EXHIBIT/P-00097

Helicopter Underwater Emergency Breathing Apparatus (HUEBA)

Offshore Helicopter Safety Inquiry
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Introduction

- Review the rationale for HUEBA
- Review HUEBA equipment and operation
- Identify the hazards and limitations associated with using HUEBA
- Review HUEBA practical

Rationale for HUEBA

- 2007 world-wide offshore helicopter operational data: (OGP Report 2009)
  - Over 9 million passengers
  - Over 900,000 flying hours
  - 10 accidents
  - 5 fatalities
- 5 year average:
  - 16 accidents
  - 5.8 fatalities

Rationale for HUEBA

- Out of 110 accidents: (Taber & McCabe 2006)
  - 69 (63 %) capsized
  - 27 remained afloat
  - 38 sank

Rationale for HUEBA

- Capsize equally likely in both ditching and crash landings: (Cliffords 1996)
  - 69% controlled
  - 56% limited control
  - 65% fly-ins
  - 68% uncontrolled

Rationale for HUEBA

- 83% of UK military fatalities due to drowning with only 17% due to impact injuries (Cliffords 1996)

Rationale for HUEBA

- High incident of capsize = high incident of drowning
- Cause of drowning;
  - Incapacitation due to injury
  - Disorientation
  - Jammed or obstructed exit
- Cold Shock single most important factor limiting escape of an uninjured person

Rationale for HUEBA

- Suggested times required to escape from a capsized helicopter are between 40 – 60 seconds (Tipton et al, 1997)
- Average breath-hold times: (Cheung et al, 2001)
  - 25 C = 37 s
  - 16 C = 29.7 s
  - 1 C = 15.9 s
  - Cold Shock BHTw as little as 6s with average < 20s (CAA Report 2003)
- Need to bridge the gap between breath-hold and escape time

Two Solutions

1) Re-breather

- *Survival in the Sea Project* (Shell) 1989
  - Extent underwater survival time
  - Without introducing additional dangers
  - Simple to use
- Air Pocket® Re-breather
  - Counter lung, hose, mouthpiece and nose clip
  - Allows respiratory movement
  - Re-breathe 2 to 4 times as long as holding breath

Two Solutions

2) Compressed air

- Military worldwide

Compressed Air HUEBA

- HUEBA - Helicopter Underwater Emergency Breathing Apparatus aka:
  - EBS – Emergency Breathing System
  - HEED – Helicopter Emergency Egress Device
  - HABD – Helicopter Aircrew Breathing Device
  - HEBE – Helicopter Emergency Breathing Equipment
  - UER – Underwater Escape Re-breather
  - STASS – Short Term Air Supply System
  - APP – Air Pocket Plus
  - SEA – Survival Egress Air

Compressed Air HUEBA

- First HEBE developed in 1975
- Early 1980's US Navy and Canadian Forces started using 'Spare Air'
- 1986 Canadian Forces switched to HEED2
- 1990 US Navy switched to US Divers Inc HABD
  - 1994 Canadian Forces switched
- 1992 Royal Navy started using STASS
  - 1993 unit for ordinary passengers P-STASS
- 2000 CAPP starts looking into EBS
  - 2004 selects US Divers SEA LV2

Benefits of HUEBA

- HUEBA benefits include additional time to: (CAA Paper 2003/13)
  - Overcome panic
  - Overcome disorientation
  - Release a jammed or snagged seatbelt
  - Identify alternate exits
  - Cross fuel cell to exit
  - Jettison an exit
  - Overcome any snagging due to structural damage of the airframe
  - Overcome impact injuries

Equipment & Operation

Aqua Lung
Survival Egress Air
(SEA-LV2 Exxon)

Aqua-Lung EBS

Helicopter Aircrew Breathing Device (HABD)

GEN 1

Survival Egress Air MK (SEA-MK)

