

# **Optometry Undersea & In The Air**

# LT John Vingoe, OD, FAAO LCDR Micah Kinney, OD, PhD, FAAO

04 JUNE 2021 1100-1200 (ET)



"Medically Ready Force...Ready Medical Force"

#### Presenter



# LT John A. Vingoe, OD, FAAO Aerospace Optometrist NMRTU North Island Naval Medical Center San Diego

# LT John A. Vingoe, OD, FAAO





Photo courtesy of LT. Vingoe

 Aerospace Optometrist at NMRTU North Island
NAMI 2020-2021
NMRTC Quantico 2017-2020
NBHC Groton 2013-2017
Pacific U (HPSP) 2013

"Medically Ready Force...Ready Medical Force"

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At the conclusion of this activity, participants will be able to:

- 1. Recognize the visual demands of undersea operational environments.
- 2. Know the physical standards required for undersea applicants and designated personnel.
- 3. Organize with the Undersea medical team.
- 4. Discover a rapport with the undersea community.

#### **Undersea Population**







Enlisted Submarine Rates (Nuclear and Non-Nuclear)

- Submarine Officers
- Divers

**Special Ops** 

### **SUBMARINERS**





"Medically Ready Force...Ready Medical Force"

## **Enlisted Submarine Rates**



Nuclear:

Machinist Mates (MM)

Electricians Mate (EM)

**Electronic Technicians (ET)** 



# **Enlisted Submarine Rates**



#### Non-Nuclear:

- Fire Control Technician (FT)
- ET Communications (COM)
- ET Navigation (NAV)
- Sonar Technician Submarine (STS)
- Information Systems Technician (ITS)
- MM Auxiliary Equipment (AUX)



# **Enlisted Submarine Rates**



Non-Nuclear:

MM Weapons (WEP)

Missile Technician (MT)

Logistics Specialist [LS(SS)]

Culinary Specialist Submarine [CS (SS)]

Yeoman [YN (SS)]

Corpsman (HM)



# **Submarine Officers**





#### Skipper and XO

- "Navigator/Ops" -Nav and Coms
- "Weps" -Sonar, Fire Control, Missiles/Torpedoes
- "Enge" Engineering, atmosphere, damage control
- "Chops" -Supply

Other JOs

**Submarine Training** 



# Basic Enlisted Sub School (BESS) -6 weeks

Submarine Basic Officer Course (SOBiC) -10 weeks

Nuclear Power School -26 weeks

Nuclear Power Training Unit "Prototype" -26 weeks



Fast Attack (SSN):

 Los Angeles Class Ballistic and Guided Missile (SSBN, SSGN):

• Ohio Class

- Seawolf Class
- Virginia Class

### **Operational Environments**





Photo courtesy of DVIDS

Los Angeles Class

#### **Seawolf Helm**





#### USS Connecticut (SSN22)

Photo courtesy of DVIDS

### **Virginia Class Control Room**





Photo courtesy of DVIDS

Virginia Class Control Room

#### Periscopes



Optical Periscope vs. Photonics Mast 2-4 People 15 Min Shifts Officers and Qualified FTs



Photo courtesy of DVIDS

#### Sonar Room







- Navigation: buoys and lights are red and green Wiring Display screen symbology
- Instrument and Other Indicator lights
- Convention: Red=bad, Green=good



- Pressure hull maintains interior at 1 atmosphere
- Use of CO2 scrubbers when submerged
- Monoethanolamine "amine" absorbs CO2, has distinctive smell
- At high concentrations is a skin, eye, and respiratory irritant
- Delayed healing of skin and eye lesions

# **Submarine Ocular Issues**



Very Dry Air=**Dry Eyes** and CLs Myopic Shift EAB Mask Seal in Specs Optical Periscopes Binoculars and NVGs



# **Optical Options for Submarines**



EAB frames

Dispense specs by boat to their IDC

# Recommend Daily Disposable CL modality



Photo courtesy of DVIDS



Contact lens exams and supply for officers and other qualified periscope operators. Need letter from their commander to authorize. Your SPO orders through the comptroller.





