Equipment Specialist

Specialty Course
Instructor Outline

Product No. 70220 (Rev. 2/10) Version 1.06

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Legend

Note to instructors:	Points for the instructor to consider that give additional qualifying information about conducting the course. Not intended to be read to students.
Note to students:	Required information. Read to students as printed.
By the end of this session, you will be able to: • Objective • Objective • Objective	Important information. Read to students. Objectives always precede individual Academic Topics and open water dives.
!	Important safety information. Read to students.

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Please read this first.

Qualifying To Teach PADI Specialty Diver Courses

To apply for a Specialty Instructor rating, an individual must be certified as a PADI Underwater Instructor or higher. There are two ways to qualify to teach PADI Specialty Diver courses: 1) Attend a Specialty Instructor Training Course conducted by PADI Course Directors, or 2) apply directly to PADI.

Specialty Instructor Training Course attendance is *highly recommended* and *encouraged.* These courses provide hands-on training, technique demonstrations, course marketing information, current PADI Standards information and, when applicable, instructor-level open water training.

Application made directly to PADI requires either: 1) use of a PADI standardized Specialty Course Instructor Outline (this document), or 2) the submission of a self-generated specialty course outline for review. To speed outline approval, reduce liability exposure and ensure educational validity of your specialty courses, it is highly recommended that PADI standardized Specialty Course Instructor Outlines be used for courses they have been developed for. The Specialty Course Instructor Application is to be used whether attending a Specialty Instructor Training Course or applying directly to PADI.

> *Important Note: Prior to promoting or teaching a PADI Specialty Diver course, written confirmation of instructor certification in that specialty must first be received from PADI.*

For more information on certification as a PADI Specialty Instructor, please refer to the "General Standards and Procedures" section of the PADI *Instructor Manual.* If you still have questions after reading this section, call your PADI Office.

COURSE STANDARDS AND OVERVIEW

This course is designed to be an introduction to new types of equipment and to familiarize divers with the operation and maintenance of equipment.

Prerequisites

To qualify for the Equipment Specialist course, an individual must:

1. **Be certified as a PADI Scuba Diver, Junior Scuba Diver, Open Water Diver, Junior Open Water Diver or have qualifying certifications from another training organization.**
2. **Be 10 years of age or older.**

Instructor Supervision

Equipment Specialist courses may be conducted by a Teaching status PADI Assistant Instructor, Underwater Instructor or PADI Instructor with a higher rating who has been certified as a PADI Equipment Specialist Instructor.

The maximum student diver-to-instructor ratio is limited only by instructor control.

Considerations for Training

The Equipment Specialist course does not require any open water training dives. The minimum number of recommended hours is six, with time being equally divided between knowledge development and practical training sessions.

It is recommended, but not required, that the student divers be given the opportunity to try out new or unfamiliar equipment items in confined water during this course.

COURSE OVERVIEW

This course is intended to familiarize divers with the operation and maintenance of equipment. It is not an equipment repair course. Training relative to the repairing and overhauling of equipment, except for very minor servicing, is not to be part of the curriculum. **To conduct an Equipment Specialist course, the following is to be included:**

1. **The theory, principles and operation of diving equipment**
2. **Routine, recommended care and maintenance procedures, and equipment storage**
3. **Common problems with equipment and recommended professional maintenance procedures** (May include a demonstration of repair procedures.)
4. **Simple suggestions for comfortable equipment configurations and an introduction to new equipment** (Optional trying of new or unfamiliar equipment in confined water may be included.)

CERTIFICATION PROCEDURES

The certifying instructor obtains an Equipment Specialist certification by submitting a completed, signed PIC to the appropriate PADI Office. **The instructor certifying the student diver must insure that all certification requirements have been met.**

KEY STANDARDS

Prerequisite Certification: **PADI (Junior) Scuba Diver, Open Water Diver, Junior Open Water Diver or qualifying certification**

Minimum Age: 10

Recommended Course Hours: 6

Minimum Open Water Training: None required

Student-to-Instructor Ratio: Not applicable

Minimum Instructor Rating: Equipment Specialist Instructor

Introductory Information
Equipment Specialist Course Instructor Outline

Heading IV on the outline "Academic Topics provides specific information that is to be presented to students prior to the conclusion of the course. At the discretion of the instructor, the topics in this section may be "modularized" (divided into several academic presentation sessions).

Heading V on the outline "Recommended Demonstration Activities" provides information on how to conduct the practical portion of the course. Course hours should be equally divided between academic and practical sessions.

I. Course Overview

The purpose of the PADI Equipment Specialist course is to familiarize divers with the operation and maintenance of diving equipment. It is not an equipment-repair course. Training relative to the repairing and overhauling of equipment, except for very minor servicing, is not to be part of the curriculum. Time should be equally divided between academic and practical sessions. The goals of PADI Equipment Specialist training are to:

A. Develop the student's practical knowledge of the theory, principles and operation of diving equipment.

B. Enable the student to perform routine, recommended care and maintenance procedures.

C. Enable the student to store equipment properly.

D. Provide students with simple suggestions for comfortable equipment configurations.

E. Introduce students to new equipment.

Note to Instructor

Some of the material outlined in this document is also presented at the PADI Open Water Diver level. While some students may need a detailed review of this entry-level information, others may not. Evaluate the needs of the enrolled students based on how recently they completed their beginning training.