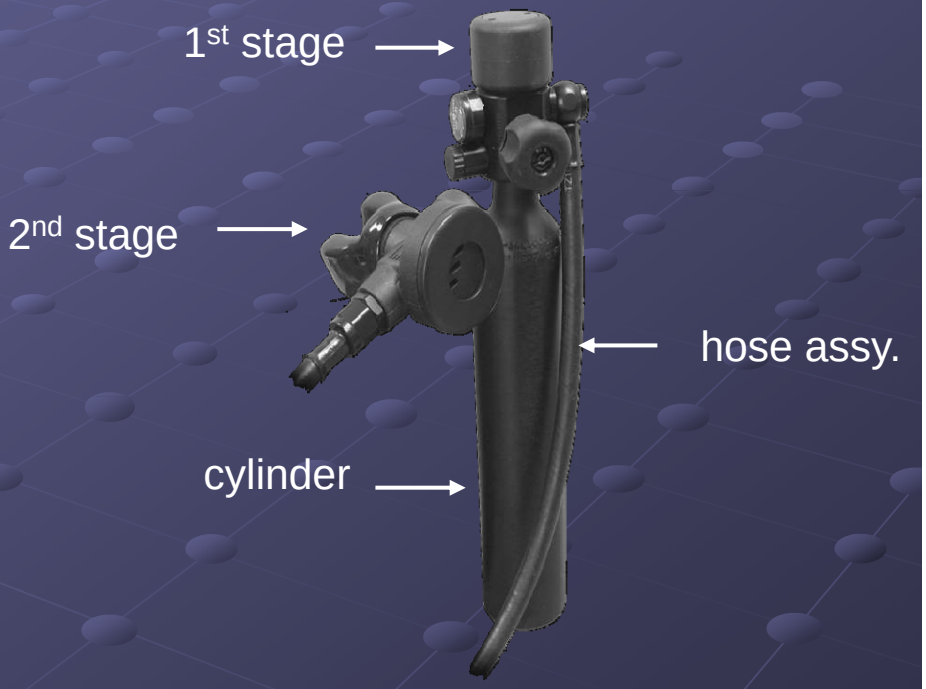
GEN 2

Survival Egress Air LV2 (SEA-LV2)

GEN 3

SEA LV-2 (Exxon) Major Components

- Cylinder stores HP air
  - 21% oxygen & 78% nitrogen
  - 3000 psi
  - 1.5 cubic feet
- 1st stage reduces HP air
  - intermediate pressure 135 (+/- 20 psi)
- Hose delivers air to 2nd stage
- 2nd stage delivers air at ambient pressure

