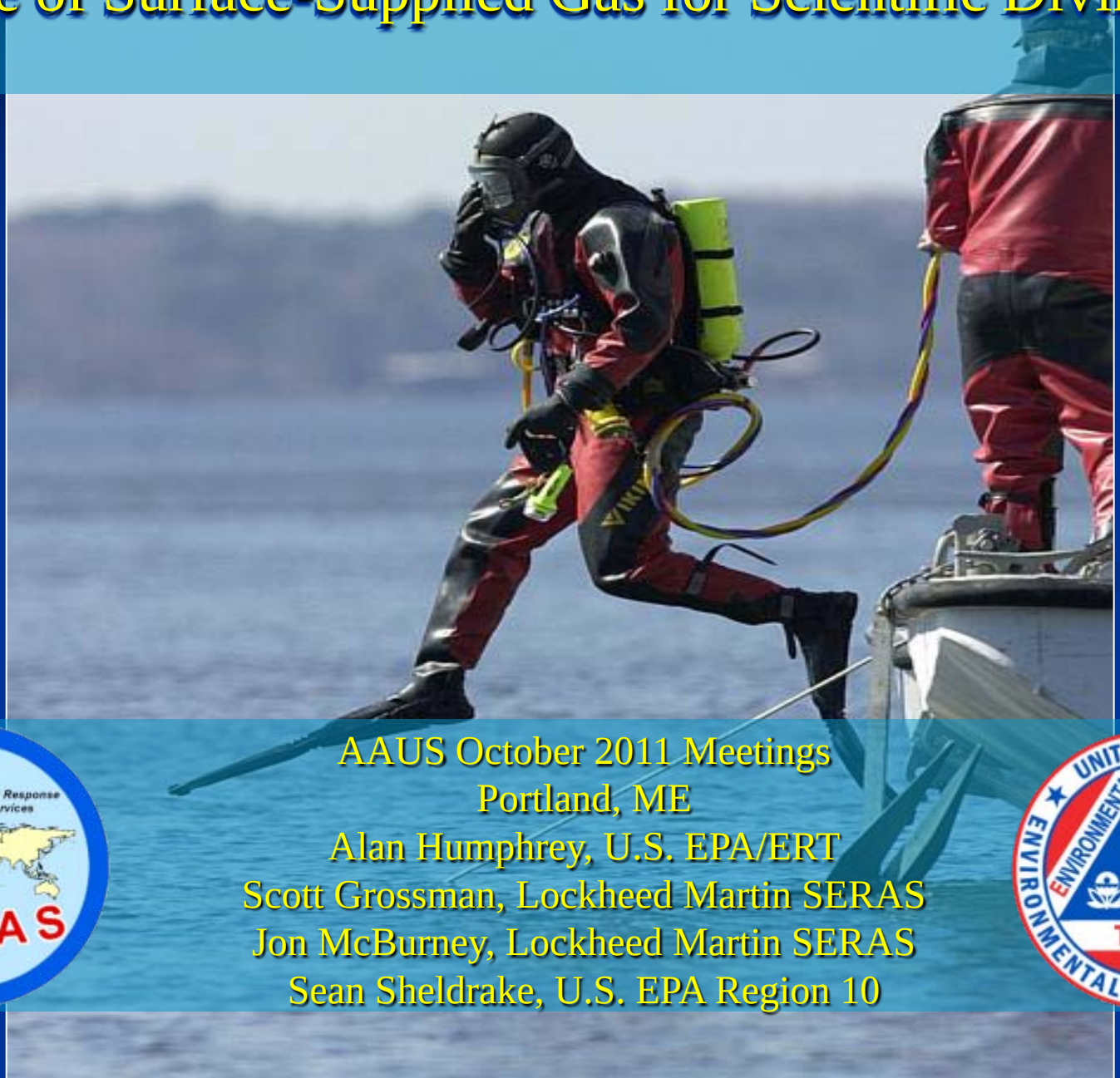
Use of Surface-Supplied Gas for Scientific Diving



AAUS October 2011 Meetings
Portland, ME
Alan Humphrey, U.S. EPA/ERT
Scott Grossman, Lockheed Martin SERAS
Jon McBurney, Lockheed Martin SERAS
Sean Sheldrake, U.S. EPA Region 10

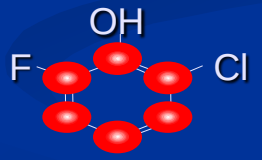
Environmental Response Team (ERT)
Lockheed Martin SERAS