Naval Spec Warfare/SEALs **Explosive Ordinance Disposal** (EOD) MARSOC Force RECON Underwater Construction Team (UCT) Ship/Boat divers Safety/Instructor divers









# Dive School -6 months Basic Underwater Demolition/SEAL (BUD/S) -24 weeks

**Diving Duty** 



- Salvage
- Construction and Demolition
- Search and Rescue
- Military and Civilian Law Enforcement Support
- Expeditionary Warfare Security, Coms, and Logistics
- Ship maintenance, restoration, and repair
- Special Ops



### **Ocular Decompression Sickness**

-Loss of vision, blurred vision, diplopia, scotomas, periocular pain, nystagmus (inner ear barotrauma)

- -Arterial Gas Embolism
- Facial Barotrauma: Subconjunctival hemorrhage (mask squeeze)

Contact lenses vs. mask inserts (no specific inserts from NOSTRA)

#### **Facial Barotrauma**





#### **EOD Diver**





#### **Boat Diver**







Contact lenses and solutions will be provided to... naval special warfare personnel (SEALS) whose operational effectiveness would be enhanced by wearing contact lenses.





- Undersea Medical Officer (UMO) MD or DO
- Submarine Independent Duty Corpsman (IDC) "Doc"
- Radiation Health Officer (RHO)
- Researchers: Psychologists, audiologists, physicians, physiologists, and more.





6 months for UMOs (Submarine Medical Officer and Diving Medical Officer Courses)

58 weeks for IDCs

**Radiation Health Officer Course** 

#### **PHYSICAL STANDARDS**



# Chapter 15

# Physical Examinations and Standards for Enlistment, Commission, and Special Duty





#### **MANMED 15-102 Diving Duty**

# MANMED 15-103 Nuclear Field Duty

### **MANMED 15-105 Special Operations Duty**

### **MANMED 15-106 Submarine Duty**
# MANMED 15-102 Diving Duty



"Diving duty is characterized by intense physical and mental demands in a hostile environment."

# MANMED 15-102 Diving Duty



- Refraction >+/-8.00D is disqualifying (DQ)\*
- VAsc >20/200 in either eye is DQ\*
- Refractive surgery within 3 months is DQ for candidates.
- No depth perception requirement

MANMED 15-102 Diving Duty



DD 2808 Vision Exam to Include:

- Visual Acuity
- Manifest refraction if uncorrected distance or near visual acuity is less than 20/20
- Field of vision
- IOP if >40YO
- Color Vision

# MANMED 15-103 Nuclear Field Duty



- -Visual acuity not **correctable to 20/25 in at least one eye** is disqualifying.
- -Defective color vision is disqualifying.

# MANMED 15-105 Special Operations Duty



"...duty takes place in every part of the world under harsh conditions at the extremes of human physical capabilities. Medical austerity and the presence of armed opposition are common...parachuting, high angle activities, high-speed boat and unconventional vehicle operation, weapons operation, demolitions employment, and waterborne activities, to include SCUBA diving."

# MANMED 15-105 Special Operations Duty



- Navy SEALs
- Special warfare combatant craft crewmen (SWCC)
- USMC Reconnaissance (RECON)
- USMC Special Operations Command (MARSOC)
- USMC Special Operations Officer (SOO)
- USMC Critical Skills Operators (CSO)
- USMC Special Amphibious Reconnaissance Corpsman (SARC)
- Explosive Ordnance Disposal (EOD)

# MANMED 15-105 Special Operations Duty



- Refraction, by autorefraction or manifest, if uncorrected visual acuity (near and far) is not
   20/20 or better.
- Color vision
- **Depth Perception** 40 arc sec



"Submarine duty is characterized by isolation, medical austerity, need for reliability, prolonged subsistence in enclosed spaces, exposure to atmosphere contaminants, and psychological stress."



- Examination:
- Visual Acuity
- Color Vision



Standards:

- Visual acuity that cannot be corrected to
   20/25 in at least one eye is disqualifying.
- Defective color vision is disqualifying except for: CS, HM, LS, and YN.



# 10/14 on PIP is passing. WATCH OUT FOR CHEATING!

If FALANT was passed prior to 01 JAN 2017, they may continue using FALANT



Defective color vision for qualified nuclear field personnel and qualified submariners: Waiver requests must include a statement from the member's supervisor stating that the member is able to perform his or her job accurately and without difficulty.