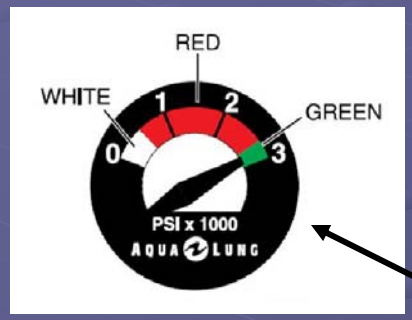


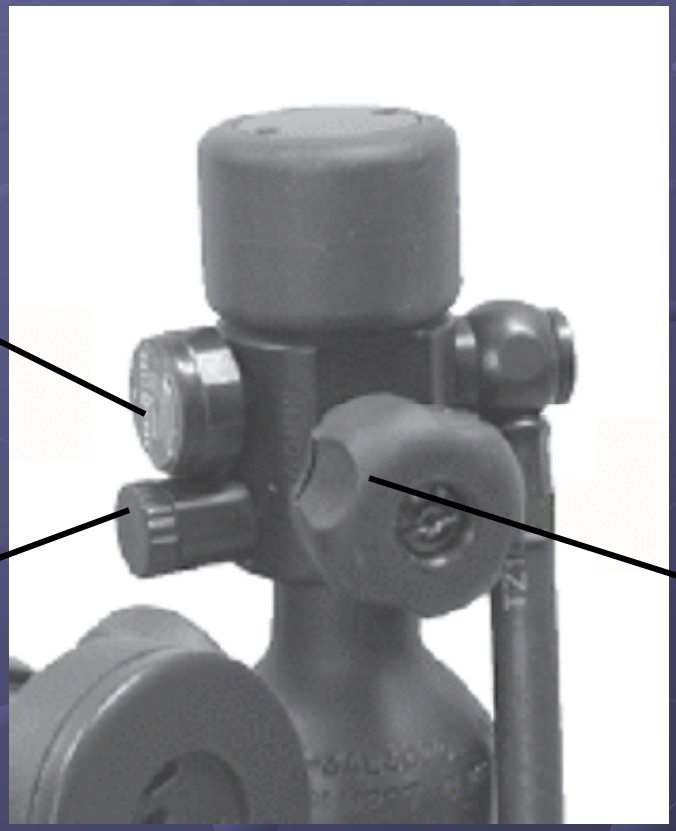
Cylinder

Cylinder Specifications	
Air Volume	1.5 cu/ft / 42.5 liters
Service Pressure	3000 PSI / 207 BAR
DOT Test Pressure	5000 PSI / 345 BAR
TC test Pressure	4500 PSI / 310 BAR
Aluminum Alloy	6061-T6