- ERT Established in 1978
- 41 Experienced Responders
- About 75 Dedicated Lockheed Martin Contractors
- Focus: "Classic Environmental" Emergencies

  Sampling/monitoring — Characterization

  Hazard Evaluation — Decon/Disposal

  Risk Assessment/Safety



2-chloro-6-fluorophenol

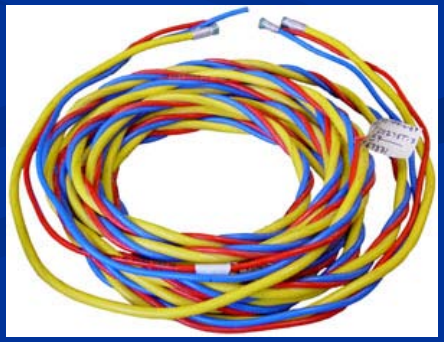
PFIB

ERT Dive Support

- Contaminated and Clean Water Dive Operations
- ERT's Divers Support a Variety of Agency Needs
  - Benthic Habitat Assessments/Coral Research
  - Survey of Ocean Dredge Disposal Sites
  - Environmental Criminal Investigations
  - Sunken Drums
  - Multimedia Aquatic Sampling
  - SUPERFUND Assessments
  - Biological Assesments

What is Surface-Supplied Diving?

- Surface-Supplied Air to Diver via Umbilical
  - Virtually Unlimited Air Supply
  - Tanks or Compressors
- Diver Carried Air tanks for Emergency Gas Supply (EGS) Only
- Three Part Umbilical
  - Breathing Gas Hose
  - Pneumofathometer (pneumo) Hose
  - Communication line (comm line)/Strength Member
- Surface Control Box/Station
- Dive Controlled By Surface as Opposed to Diver

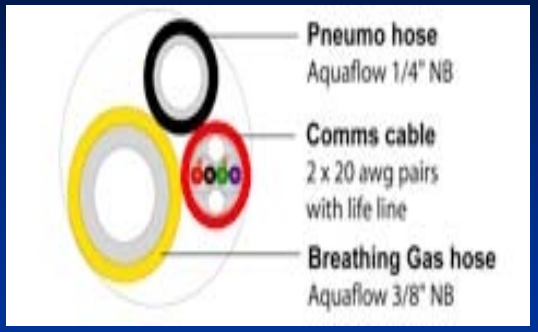


Equipment

- AIR SUPPLY
  - SCUBA Tanks
  - Air Bank
    - Large Banks – slower air usage
    - Safer and less tank switching
  - Compressor
    - High Volume; Low Pressure
    - Back up with Compressed Air
    - Air Testing/Compressor Maintenance
  - Air or Nitrox* May be Used for a Breathing Gas

*As approved by equipment manufacturer

Equipment



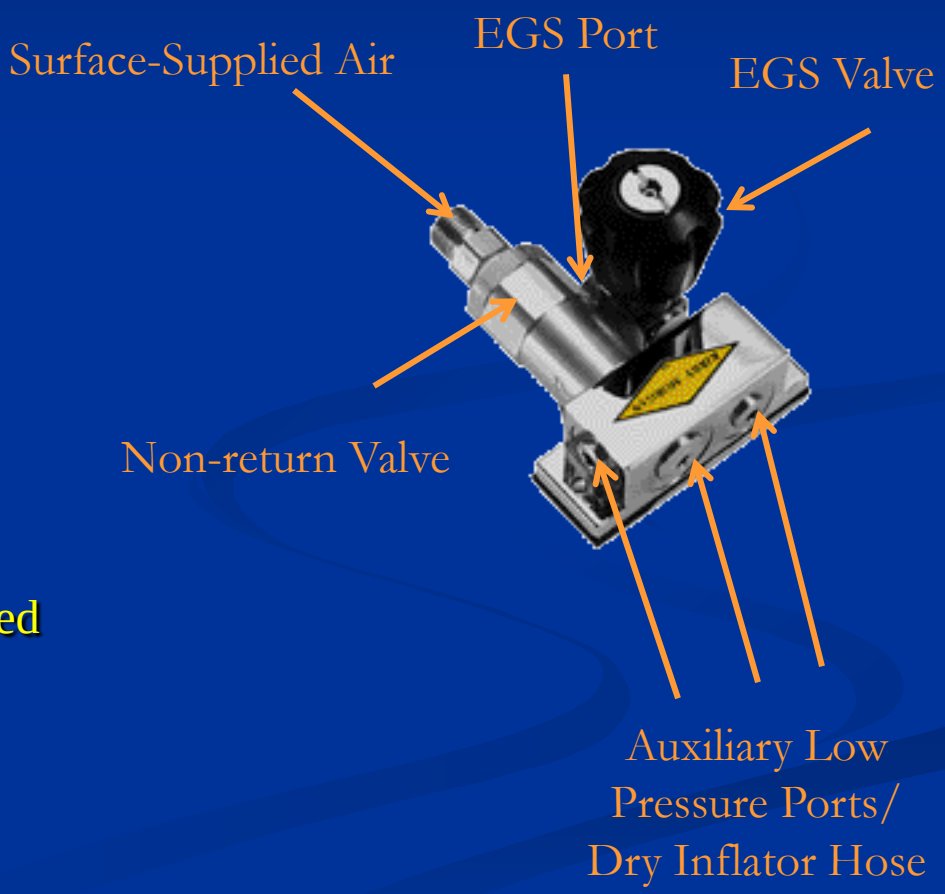
- Dive Umbilicals
  - Sinking or Floating
  - Smooth Polyurethane Spiral-Wound
  - Length Typically Ranges from 150 to 500 feet
  - Three Part Umbilical
    - *Air Line (Typically 300 psi and 3/8 inch ID)*
    - *Pneumofathometer (pneumo) Hose*
    - *Communication line (comm line)/Strength Member*