Refractive Surgery:

- PRK, LASIK, and LASEK are allowed (no waiver required) if vision standards are met
- 3 month waiting period for candidates
- Qualified personnel: Prior authorization from CO, must be on shore duty or in shipyard maintenance for at least 3 months and have at least 30 days remaining after surgery.



- Keratoconus is disqualifying
- Recurrent corneal abrasions associated with ocular infection are disqualifying
- History of iritis is disqualifying (What constitutes a "history"?)
- Glaucoma is disqualifying
- Pre-glaucoma requiring follow-up intervals of 1 year or more and no treatment is NOT disqualifying.



- PIP: 9/14, New service member
- PIP: 9/14, Joined Navy and passed FALANT in 2016
- 0.65 C/D ratios with unremarkable OCT, VF, IOPs, and FHx, repeat exam and OCT in 1 year.
- Bilateral anterior uveitis 2x
- -7.50 Best corrected to 20/25 in one eye



- Submariners, Personnel assigned to submarine duty will be issues submarine frames "insert" (EAB frames)
- The supporting Navy MTF will be responsible for procurement of lenses and solutions for mission essential contact lenses.





- 1. Divers and Spec Ops need 20/20 corrected, but submariners are qualified with only 20/25 in one eye.
- 2. All undersea personnel need color vision except submarine rates CS, YN, HN, and LS.
- 3. Divers (except spec ops) and submariners don't need stereopsis.
- 4. Submarine air is dry, not compressed, and delays healing of skin and cornea lesions.
- 5. The only "doc" onboard a submarine is the IDC.





Department of Defense. Defense Visual Information Distribution Service. <u>https://www.dvidshub.net</u>

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### Visual Topics in Aviation LCDR Micah Kinney, OD, PhD, FAAO 04 JUNE 2021



"Medically Ready Force...Ready Medical Force"

### LCDR Micah Kinney, OD, PhD, FAAO





Photo courtesy of LCDR Micah Kinney

- Aerospace Research Optometrist at NAWC-AD 2020-Present
- NAMRU-D 2017-2020
- NAMI 2016-2017
- DUINS PhD at UAB 2013-2016
- NAS Oceana 2010-2013
- OD from UAB 2010

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At the conclusion of this activity, participants will be able to:

- 1. Outline how optometry is enabling the U.S. Naval Aviation Enterprise.
- 2. Analyze human systems engineering and how optometry fits within that domain.
- 3. Describe how vision science is critical to warfighter performance.







### Vision at Night



- Reduced lighting
- Reduced Visual Acuity
- Reduced Color Information
- Increase in Pupil Size
  Abberations
  - □ Myopic Shifts

#### Night Vision Goggle



Image courtesy of NAMRUD/ Dr. Kinney

#### Vision at Night



- Night Vision Goggle Devices
  - Monocular
  - Binocular
  - Biocular
  - Panoptic
  - □ AT BEST 20/30 with NVG
- Green Phosphor
- White Phosphor
- \*\*DO NOT OVER MINUS\*\*



Image courtesy of NAMRUD/ Dr. Kinney

#### **Night Vision Goggles**





Note presence of scintillation

Images courtesy of Dr. Kinney

#### Vision at Night

- NVGs focused at optical infinity
   Incompatible lights
- High moon illumination
- WeatherLimited FOV







#### Vision







Videos source: Instagram



#### **Laser Considerations in Aviation**



#### Low Intensity Handheld Laser Pointers □ Red/Green/Blue

#### CAS Lasers □ Visible/Infrared

Laser Threats

Airborne Lasers- Targeting and Countermeas □ Visible/Infrared

Anti-personnel Lasers □ Visible Green (Dazzler)



Source: DVIDS



Source: soldiersystems.net



Source: www.militaryaerospace.com

Source: wikicommons







#### **Lasers Targeting Military Aircraft**



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#### POLITICS | NATIONAL SECURITY

### American Military Aircraft Targeted By Lasers in Pacific Ocean, U.S. Officials Say

U.S. officials wouldn't definitively confirm Chinese personnel were behind laser incidents

#### Science

#### Pentagon in uproar: 'China's lasers' make US pilots shake in Djibouti

#### Begun, the laser wars have, it is claimed

By Iain Thomson in San Francisco 4 May 2018 at 21:12 110 🖵 SHARE ▼



The US military has formally complained to China after blinding lasers were fired at Uncle Sam's aircraft coming in to land at the American airbase in Djibouti.

