flown in space were assessed for the various aspects of crew communication in the space environment. RESULTS: Social activities (Watching and Listening) were judged to significantly increase in quality during Shuttle missions (Reading, Gesturing, and Writing) significantly decreased. Four factors were perceived to significantly help intra-crew communication: Shared Experience, Excitement of Space Flight, Close Environment may influence crew member communication. CONCLUSIONS. The space environment may increase sensory input which can hinder intra-crew communication activities. Intra-crew communication may be helped by factors related to sharing a unique similar life experiences or being brought closer together physically. It may be hindered by factors related to physical or physiological stress. Weightlessness per se appears to have no effect on crew member communication.

THE INFLUENCE OF AGE ON SUSCEPTIBILITY TO MOTION SICKNESS. B.S.K. Cheung, K.E. Money*, Defence and Civil Institute of Environmental Medicine, Toronto, Ontario, Canada, M3M 3B9.

INTRODUCTION. The influence of age on susceptibility to motion sickness has not been systematically studied. Most reports suggest a characteristic decline in susceptibility from a maximum in pubertal childhood to relative insensitivity by the sixth decade of life. However, Noble contends that susceptibility to swing sickness increases above the age of 40. In primates, older squirrel monkeys were reported to have longer latencies to vomiting in response to rotation than young ones. METHODS. A longitudinal study on the effects of age on the susceptibility to motion sickness was performed in subjects of different ages. METHODS. Squirrel monkeys, cynomolgus monkeys and cats were exposed to continuous linear vertical sinusoidal displacement at 25 rpm in a visually unrestricted environment. Signs of motion sickness were induced by a combination of vertical oscillation at 0.5 Hz and horizontal rotation. Neuronal centers for vomiting (CTZ) were surgically ablated in some subjects. RESULTS. Squirrel monkeys of Bolivian phenotype developed MS syndrome readily during rotation but never during vertical linear oscillation. A different phenotype was highly resistant to all motion. Neither vertical displacement nor horizontal rotation created signs of MS in cynomolgus monkeys or cats. Based on data from CTZ-ablated animals, we have postulated a link between beta rhythm, poisoning and MS is questionable. CONCLUSION. Contradictory findings for the experimental animal model further illustrate the importance of the resonance hypothesis of MS as it is currently formulated.


INTRODUCTION. Lychak et al. proposed that motion sickness develops in man and animals when rhythmic changes in body displacement centering around 12/sec synchronize brainwaves occurring in the alpha range (0.17-0.25 Hz for beta rhythm). The resonance hypothesis is based on some selected factors associated with MS, but is inconsistent with many other evidence. METHODS. Squirrel monkeys, cynomolgus monkeys and cats were exposed to continuous linear vertical sinusoidal displacement at 25 rpm. Results. A 30 degree, constant, horizontal horizontal rotation. Neural centers for vomiting (CTZ) were surgically ablated in some subjects. RESULTS. Squirrel monkeys of Bolivian phenotype developed MS syndrome readily during rotation but never during vertical linear oscillation. A different phenotype was highly resistant to all motion. Neither vertical displacement nor horizontal rotation created signs of MS in cynomolgus monkeys or cats. Based on data from CTZ-ablated animals, we have postulated a link between beta rhythm, poisoning and MS is questionable. CONCLUSION. Contradictory findings for the experimental animal model further illustrate the importance of the resonance hypothesis of MS as it is currently formulated.

MOTION SICKNESS IS ASSOCIATED WITH A GENETIC POLYMORPHISM OF THE ALPHA-2 ADRENERGIC RECEPTOR. M. Lockette, R. A. Shepard, J. E. S. Mackenzie, and E. Miles. Wayne State University School of Medicine, Detroit; VARC, Allen Park; University of Michigan Medical School, Ann Arbor, MI; and Naval Health Research Center, San Diego.