Equipment

- Emergency Gas Supply (EGS)
  - SCUBA Tank (Bail-Out Bottle) Worn by Diver
    - Size May Range from 6 to 80 Cubic Feet
    - Size Dependant Upon Dive Profile and Dive Environment
    - Attached to Manifold Block
    - Pressure Checked and Open at Start of Dive
    - Visible Tank Pressure Gauge
    - Over Pressure Relief Valve on First-Stage Regulator
      - Prevents hose failure if First Stage Reg. Fails
  - Accumulation Bottle
    - Small Bottle Used with Light Weight (1/4”) Umbilicals

Equipment

- Manifold Block
  - Must Always be Accessible to Diver
  - Helmet or Harness Mounted
  - Multiple Ports
    - *Surface-Supplied Air*
      - ***Non-return Valve or One-way Valve***
      - Tested Prior to Every Dive
    - *EGS*
      - EGS Valve MUST be Closed Until Needed
    - *Dry Suit Inflator Hose*
    - *Auxiliary Low Pressure Ports*



Equipment

- Harness
  - Must Always Be Worn for Surface-Supplied Dive Operations
  - Attachment Point for:
    - Comm. Line/Strength Member
    - EGS/Bail-out Bottle
    - Possibly Manifold Block
  - Allows Diver Be Safely Pulled to Point of Entry in an Emergency
  - No Strain on Vital Gas or Communication Links