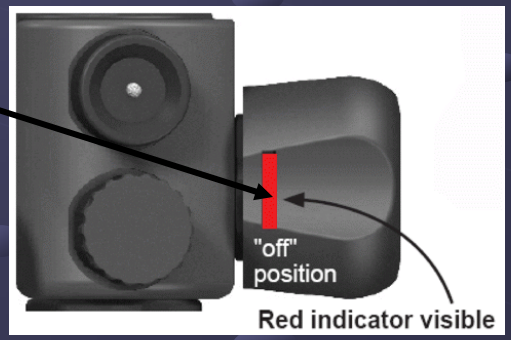
Cylinder Identification

1st Stage



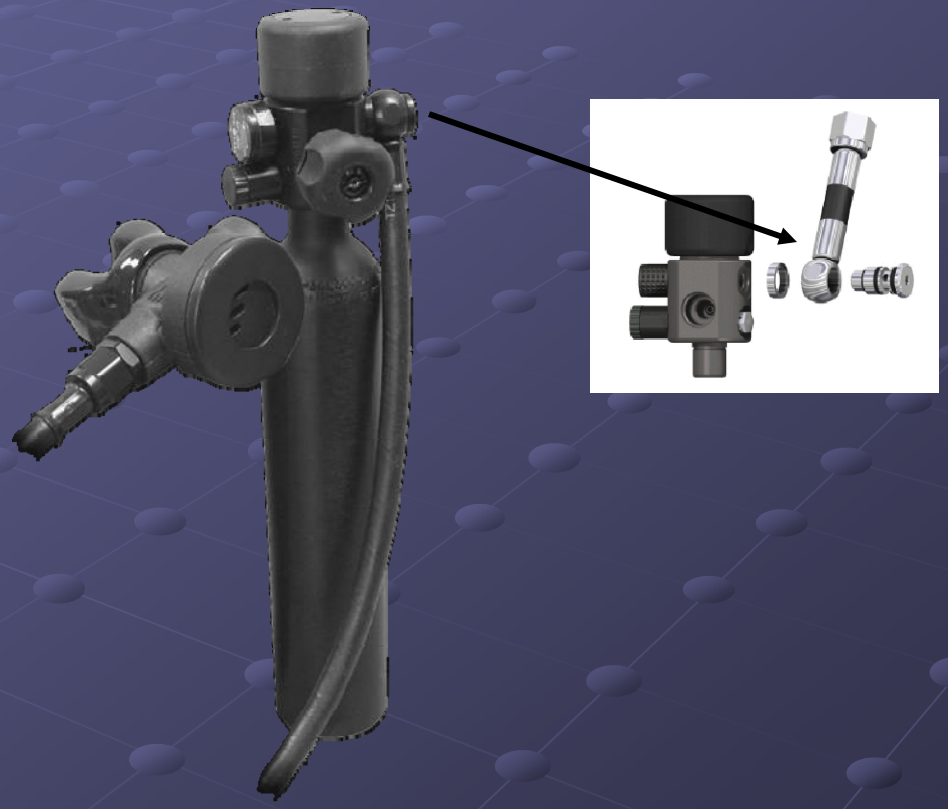


- Dial gauge
- Fill port
- On / off knob
- Burst disk



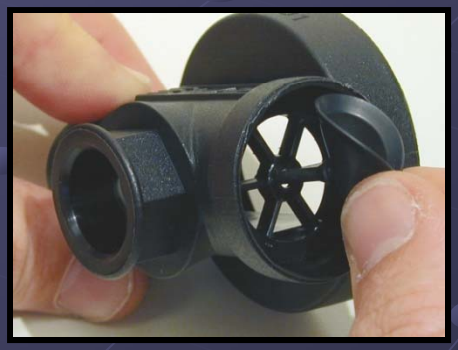
Hose Assembly

- Swivel adapter
- Hose
  - 28 inches
  - 3/16 I.D.
  - Low pressure



2nd Stage

- Low volume
- Open circuit demand valve
- Indexable mouthpiece
- One-way exhaust valve
- Purge button



Breathing Routine

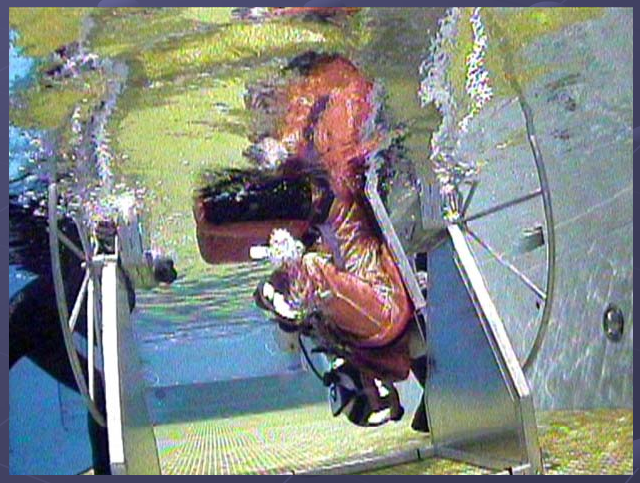
- Place 2nd stage mouth piece in your mouth and breathe
- If necessary (U/W) clear the second stage
  - Blast method
  - Using purge button
- Inhale first breath cautiously

When to use HUEBA

- Deploy just before submersion
- If unable to deploy prior to submersion
  - Decide whether to escape without HUEBA
    - Deployment could delay escape by 5 to 10 s
  - Deploy and clear HUEBA

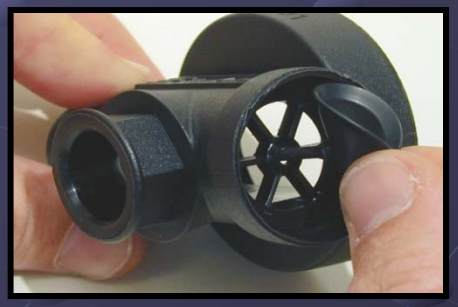
HUEBA Limitations

- Intended for use as an emergency egress device
- Limited air supply with endurance depending on:
  - Breathing rate
  - Work rate
  - Water temperature
  - Depth
  - With or without face mask
  - Charge in cylinder