We reported that hypertensive individuals are significantly more prone to develop motion sickness than normotensives. We also described an association between blood pressure and susceptibility to motion sickness: Blood pressure was significantly higher in normotensives who were prone to motion sickness than normotensives who were not prone to motion sickness. We tested an alternative hypothesis--the increase in [AVP] during movement may be associated with a genetic polymorphism of a gene coding for the alpha-2 adrenergic receptor (α2-AR). We now hypothesize that polymorphism of the α2-AR gene may be associated with susceptibility to motion sickness. METHODS. Two factors were perceived to significantly help intra-crew communication: Shared Experience, Excitement of Space Flight, Close Environment may influence crew member communication. CONCLUSIONS. The space environment may increase sensory input which can hinder intra-crew communication activities. Intra-crew communication may be helped by factors related to sharing a unique similar life experiences or being brought closer together physically. It may be hindered by factors related to physical or physiological stress. Weightlessness per se appears to have no effect on crew member communication.

VASOPRESSIN DOES NOT INCREASE SUSCEPTIBILITY TO CORIOLIS STRESS. G. R. Shepherd, J. E. S. Mackenzie, and E. Miles. Wayne State University School of Medicine, Detroit; VARC, Allen Park; and University of Michigan Medical School, Ann Arbor.

Results demonstrated that intravenous administration of 1-DOAM-8-D-arginine vasopressin (DDAVP), a synthetic V 2 analogue of antidiuretic hormone, has no effect on susceptibility to motion sickness. Our results suggest that vasopressin does not increase susceptibility to motion sickness in healthy subjects. Coriolis stress susceptibility (CSS) was measured in 23 volunteers with normal vestibular function. CSSI was measured by determining the number of head movements subjects could complete while being rotated at increasing velocity before they developed motion sickness. We measured the Coriolis stress susceptibility index (CSSI) in six individuals receiving placebo 2D-arginine vasopressin (AVP), 4D-arginine vasopressin (AVP) and placebo. All subjects had normal vestibular function as demonstrated by response to sinusoidal harmonic acceleration, suppression of post-rotatory nystagmus, and dynamic posturography. The CSSI was measured by determining the number of head movements subjects could complete while being rotated at increasing velocity before they developed motion sickness. DDAVP had no discernible effect on the number of head movements completed (placebo, 318 ± 38; vs. DDAVP, 316 ± 30, p = n.s.) or CSSI score (placebo, 16.3 ± 6.0; vs. DDAVP, 15.6 ± 6.0, p = n.s.). DDAVP can be a helpful, adjunct measure for individuals who must perform tasks in the microgravity of space or endure prolonged water immersion.

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EXPERIENCES WITH USING THE HELMET AS A PLATFORM FOR VISUAL DISPLAY IN HIGH-VELOCITY ENVIRONMENTS. R. M. McTaggart* and D. K. Patterson, USAF Armstrong Laboratory, Weight-Pattern Research Office, Ohio 45433-0170.

ABSTRACT. Techniques designed to measure the effects of acceleration on helmet-mounted displays (HMD's) have been developed on the Dynamic Particle Simulation (DPS) centrifuge. These techniques include manikin tests, human measures of "image migration," three-dimensional simulations, computer models of human head movement, fit assessments, and subjective measures of helmet comfort. These types of measurement techniques have been correlated with each other and with neck load, outer helmet profile, helmet center-of-gravity (COG), and with each subject's neck strength. CONCLUSIONS. One basic issue was the effect of image migration (the amount of movement away from the eye) displayed via HMDs on neck loads. This amount was strongly affected by helmet weight, neck profile, helmet COG, and the shape of the helmet profile (which determined the amount of physical interference between the helmet and the HMD's). The results indicated a surprisingly weaker impact on image migration during acceleration included in fit assessment only one system tested was adversely affected by poor fit; and neck strength. A related issue was that, overall, the systems which exhibited the least amount of image migration were rated the least comfortable (increased incidence of "hotspots" and uncomfortable tighnesses). Another issue was head stability. As the weight of the helmet-mounted systems increased, head stability under acceleration decreased; again, neck strength as a mediating variable in this relationship proved weaker than originally thought. RECOMMENDATIONS. Relevant test and evaluation efforts should be conducted before deploying helmet-mounted systems in operations. The most important design recommendations may prove to be that helmet weight be minimal and the helmet COG be as close to the natural human head COG as possible. In addition, the trade-off between helmet stability and comfort may be a major factor concerning pilot acceptance of helmet-mounted systems. Finally, neck strength needs to be evaluated further in a more realistic flight research environment where subjects are rapidly moving their heads during target location under varying g-loads and levels, before any definitive recommendations can be made.