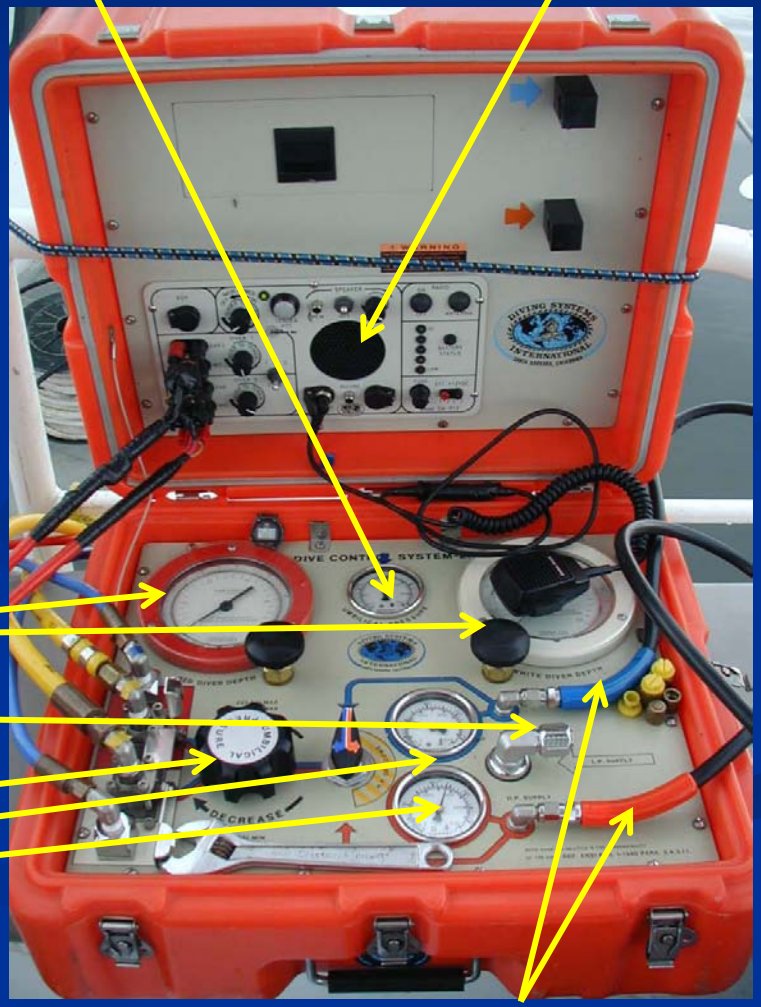
Equipment

- Helmet or Full Face Mask
  - Required for Communications During Surface-Supplied Air Dives
  - Helmet
    - Head Protection
    - Potentially Better Protection from Contaminates when Mated to Dry Suit
    - Potentially Increased Air Consumption Rates
  - Full Face Mask
    - Less Cumbersome
    - Diver Remains more Mobile

Equipment

- Surface Control Box
  - Dive is Controlled On Surface

    Not By Diver
  - Box Operator Monitors and Controls:
    - Duration/Timing of Dive
    - Diver Depth
    - Air Supply to Diver
    - Communication with Diver



Dive Team

- Minimum 4 Person Dive Team
  - Multiple Dives/Deeper Dives Require Additional Team Members
  - Two Divers in Water = 6 Person Team
    - Each Diver in Water Needs a Dedicated Tender
  - Dive Team Roles:
    - Diver
    - Stand-by Diver
    - Tender
    - Control Box Operator
    - Divemaster/Dive Supervisor
      - May also act as Control Box Operator or Tender
      - Must be on Surface – Not in Water While Overseeing Operations

Dive Team Responsibilities

- Diver
  - Diver Must Assure All Gear is Present and in Working Order Prior to the Dive
  - Understanding and Implementing Dive Plan
  - Performing In-Water Work
    - Remain Focused on Completing Tasks is NOT Burdened with Monitoring Depth, Bottom Time and Air Pressures
  - Be in Communication with Box Operator

Dive Team Responsibilities

- Stand-by Diver
  - MUST Be Ready to Enter Water PROMPTLY in Case of Emergency
  - Typically the Next Diver in the Rotation

Dive Team Responsibilities

- Tender
  - Assist Diver Continuously (Preparation, During Dive, After Dive)
  - Maintain Control of Dive Umbilical
    - Move Freely, But Not Present Entanglement Hazard
  - Tracking Divers Location in Water at ALL Times
  - Watching For Vessel or Other Hazards Enter Dive Area
  - Must Be Trained to Perform Function


Dive Team Responsibilities

- Control Box Operator
  - Dedicated Person Who is Responsible For:
    - Maintaining Sufficient Breathing Gas Delivery to Diver
    - Track Divers Profile (Depth and Bottom Time)
    - Ensure Diver Does Not Exceed Depth or Time Limits
    - Communications With Diver, Tender and Divemaster/Dive Supervisor

Dive Team Responsibilities

- Divemaster/Dive Supervisor
  - Overall Person Responsible For Daily Dive Operations
  - May Also Fill Role of Surface Control Box Operator or Tender
  - If Diving, Must Designate Acting Divemaster/Dive Supervisor While In Water
  - Coordinating Between All Team Members While Implementing Dive Plan

