

Tethered SCUBA Diving for Science, AAUS, October 2011

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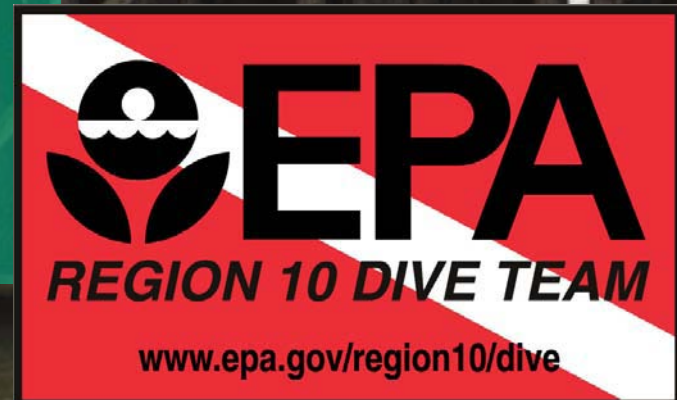
Rob Pedersen Region 10

Chad Schulze Region 10

Steven Donohue Region 3

Alan Humphrey, Environmental Response
Team

40 Year Anniversary: 1970-2010, Protecting Region 10 Waters



Acknowledgements



- NOAA Tethered Diving Standards and Training Module
- University of Michigan “Use of Tethered SCUBA Diving to Improve Safety and Efficiency”, AAUS Symposium Proceedings, 1990
- Hendrick, “Public Safety Diving,” 2000
- EPA Environmental Response Team, Region 3, and ORD-Gulf Ecology Division EPA Dive Training Center

Tethered SCUBA for Science, Overview:

- Why use a tether?
- Equipment
- Personnel
- Procedures
- Next Steps

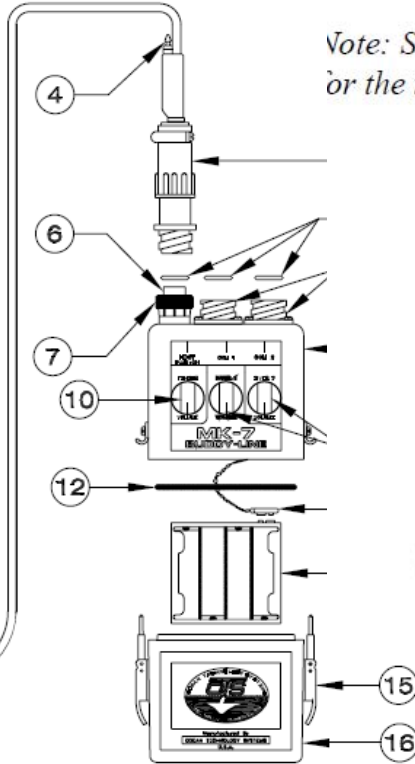
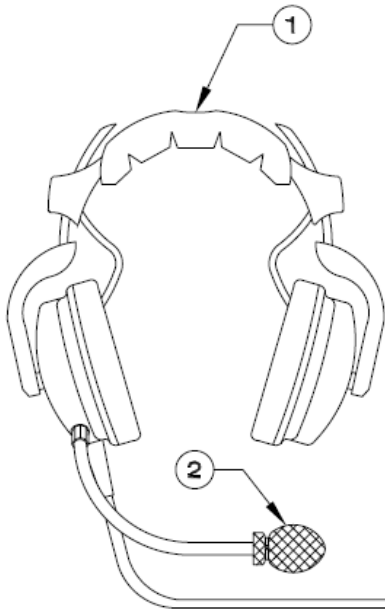
Why Tethered SCUBA for Science?