INTRODUCTION. Throughout Desert Shield deployed aircrew members lived under conditions of great uncertainty concerning the nature and magnitude of their mission should efforts for a peaceful solution fail. As the United Nations deadline passed and hostilities were imminent, it became clear that large numbers of additional medical personnel would be required and they would have to be prepared for war in a very short period of time. This presentation will fully describe the training program developed to address this emergent need. METHODS. The intent of the program was to provide: (1) a rapid orientation to a combat environment, (2) instruction on conventional, chemical and biological warfare, (3) aeromedical operations training, and (4) psychological preparation for further deployment and the reality of combat. RESULTS. Within 6 weeks, a total of 946 medical, operations, MASF personnel and aeromedical crew members completed the training and were deployed to numerous sites within the theater of operation. Anecdotal evidence suggests that such intensive on-site training provides focused instruction, enhances cohesion among crewmembers, and sharpens real world performance. CONCLUSION. This on-site program provided extensive training in hostile and threatening environment under extreme and adverse conditions. Despite these circumstances, personnel were committed to learning because of the immediate implications of their ability to perform in a wartime environment. The implications of this type of real-world training program for the structure and context of peacetime readiness training are numerous.

INTRODUCTION. As personnel began to return to the 32nd AES from Operation Desert Storm, obvious signs and symptoms of stress and readjustment difficulties were observed. This presentation will review the unique pre-deployment factors that influenced the stress levels of personnel, give guidelines to assist units in developing/developing a plan to provide support during the readjustment phase. In addition, Critical Incident Stress Debriefing concepts/practice and design will be discussed.

METHODS. Transparency/Slide presentation 1) members of the 32nd AES during deployment and upon return 2) Critical incident Stress Debriefing concept/practice 3) checklist for developing a unit specific plan for CISD implementation. RESULTS. Identification of the responsibility of each Reserve unit to develop an ongoing plan for prevention and management of stress through education, training, and facilitation through the practice of CISD.

CONCLUSIONS. This presentation will acknowledge the responsibility of all personnel to stress and the need for development of a unit specific plan to ensure the mental health, performance and safety at the highest possible level, particularly during wartime.


INTRODUCTION. Various types of paint schemes on aircraft propeller and rotor blades are used to improve the visual conspicuity and attention-getting value of those blades when they are rotating. The improved conspicuity resulting from the paint schemes has the purpose of reducing the number of injuries and fatalities that might occur due to accidental contact with a rotating blade by pilots, passengers or ground crew. The present study was undertaken to provide information regarding the circumstances surrounding such accidents in recent years and to compare those findings with the frequency and circumstances of propeller accidents during a pre-1980 period. METHODS. Computer retrieval of brief reports of all propeller accidents during the period from 1983 through 1989 were provided by the National Transportation Safety Board. These reports were examined and analyzed in terms of type of accident, degree of injury, actions of pilots, actions of passengers and ground crew, night or day, and other conditions. RESULTS. The computer search yielded a total of 88 reports of propeller accidents for the 7-year period. Twenty of these involved operation of the aircraft. The remaining 68 cases were "propeller-to-person" accidents. Causes and circumstances associated with the 68 accidents were analyzed and categorized.