HUEBA Malfunctions

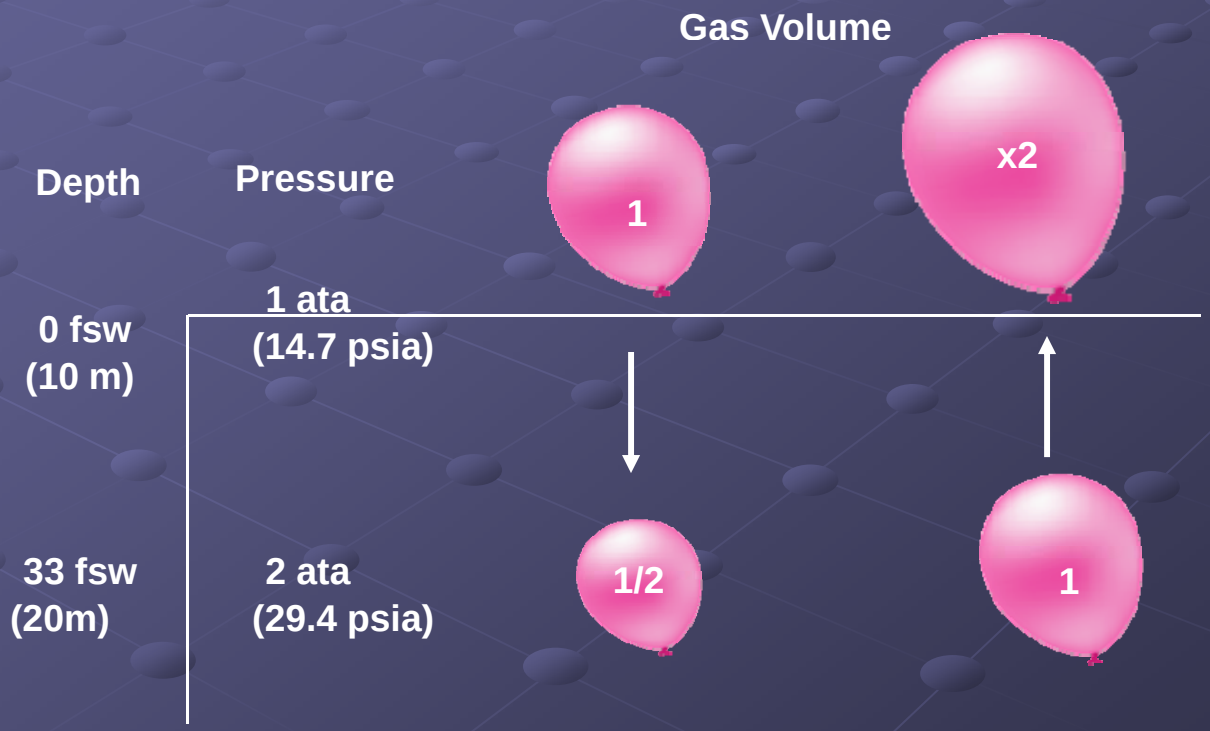
- Leakage or free flow of air from second stage
  - Freeze-up
    - Regulator will freeze open
  - Purge button depressed/stuck
- Flooding 2nd stage
  - Mouth piece
  - Diaphragm
  - Exhaust valve



Direct Effects of Pressure

Boyles Law

"For any gas at a constant temperature, the volume of the gas will vary inversely with the pressure."