Pentagon spokeswoman Dana White said two US military pilots suffered minor eye damage from lasers hitting the cockpit of their C-130 transport

#### Lasers in the News





Source: British Journal of Ophthalmology Press Release 20 April 2016. Available at: <u>http://www.bmj.com/company/wp-content/uploads/2016/04/laser-pilot.pdf</u>. Accessed on 4 Jan 2018.

#### **FAA Laser Effects**





Source: LaserPointerSafety.com





6 months after surgery VA remained 20/80 16 Year old 1000 mW blue diode (445 nm) 2 weeks post exposure 1 week post exposure- playing with a friend in a classroom Entering VA 20/80

(Dhoot, 2004)

#### **Laser Pointers**




### **FAA Reported Lasing Incidents**





#### Laser illuminations reported to FAA, annual total

Source: LaserPointerSafety.com

# Classifications



- Class I- no cautions, no injury (< 0.39 mW)</p>
  - □ Grocery store scanner
- Class IIa- laser pointers, caution label (< 1 mW)</p>
  - □ Blink reflex usually sufficient
  - □ Eye injury unlikely unless prolonged exposure (> 0.25 sec)
- Class IIIR- medical, research, CAUTION (1-4.99 mW)
  - Eye injury possible < 0.25 sec
- Class IIIb- weapons, WARNING (5-500 mW)
  - □ Eye injury likely, blink reflex too slow
- Class IV- weapons, surgical, DANGER (> 500 mW)
  - Reflections dangerous
  - Skin injury and burns to exposed areas
  - Fire hazard

### **Commercial Off The Shelf Lasers**





# Laser Eye Protection Design Challenges



- Operational integration
  - 🖵 Helmet
  - Visor
  - □ Spectacles
  - Night Vision Goggles
  - Oxygen mask
  - Chem-bio defense



Image courtesy of Dr. Kinney

### **LEP Color Distortion**





Image courtesy of NAMI/ Dr. Dohm

# "Doc! We've been lased. What do we do now?"



- Pre-Flight Crew Procedures
- In-Air Exposure Procedures
- After-Landing Crew Procedures
- Flight Surgeon Procedures
  - Laser injury guidebook
- Ophthalmology/Optometry Consultation
  Laser injury guidebook



Source: LaserPointerSafety.com

# **In-Flight Exposure Procedures**



- Look Away & shield eyes (don LEP if available)
- **DO NOT rub the eyes** increases irritation
- Turn up instrument lights
- Self-examination using small print or Amsler grid (if available)
- 'Self-triage' vision
  - □ able to read small print,
  - □ check individual eyes,
  - □ check pocket Amsler grid, nav charts, HUD or MFD for any visual defects
- Mark the position, time, and report to ATC
- Unexposed co-pilot gets on instruments
- Query other crew members for exposure
- Determine mission viability, if significant vision symptoms prevent safe continuance



Image courtesy of NAMI/ Dr. Dohm

# **After-Landing Crew Procedures**



- Notify Chain of Command
- Notify Flight Surgeon & Laser Safety System Officer (per OPNAVINST 5100.27B)
- Undergo eye exam by Flight Surgeon as soon as practicable
- Complete HAZREP
- Complete FAA laser exposure web report

http://www.faa.gov/aircraft/safety/report/laserinfo/

■ Call DoD Laser Hotline (24/7)

Toll-free: 800-473-3549

Federal Aviation Administration	Mobile
Laser Incident Reportin	ng Form
Your Details	
Name of pilot/crew member reporti	ng
First and last name	
Email address	
example@domain.com	
Flight Details	
Flight number, call sign, and aircra	ft registration number
e.g. SWA572, Southwest, N12345	
Aircraft Make and Model	
e.g. Boeing 737, Cessna 172, Airbus	A320
Laser Incident Details	
Laser light color:	
Select Beam (	
Select Bealling	Color C
Date	Color
Date 2013-01-16	color C
2013-01-16 Time (UTC/Zulu)	iolor C