CONCLUSIONS. "Prop-to-person" accident frequency for the 1983-1989 period was notably lower than for the pre-1980 period for the 1960's and 1970's. Differences in the causes and circumstances of such accidents for the two time periods suggest the focal points for safety improvements.

INFLUENCE OF SAFETY CONCERNS ON DESIRE TO CHANGE AIRCRAFT TYPE. S. J. Dugue, D. E. Collins, K. Leid, K. Backhouse, J. Kornish. INTRODUCTION. The USCG is known for conducting flight operations sometimes in the most hazardous of conditions. USCG pilots have the potential to request and change aircraft (a/c) type, i.e., change from the fixed wing (fx) to helicopters and visa versa. The purpose of this study was to determine pilots perception of a/c and mission safety and the influence that has on pilot choice of a/c type. METHODS. A voluntary questionnaire was sent to all operational USCG 292 pilots, 461 (72%) participated. RESULTS. Two thirds (204) of helicopter pilots stated a desire to change a/c type. Only 44 (42%) of the fixed pilots stated a desire for a/c change. 81 (40%) of helicopter pilots stated a desire for a/c change was influenced, in part, by mission and a/c safety concerns. Over 90% of all pilots thought that compared to fx aircraft, helicopters had more dangerous missions and were otherwise unsafe. Pilots whose desire for transition was influenced by safety concerns were found; to be more senior, have more flight experience, and feel that they were engaged in dangerous flight operations. Other descriptive statistics and associations are given. CONCLUSION. Helicopters are considered to have more dangerous missions and be less safe. Many helicopter pilots but few fx pilots would change a/c type due, in part, to safety concerns.

COMPARISON OF SINGLE LOcus AND MULTICuLOUS GENE PRoBES IN DNA FINGERPRINTING. S. Baker, S. Mackenzie, F. Miles, F. Tranchida, and W. Lookette*. Wayne State University School of Medicine, Detroit; VAMC, Allen Park; the University of Michigan Medical School, Ann Arbor, MI; Naval Health Research Center, San Diego, CA.

In our attempt to identify the gene(s) associated with certain traits in the population, such as hypertension or a predisposition for motion sickness, we perform DNA fingerprinting. This technique can be used to identify victims of aviation mishaps. DNA fingerprinting can be done with single and m ultilocus gene probes; we compared the advantages of each. The human genome has repetitive DNA sequences arranged in hundreds of millions of tandem repeats within known as variable number of tandem repeats (VNTR). Discrimination between individuals is based on the number of repeats in each unit. VNTRs are length, rather than sequence, polymorphisms. VNTRs can be amplified with polymerase chain reaction. This technique is rapidly performed, and analysis can be performed on minimal tissue from an accident site (i.e., a few cells). The human genome also contains multilocus, dispersed tandem-repeat 'minisatellite' regions which are highly polymorphic due to allelic variation in the repeat copy number in the minisatellites. DNA fingerprints specific for an individual can be detected with a probe based on a tandem-repeat sequence of many variable loci simultaneously. This technique is more lengthy, and it requires a larger tissue sample. However, the accuracy of multilocus probes is much greater than techniques with single locus probes. We adv.Seek the use of both of these techniques over traditional forensic methods in the identification of victims of aircraft mishaps.
MEDICAL CONFDIGENCY OPERATIONS DURING A PEACETIME FOODBORNE ILLNESS MASS CASUALTY SITUATION. Q. C. Snyder*. USAF School of Aerospace Medicine, Brooks AFB, TX 78235.