- Currents
- Entanglement
- Low visibility
- Need for constant communication &/or to relay video
- Mapping/search



Tethered SCUBA for Science: Equipment

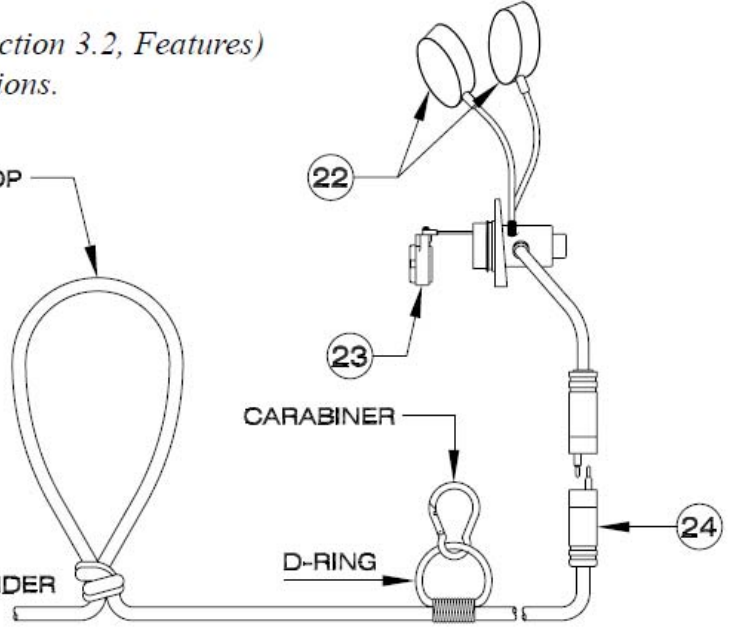




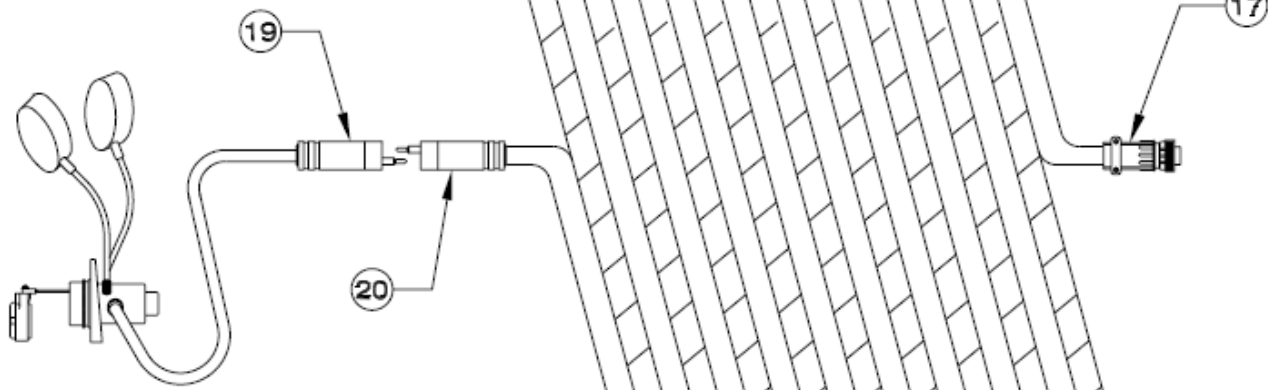
Note: See p. 4 (in Section 3.2, Features) or the item descriptions.

HAND LOOP

THIS END TOWARD TENDER



Communications Unit



EAR/MIC ASSEMBLY
ITEM (21)

(18) **COMROPE ASSEMBLY**

Table 8-3. Line-Pull Signals.

From Tender to Diver		Searching Signals (Without Circling Line)	
1 Pull	"Are you all right?" When diver is descending, one pull means "Stop."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Going Down." During ascent, two pulls mean "You have come up too far; go back down until we stop you."	1 Pull	"Stop and search where you are."
3 Pulls	"Stand by to come up."	2 Pulls	"Move directly away from the tender if given slack; move toward the tender if strain is taken on the life line."
4 Pulls	"Come up."	3 Pulls	"Face your umbilical, take a strain, move right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face your umbilical, take a strain, move left."
3-2 Pulls	"Ventilate."		
4-3 Pulls	"Circulate."		
From Diver to Tender		Searching Signals (With Circling Line)	
1 Pull	"I am all right." When descending, one pull means "Stop" or "I am on the bottom."	7 Pulls	"Go on (or off) searching signals."
2 Pulls	"Lower" or "Give me slack."	1 Pull	"Stop and search where you are."
3 Pulls	"Take up my slack."	2 Pulls	"Move away from the weight."
4 Pulls	"Haul me up."	3 Pulls	"Face the weight and go right."
2-1 Pulls	"I understand" or "Talk to me."	4 Pulls	"Face the weight and go left."
3-2 Pulls	"More air."		
4-3 Pulls	"Less air."		
Special Signals From the Diver		Emergency Signals From the Diver	
1-2-3-4 Pulls	"Send me a square mark."	2-2-2 Pulls	"I am fouled and need the assistance of another diver."
5-1-1 Pulls	"Send me a line."	3-3-3 Pulls	"I am fouled but can clear myself."