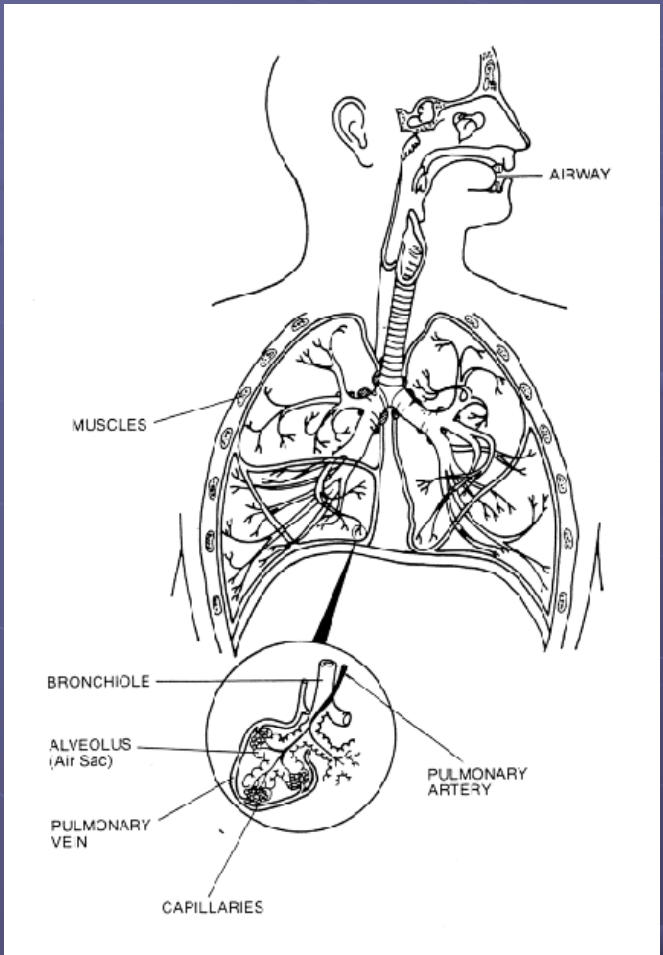
Boyles Law

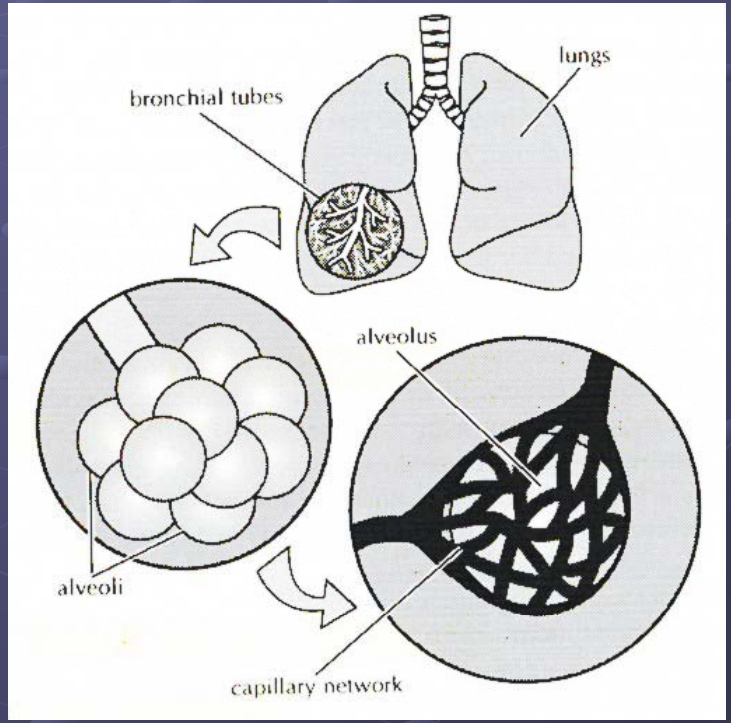
- The following air filled spaces are affected by pressure and density changes:
  - sinuses
  - ears
  - mask
  - suit
  - lungs
- If the pressure in these air filled spaces is not equalized then a barotrauma injury may occur

Lung Expansion Injuries

- Normally caused by
  - Holding your breath
  - Inflammation and blockage of smaller bronchial passages
    - As a result of a chest cold, asthma, emphysema or bronchitis
- Can occur in as little as 1 meter of water

Lung Expansion Injuries





Lung Expansion Injuries

- There are four principal lung expansion injuries
  - Pneumothorax
  - Mediastinal Emphysema
  - Subcutaneous Emphysema
  - Arterial Gas Embolism (AGE)
- Signs & Symptoms occur immediately upon surfacing or shortly (within 15 min) after

Practical Exercises

Practical Exercise Objectives

- Demonstrate:
  - donning a flight suit with HUEBA equipment
  - preflight checks
  - deployment and operation of HUEBA equipment
  - Breathing actions including
    - Breathe u/w
    - Deploy and clear HUEBA while u/w
    - Deploy and clear HUEBA while inverted u/w