INTRODUCTION. From 13-15 July 80, approximately 750 cadets from the USAF Academy sought treatment for an acute gastrointestinal illness. Over 400 cadets required intravenous therapy and 100 were admitted to the hospital. The capacity of the local clinic and hospital. Key decisions by senior military medical officials resulted in rapid and effective treatment of all casualties. Ensuring the availability of contingency plans was deemed inappropriate due to construction at the main hospital and the designated hospital expansion site. Rapid re-evaluation of available space to set up an Alternate Medical Facility allowed personnel seeking care to be treated expediently on scene. A staged selective recall of assigned hospital personnel augmented by local military medical facilities assured prompt triage and treatment. Medical leadership recruited military line commanders, civil engineers, public affairs officers and the USAF Epidemiology team to support the mass casualty situation. A problem identified was obtaining real-time information of available bedspace and personnel tasking requirements. Also recognized was that available personnel and resources could have been severely strained if required to support a similar level of surge operations for an extended time period. CONCLUSIONS. Effective medical leadership resulted in implementation of existing medical contingency plans. These revisions ensured prompt and effective treatment of all affected casualties.

THE ASSOCIATION OF AVIATION ACCIDENTS FOR APHAKIC VERSUS NON-APHAKIC CIVIL AIRMEN. V. B. Naga trekara* and R. H. Brown. FAA Civil Aeromedical Institute, Oklahoma City, Oklahoma 73125.

INTRODUCTION. Postaviation-accident toxicology assessment is directly provided by the Civil Aeromedical Institute (CAI) as part of an FAA/STAB agreement. Specimens are recovered from nearly all fatal aviation accidents through USAF, directly coordinated from the USAF. METHODS: Specimens are subjected to a complete forensic toxicology screen for drugs, alcohol, carbon monoxide, and cyanide. Drugs are subfemale from therapeutic to subtherapeutic levels. RESULTS: CAI received biological specimens from 367 pilots in fatal aviation accidents in the US Air Force. In 1990, eighty percent (80%) of the pilots were found to have ethanol readings at or above the 0.04 limit allowed by FAA regulations. It was determined that 134 (41%) of the positive cases were from the ingestion of ethanol. 9 (11%) were found to be from patraesthesia and 8 (2%) could not be controlled. Determined Dangerous Substances (Schedules I & II) were found in 15 (42%) of the cases. CONCLUSIONS: The number of detected abused drugs exceeds the percent found in the random drug testing program by more than a factor of eight. Benzodiazepine are being found more often than some of the required NIDA test drugs. Postmortem ethanol continues to be a problem in the interpretation of toxicology results.


INTRODUCTION. During a five-year period, total of 6,139 invalid passengers arrived in South Korea. The study was done to analyze such invalid passengers with respect to airline medical practices. METHODS: The study was conducted using data filed in the medical department of a civil airline for invalid passengers. RESULTS: During the 5 years, a total of 6,139 cases were transported with their rates decreasing despite their annual increase. Among the total, 3,267 invalid passengers were transported on international flights and the rest on domestic flights. The use of aero-charters was twice as high on domestic compared to international flights. The use of aero-charters was 5 times higher on domestic compared to international flights. The oxygen use rate per 100 invalid passengers in domestic flights was 9.1 compared to 3.2 on international flights. Flight irregularities occurred in 242 cases; also, there were 3 inflight deaths. 298 off-loadings, and 1 diversion. CONCLUSION: With respect to the increasing number of invalid passengers utilizing airline services, air transportation, the necessary provisions and adequate services must be set and maintained with the coordination of the medical department of the airline, the invalid passenger, and the physical physician of the passenger.

EMPIRICAL PREDICTION OF PHYSIOLOGICAL RESPONSE TO PROLONGED WORK IN THE CHEMICAL DEFENSE ENSEMBLE. P. Bishop, M. Smith, R. Ray, J. Beaird, and J. Smith. Human Performance Laboratory and Department of Industrial Engineering, University of Alabama in Huntsville, AL 35487-0312.