Navy Rev. 6 Line Pull Signals

Harness

- Provides strain relief for diver's head
- Quick release for emergency escape
- Ensures against sudden loss of tether connection
- Gives ability of tender to conduct rescue



Full Face Mask


- Provides ability to communicate
- Compatible with lower level polluted water diving when used with dryhood /drysuit/drygloves





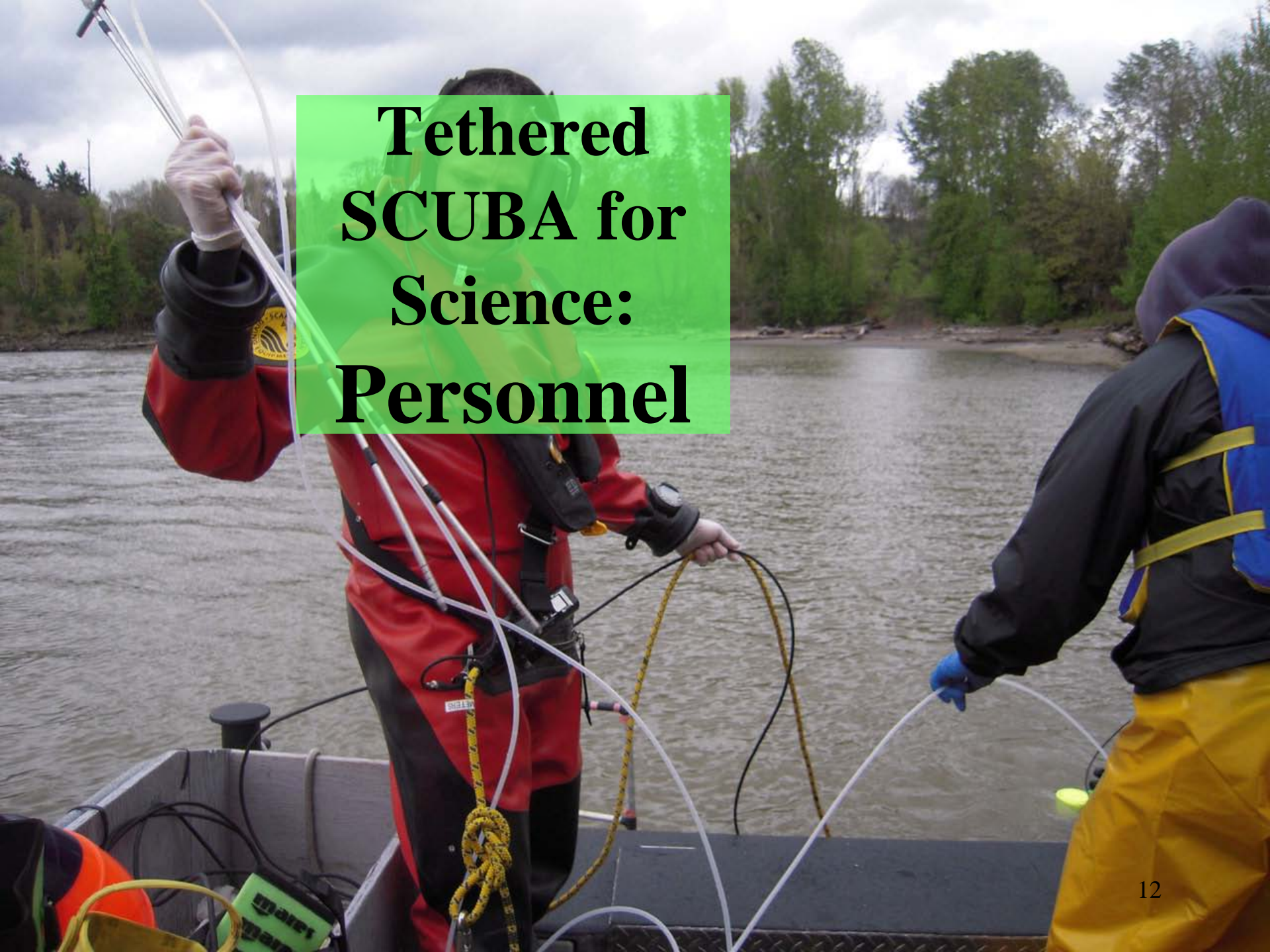
Tether

- Typically a comm. Line
- Strength member
- Should be fitted with quick release
- Distance to dive site plus 1.5 x depth
- Marked in regular intervals
- Span of control
- Segregation for polluted water

A close-up photograph of a diver's equipment on a boat. The gear includes a black buoyancy compensator device (BCD) with a black hood and goggles, a yellow gas cylinder, and a manifold block with various hoses and gauges. The background shows a calm body of water reflecting the sky.

Emergency Gas Supply (EGS)

- Required as this is “solo diving”
- EGS typically connected thru manifold block
- Size of bailout determined by depth & hazards
- EGS SPG must be in diver’s field of view