# Joint Trauma System Clinical Practice Guideline





First Publication Date: 14 Feb 2020



- Does laser eye exam reveal significant visual or ocular findings? If yes, consult ASAP to ophthalmology or optometrist
- Navy/USMC: OPNAV 5100.27 (Laser Hazards Control Program):
  \*\*ALL exposures get consult exam "immediate" or "urgent"\*\*
- Make recommendation on Fitness for Aviation Duty or further medical management





- 99%+ of exposures will <u>not</u> cause permanent injury– may return to flight immediately if <u>no persistent symptoms</u>, <u>normal vision</u> <u>testing and normal exam</u>.
- Laser Hotline advice on ALL exposures
- Document follow-up in 1-3 days.
- Actual injuries or persistent symptoms:
  - "Down" chit pending further workup
  - Ophthalmology/Optometry consult "TODAY" (aerovac as needed)



### **Spatial Disorientation**





Spatial Disorientation (SD): an aviator's inaccurate perception of the attitude, position, or motion of his/her aircraft relative to the Earth's surface and gravitational vertical

Adapted from U.S. Naval Flight Surgeon's Manual, 1991

# **Primary Orientation Systems**





### **Visual orientation incorporates:**







#### **Comparison of Day and Night Sight Pictures**



Recreation of TH-57 sight picture during day VMC

Sight picture changes help indicate attitude changes

Angular relationships enhance SA

Much wider FOV

# **Visual Illusions**

- Linear perspective
- Upsloping/Downsloping terrain
- Black-hole approach
- Autokinetic
- False visual reference

Blue Blue Green Red Blue

Central vision- color and detail Peripheral vision- motion and spatial orientation



### **Linear Perspective**



- Linear perspective
  - □ Typical length and width of runway
  - □ Learned over time
  - □ Pilots can become accustomed to what they know
  - Unusually Narrow/Long
  - Unusually Wide



# **Upsloping/Downsloping Terrain**



- Upsloping terrain
- Downsloping terrain





### **Black-hole Approach**



### Black-hole approach





Source: FAA

### Autokinetic



Autokinetic

### **False Visual Reference**



### ■ False visual reference



Source: FAA





- The aviation environment is dynamic and requires visual attention at all times.
- Night conditions reduce visual acuity, color perception, and depth cues.
- Lasers can produce veiling glare from great distances which can negatively impact aircrew's visual performance.
- Spatial orientation relies heavily on visual information.

### References



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FAA Reported Laser Illumination Events. <u>www.laserpointersafety.com</u>.

Joint Trauma System Clinical Practice Guideline: Ocular Evaluation Disposition After Laser Exposure.

https://jts.amedd.army.mil/assets/docs/cpgs/Ocular\_Evaluation\_D

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Spatial Disorientation: Visual Illusions. Federal Aviation Administration.

https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/spaiald\_visillus.pdf.

U.S. Navy Flight Surgeon's Manual. <u>http://www.operationalmedicine.org/TextbookFiles/USNavalFlight</u>

urgeonsManual.htm.

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To receive CE/CME credit, you must register by 1100 ET on 5 June 2021 to qualify for the receipt of CE/CME credit or certificate of attendance. You must complete the program posttest and evaluation before collecting your certificate. The posttest and evaluation will be available through 18 June 2021 at 2359 ET. Please complete the following steps to obtain CE/CME credit:

- 1. Go to URL <u>https://www.dhaj7-cepo.com/</u>
- 2. Search for your course using the Catalog, Calendar, or Find a course search tool.
- 3. Click on the REGISTER/TAKE COURSE tab.
  - a. If you have previously used the CEPO CMS, click login.
  - b. If you have not previously used the CEPO CMS click register to create a new account.
- 4. Follow the onscreen prompts to complete the post-activity assessments:
  - a. Read the Accreditation Statement
  - b. Complete the Evaluation
  - c. Take the Posttest
- 5. After completing the posttest at 80% or above, your certificate will be available for print or download.
- 6. You can return to the site at any time in the future to print your certificate and transcripts at <u>https://www.dhaj7-cepo.com/</u>
- 7. If you require further support, please contact us at <u>dha.ncr.j7.mbx.cepo-cms-support@mail.mil</u>