INTRODUCTION. Personnel required to work in moderate or hotter environments while wearing the U.S. Chemical Defense Ensemble (CDE) experience heat storage, substantial diminution of work productivity, and health risks. Predicting responses of these workers would be very useful. METHODS: Work times at 21°C of 15 subjects performing hard work (45° bench slope, 15* body flexion, 2.5level step) were based on prior brief measures of bench-step in the CDE, and heart rate responses. RESULTS: A model was developed which showed the expected work load. A predicted work time for repeated work bouts in moderate temperatures in the CDE: (total time= (7.2*bench step duration+4*bench comfort)) V. C. V. = 0.83. Unexpectedly, models which incorporated recovery heart rate as an independent variable were not as effective. CONCLUSIONS: With further research, this approach tested in this study would be immediately useful for managing personnel working in CDE, and also useful to civil entities in industry. All work could be utilized at minimal cost during routine training.

This work was supported in part by the U.S. AFOSR,AFAPC, Contract No. 349620-98-C-0053/898881-0378.

INTRODUCTION: Studies were conducted on a static cold room with the model of the foot, situated to determine the dry insulation properties of commercial and prototype cold weather combat boot systems (CWCBSs). Heat flux through the boot sole is an important criterion in selecting CWCBSs. The insolation of the model includes radiation effects of the foot and the boot sole in the winter conditions where the amount of heat flux through the sole is very important. Dry insulation of the foot model was analyzed using a cold condition model of the foot and measured at -20°C for the cold condition model.

Heat flux through the sole, which incorporates the radiant heat transfer (h_r) and the convective heat transfer (h_c), is reduced in the boot sole is compressed, thus increasing the heat flux through the sole. The heat flux through the boot sole is further augmented with the addition of a cold substance, such as mud, water, or snow in an actual cold weather environment.

Heat flux through the sole is an important criterion in selecting CWCBSs. The cold condition model of the foot was used to ensure uniformity throughout the test.


INTRODUCTION: Helicopter operations conducted in high ambient temperatures expose personnel to potentially dangerous physiological facilities. We tested two personal cooling systems to evaluate their effectiveness in reducing heat strain on aircrews.

METHODS: One of the systems was a long-sleeved shirt, while the other was a vest with an attached head unit.

RESULTS: Eight CWCBS were evaluated on the foot model according to three test methods: a free suspension (FS) control test, a coldly environmental compression (CDC) test, and a coldly environmental compression (CWC) test. Across all test conditions, the temperature was kept at 30°C and the model surface temperature was kept at 70°F.

CONCLUSION: It was expected that the CWC test method would be more responsive than the FS or the CDC test method, but it was not. Further studies are needed to develop more quantitative methods for evaluation of CWCBS.


INTRODUCTION. Fire fighters dressed in full protective ensemble and combating shipboard fires are subjected to extreme heat strain. However, physiological responses to heat stress, including biochemical, physical, and psychological countermeasures, have not been well documented. Environmental chamber simulations to date have not been true representations. Therefore, the purpose for this study was to document the physiological responses of U.S. Navy Damage Control firefighting crews aboard a fire-fighting demonstration ship.

METHODS. Nine male volunteers (36.7 yrs, 181 cm, and 81 kg) experienced in fire fighting were monitored for heart rate (HR), skin temperatures (Tsk) and rectal temperature (Tre) during three days of fire fighting (n=4 per day). Each subject wore the standard Navy fire fighting ensemble (fire retardant suit, gloves, boots, flash hood, helmet and breathing apparatus). Peak fire temperatures reached 600°C, while temperatures in the adjoining fire fighting compartment ranged from 40-100°C.

RESULTS. As expected, significant (p<0.05) heat strain occurred during approximately 25 min of fire fighting. However, the rectal temperature of change of Tre, Twsk, and HR were greater than expected. Mean responses were: peak Tre = 39±1.0°C; Tre slope = 0.04°C/min; peak Twsk = 31±0.7°C; peak HR = 186±13.3; and % of predicted maximum HR = 103±6%.

CONCLUSION. Actual shipboard fire fighting wearing protective ensembles can lead to extreme heat strain and potential heat injury. These data have implications for operational training, generation of exposure guidelines, and development of protective ensembles and heat strain countermeasures.