Tethered SCUBA for Science: Personnel

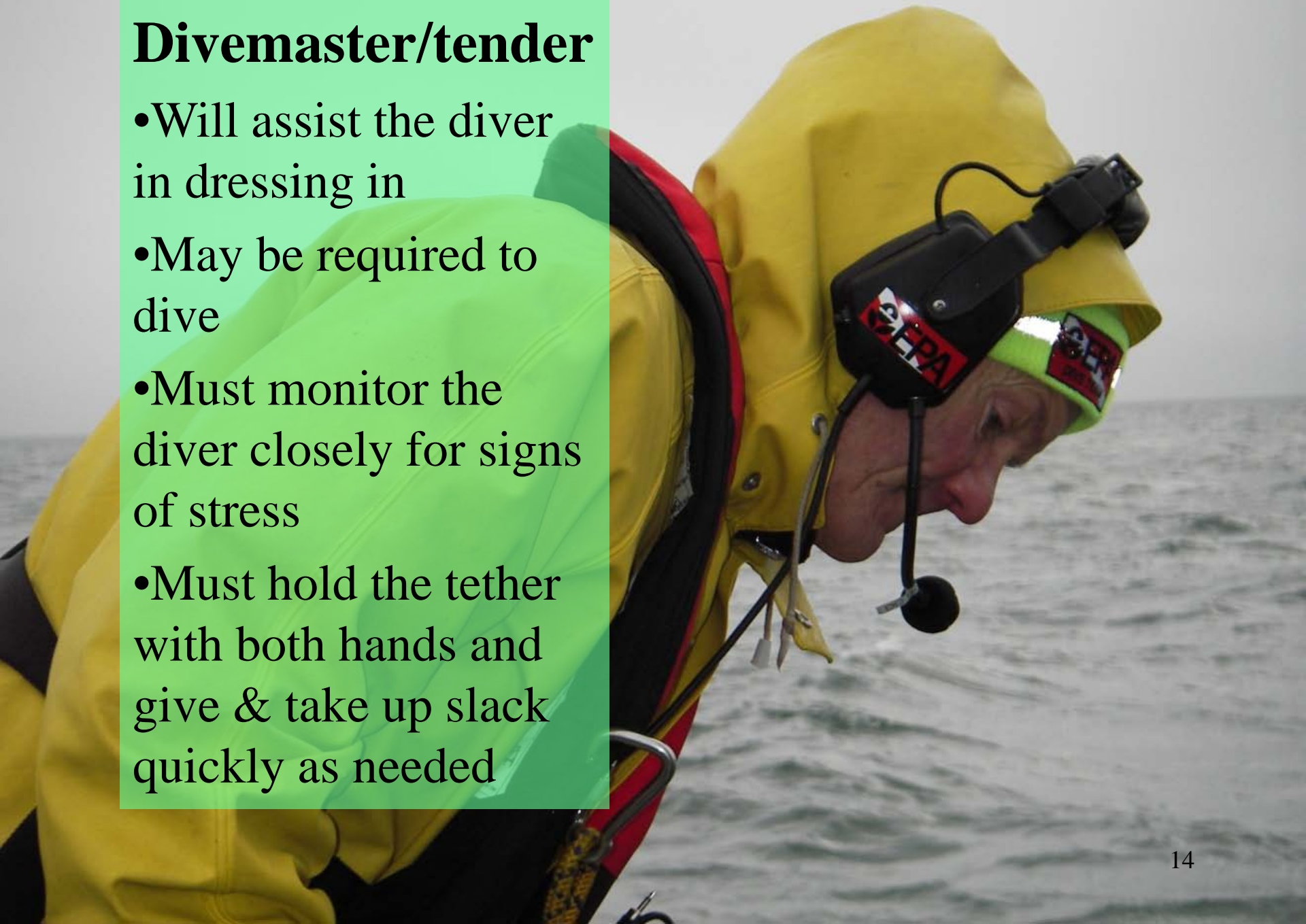
Diver

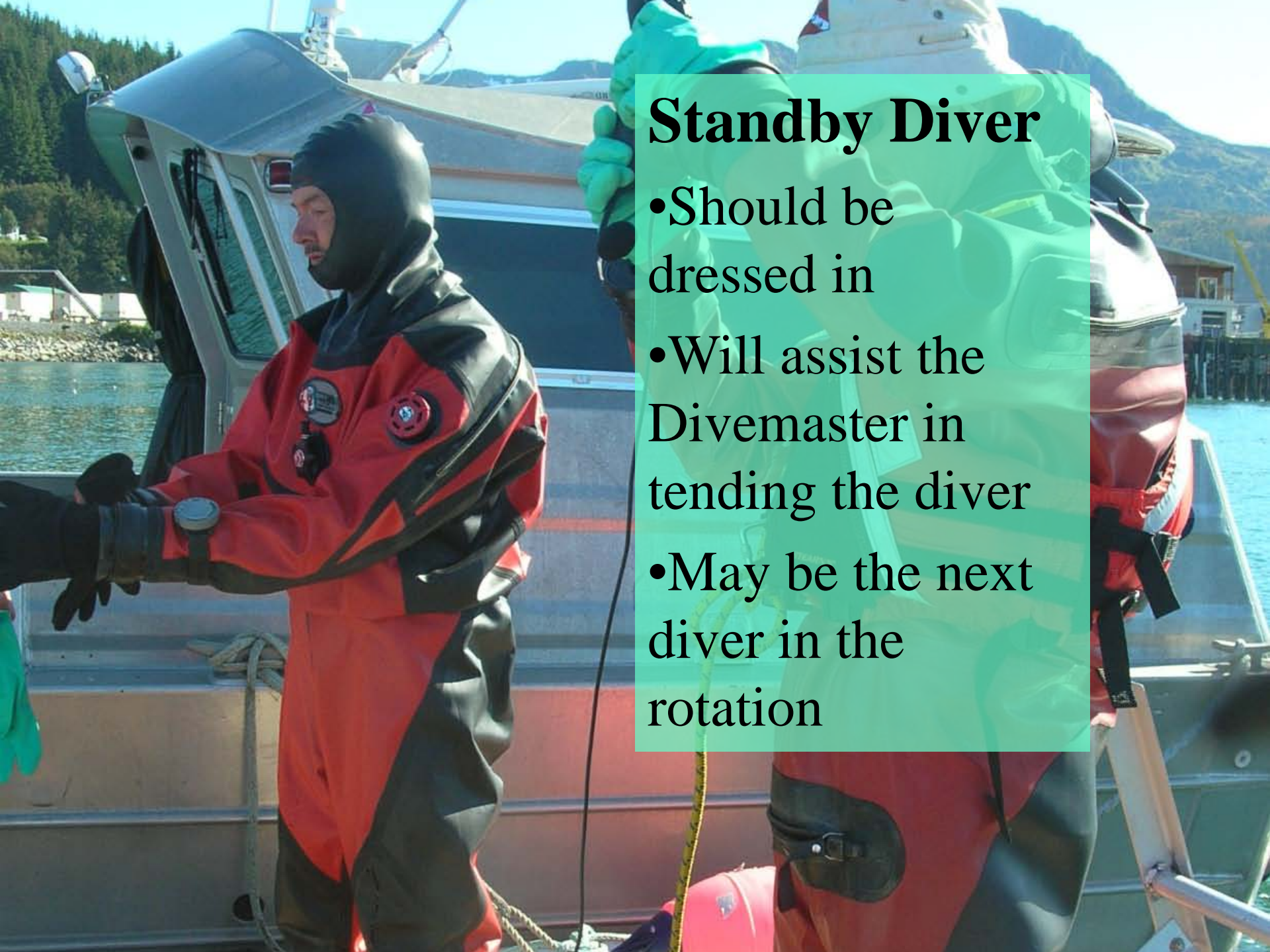
- Diving “alone”
- Diver needs to realize tender controls many aspects of dive
- Diver may rotate depending on depth profiles thru dive crew, or may be one diver per day