Scientific Diving Operations

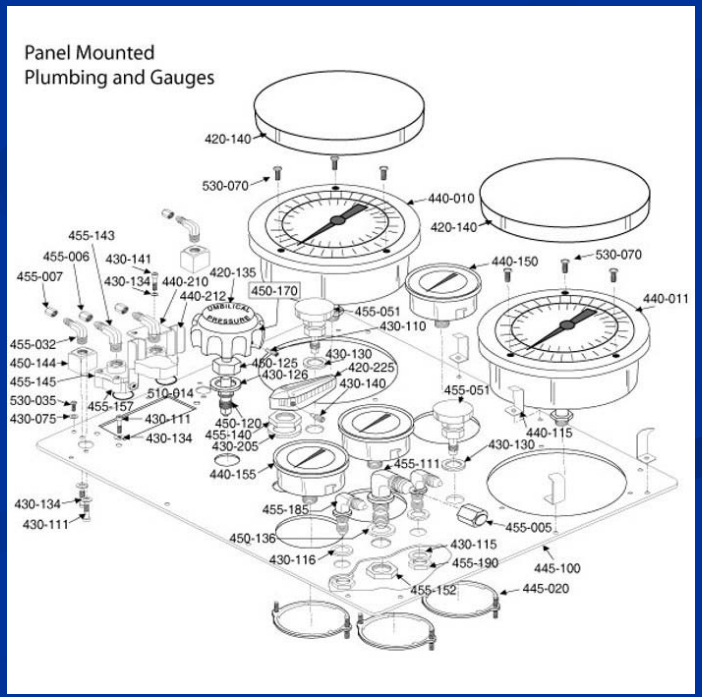
- Unit Specific SOPs or Consensus of Standards
  - EPA Diving Safety Manual
  - ERT/EPA Surface-Supplied Air SOPs
- Compliance with OSHA Regulations or Dive Program Requirements
- Dive Plan and Health and Safety Plan
- Check Lists/Pre-Dive Checks
- Suitable Work Area/Work Vessel
- Access To Water – Diver Entry/Egress
- Dive Team Rotation – Efficient and Safe Operations

Training and Experience

- All Team Members Must Be Trained and/or Have Suitable Experience Performing Roles on Dive Teams
- Initial and Annual Training with Equipment and Procedures
- Training Occurs In Controlled and Safe Environment NOT on the Job Site!
- Equipment Specific and Emergency Procedures
- Classroom and Hands On Training

Equipment Maintenance

- Daily, Weekly and Annual Equipment Maintenance
- Control Box Serviced on Annual Basis or as Recommended by Manufacturer
- Dive Umbilical Annual Pull and Pressure Test (1.5 x Working Pressure)
- Helmets and Full Face Masks



Modes of Diving

- **SCUBA (Old Reliable)**
  - Maximum Diver Mobility
  - Least Equipment and Training Intensive
  - Ideal for Shallow Dives Where Objectives Can Be Completed With Air In SCUBA Tank
- **Tethered SCUBA (Some Significant Improvements Over SCUBA)**
  - Some Additional Equipment and Training Costs
  - Always a Line From Surface to Diver
  - Improved Communication (Hardwired) – Surface Documentation of Diver Data
  - Direct Divers to Targets Using Umbilical and Communications
  - Hold Diver in Position in Strong Currents (SCUBA typically limited to < 1 knot)
  - Decreasing Diver Mobility (situational)
- **Surface Supplied Air – All of Line-Tended and…..**

Advantages of Using Surface Supplied Air

- **DIVER SAFETY - Virtually Unlimited Air to Diver**
  - Single Greatest Hazard to Diver is Running Out of Air - This Hazard is Greatly Reduced
  - Extended Time If Needed for Decontamination
- **Diver is NOT Limited to Bottom Times Based On Air that can be Carried**
  - No Need to Interrupt Dive and Return to the Surface Just to Change Tanks
  - Minimizes Unnecessary Bounce Dives and Risks Associated With Divers Entering and Exiting the Water

Advantages of Using Surface Supplied Air

- **Diver Can Fully Concentrate on Completing Objectives**
  - Bottom Time, Depth and Air Pressure Monitored on Surface
  - Can Be Monitored on Surface Even in Zero Visibility
- **Some Tasks Can be Completed More Efficiently and Safely Using a Single Diver – Especially in Low/Zero Visibility Environments**
- **Diver Will Need to Carry Less Weight – No SCUBA Tanks Just Project Appropriately Sized EGS (routinely 13 to 29 Cubic Feet)**

Disadvantages of Using Surface Supplied Air

- Additional Equipment
- Additional Training
- Larger Dive Team
  - Typically Four Person Dive Team
- Umbilical Drag or Limited Diver Range
  - Diver Range = Umbilical Length – Depth
  - Diver Range = 40’ = 150’ – 110’
  - With 150’ Umbilical in 110’ feet of water

Resources for Scientific Diving Using Surface Supplied Air

- U.S. EPA Dive Units
  - Environmental Response Team (ERT)
    - Alan Humphrey (Humphrey.Alan@epa.gov)
    - Scott Grossman (Scott.C.Grossman@lmco.com)
  - Region 10
    - Sean Sheldrake (Sheldrake.Sean@epa.gov)
    - www.epa.gov/region10/dive
  - US EPA Diving Safety Manual
  - EPA Standard Operating Procedures