Preflight Checks and Donning

Photo: J Boone

Pre-Breather

- Unlimited air supply
- LV-2 second stage

Photo: J Boone

Pre-Breather

- Practice
  - Normal breathing pattern
  - Clearing 2nd stage
    - Purge method
    - Blast method

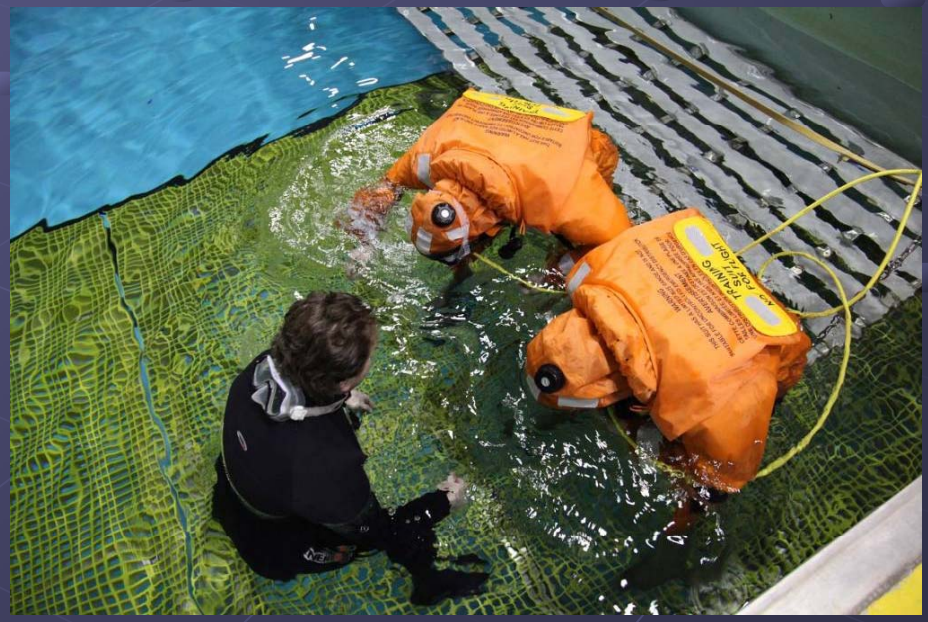


Photo: J Boone

HUEBA Operation

- Practice
  - Deploying HUEBA
  - Normal breathing pattern
  - Deploying HUEBA u/w
  - Clearing 2nd stage
    - Purge method
    - Blast method
- Breathe HUEBA down while u/w

Photo: J Boone

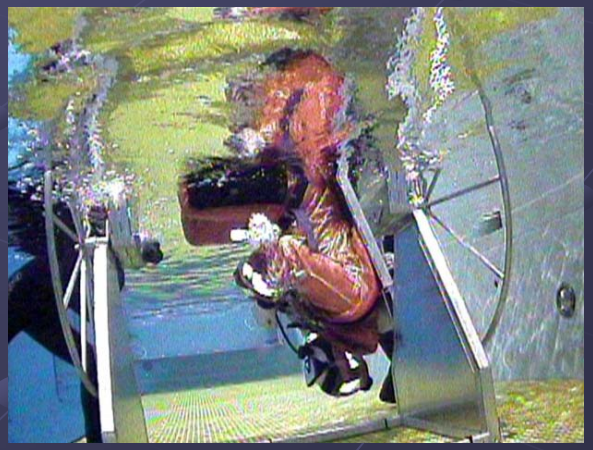
Emergency Breathing System Inversion Chair (EBSIC)

- Designed to provide a controlled way of inverting students
- 4 point harness
- Emergency release

Photo: J Boone

EBSIC

- Practice
  - Deploying HUEBA
  - Normal breathing pattern while inverted
  - Deploying HUEBA u/w while inverted
  - Clearing 2nd stage u/w while inverted
    - Purge method
    - Blast method



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