Divemaster/tender

- Will assist the diver in dressing in
- May be required to dive
- Must monitor the diver closely for signs of stress
- Must hold the tether with both hands and give & take up slack quickly as needed





Standby Diver

- Should be dressed in
- Will assist the Divemaster in tending the diver
- May be the next diver in the rotation

Tethered SCUBA for Science: Procedures

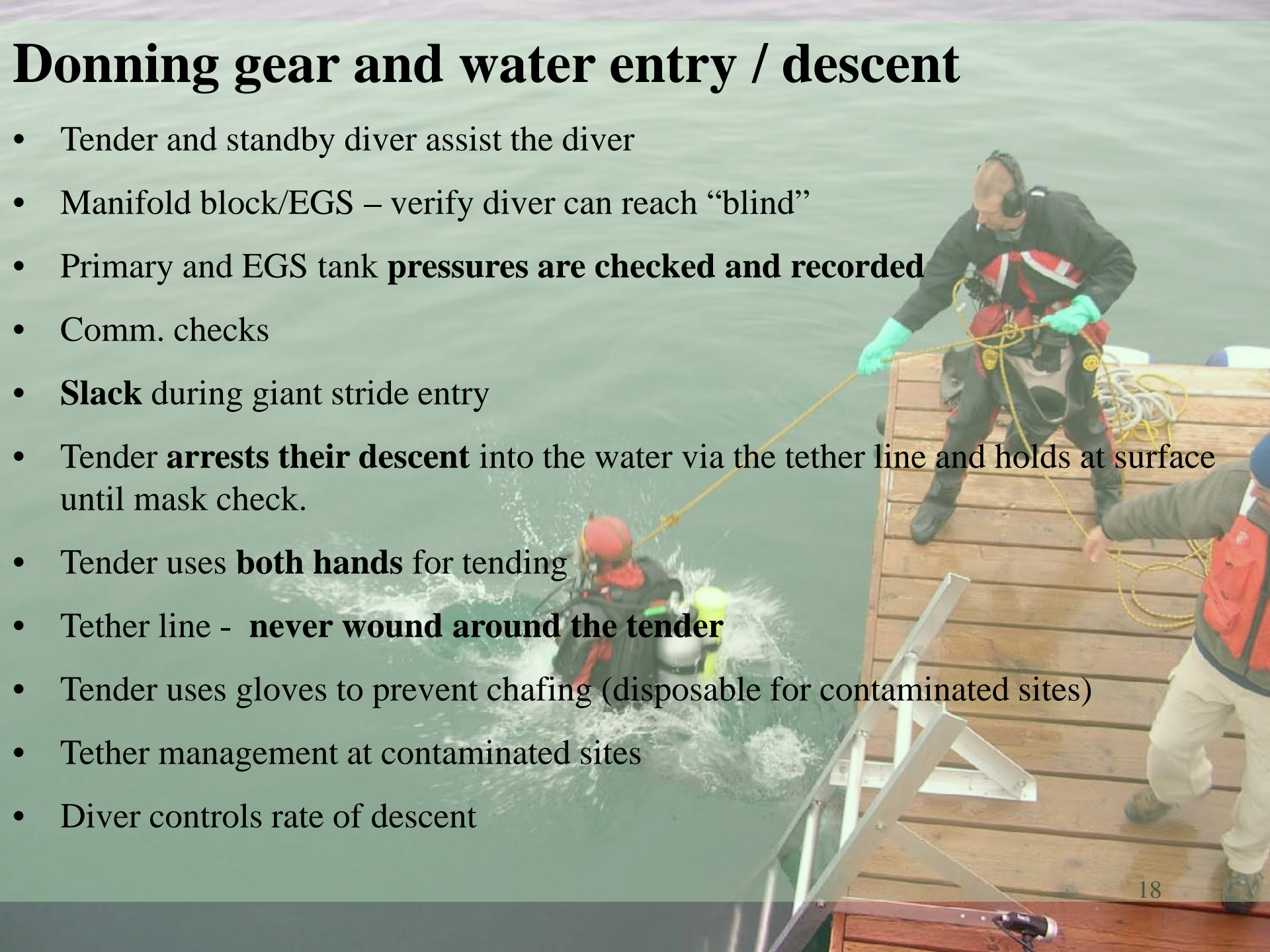


Procedures: Fundamentals

- Minimum crew size of 3
- Rotation of divers allows for maximum efficiency and safety (offgas time)

Donning gear and water entry / descent

- Tender and standby diver assist the diver
- Manifold block/EGS – verify diver can reach “blind”
- Primary and EGS tank **pressures are checked and recorded**
- Comm. checks
- **Slack** during giant stride entry
- Tender **arrests their descent** into the water via the tether line and holds at surface until mask check.
- Tender uses **both hands** for tending
- Tether line - **never wound around the tender**
- Tender uses gloves to prevent chafing (disposable for contaminated sites)
- Tether management at contaminated sites
- Diver controls rate of descent



On the bottom

- Directing the diver – all movements relative to the line “swim toward the line,” “take a 90 right”
- Diver must have trust
- Search patterns – spacing visibility dependent
- Regular pressure checks from the diver will be requested
- “Standby surface.”
- Surface holds tension at all times, and releases tension only when requested
- Understand the “airplane wing” in current
- Lack of line tension can lead to:
 1. Entanglement
 2. No feedback on status of diver
 3. Loss of backup (line pull) communications with diver
 4. Inability to convey equipment via tether

Ascent and Doffing Gear

- Surface may control the ascent
- Warn diver to protect their head from the vessel.
- Tender remains on comm. until diver is aboard and decontaminated, as needed.
- The line will be managed in the dive platform's "hot zone" with gloves such that it can be decontaminated at the end of dive operations, as needed
- Decontamination will take place as needed before other tasks, focusing on the mask and glove areas when conducting repetitive diving.
- Tender will ensure that the diver leaves the bottom with sufficient pressure to undergo any decon. deemed necessary.

Vessel Operations

- All boat/ship propellers must be deactivated
- Small boats must be on anchor
- Ships do not need to be on anchor for a ship husbandry dive, e.g. clearing a fouled propeller in deep water.
- Bow and stern anchors should be available.
- If the boat were to swing, sufficient slack must be given and/or tension is kept on the diver to ensure they are not swept away in current, or subjected to sudden changes in pressure.
- “Security” call should be made to all concerned traffic over VHF channel 16 for channel dives / monitoring VTS & channel 16



Emergency Procedures

- All divers must know and have practiced freeing an entangled line, disconnecting from tether, unconscious diver rescue, and clearing a flooded mask
- Backup line pull signal review during dive brief
- Diver must be prepared to separate from the tether, as needed
- Tether must be available for the standby “rescue” diver



Summary

- Tethered SCUBA provides a valuable tool for scientific data collection to both increase efficiency and safety of the diving mission for areas with **currents, entanglements**, a need to **relay live video, ability to clearly communicate with and monitor the diver**, and for **lighter crewing** requirements (3) and diver offgassing safety factor.
- Some drawbacks include: added **limited mobility** and **limited air supply**.
- Adoption of tethered diving standards by AAUS members and AAUS will further the usage, safety, and consensus on the approach(es) to tethered SCUBA for scientific data collection.

How To Contact the EPA Dive Team and For More Information

- *On the web* <http://www.epa.gov/region10/dive>
or GOOGLE, “EPA DIVE TEAM”
- sheldrake.sean@epa.gov
- Humphrey.alan@epa.gov



References

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