II. Equipment Specialist Course Requirements

A. Prerequisite certification: PADI Scuba Diver, Open Water Diver, or have qualifying certifications from another training organization. The instructor is to ensure that the individual can perform the skills required of a PADI Open Water Diver.

B. Minimum age requirement: 10 years.

C. Student-to-instructor ratio: not applicable.

D. Confined water training may be added at the discretion of the instructor conducting the specialty course. Confined water training could be included in the course to introduce students to new types/models of diving equipment and comfortable equipment configurations.

E. Dive data

1. No open water dives are required

III. Student and Instructor Materials/ Equipment Requirements

A. Student materials

1. PADI *Encyclopedia of Recreational Diving*

B. Instructor materials/equipment

1. Training and demonstration aids:
   a. Facilities for proper rinsing, storage and transportation of personal diving equipment
   b. Spare parts and tool kit
   c. Sample regulator first and second stage — suitable for disassembly and reassembly
   d. Submersible pressure gauge — suitable for disassembly and reassembly
   e. Scuba cylinder and visual inspection light. It is recommended, but not required that the demonstration cylinder contain highly visible examples of any of the following:
      - Corrosion
      - Pitting
      - Cracks
      - Accumulation of foreign materials
   f. Cylinder valve, with burst disk — suitable for disassembly and reassembly
   g. Exposure suit material or old exposure suits (for practicing gluing and cutting patches)
   h. Samples of the following scuba equipment (use the newest, most modern equipment available):
      - Masks, snorkels, fins and related accessories
      - Exposure suits — covering the range commonly used for local diving
      - Buoyancy control devices (BCDs)
      - Weight belts or weight systems
      - Scuba cylinders — different sizes and types
      - Cylinder valves — different types (dual tank manifolds, Y-valves, J-valve, K-valve, etc.)
      - Regulators — different types and models
      - Alternate air sources — provide as broad a variety of samples as possible
      - Instrumentation — including devices for monitoring cylinder pressure, depth, time, direction
      - Surface signaling devices

Devices used to gain attention at the surface should be a standard piece of equipment for every diver, regardless of certification level. Audible devices like whistles or air horns (devices that attach to the low-pressure inflator of the BCD) can be easily heard at night or in limited visibility conditions. For daytime use, include a visual signaling device like a signal mirror or surface marker buoy (safety sausage) in your equipment. As a professional, you need to be familiar with the latest devices on the market and incorporate them into all your courses.

Note to Instructor

It is recommended that students have the opportunity to see at least one example of an electronic dive computer.

- Log book (Adventure Log recommended.)
- Slates and Underwater Slate Pencils
- Dive float and flags
- Underwater lights — different types and models

Note to Instructor

It is recommended, but not required that: 1) this course be conducted in a PADI Dive Center or Resort or 2) a visit to a local PADI Dive Center or Resort be included in the course. This ensures that students see the type of facility in which professional equipment repairs take place and the extensive, specialized equipment or tools required to do such repairs correctly. It further ensures that students have the opportunity to see a wide variety of new, modern scuba equipment — including different brands and models — as part of the course.

2. PADI materials that may be used to teach this course
   a. General materials and teaching aids:
      - Log Book (Adventure Log recommended)
      - PADI *Instructor Manual*
      - Student Record File
   b. PADI reference materials:
      - *The Encyclopedia of Recreational Diving*
   c. Recognition materials:
      - PIC envelopes
      - Specialty Diver wall certificates
      - Equipment Specialist chevrons

IV. Academic Topics

This an actual presentation outline. Directions to, or comments for, the instructor are enclosed in [brackets]. Reference may be made to the Equipment section of the PADI Encyclopedia of Recreational Diving.

A. Introductions, course overview and welcome to the course

1. Staff introductions
    a. [Introduce yourself and assistants]
    b. [Have students introduce themselves and explain why they're interested in learning more about their diving equipment — break the ice and encourage a relaxed atmosphere.]
2. Course goals
    a. The goals of PADI Equipment Specialist training are to:
        - Develop your practical knowledge of the theory, principles and operation of diving equipment.
        - Enable you to perform routine, recommended care and maintenance procedures.
        - Enable you to store equipment properly.
        - Provide you with simple suggestions for comfortable equipment configurations.
        - Introduce you to new equipment.
3. Course overview
    a. Classroom presentations [Give the times, dates and locations.] There will be _____(number) classroom presentations during the course.
    b. You are to listen, take notes and ask questions.
    c. You will see the following demonstrations of the basic steps involved in:
        - Proper care and maintenance of diving equipment
        - Filling a scuba cylinder
        - Conducting a scuba cylinder inspection
        - Scuba regulator overhaul
    d. Several practical workshops are also conducted during the course:
        - Assembling a personalized spare parts or tool kit
        - Minor repairs to exposure suits
        - Checking a BCD for leaks
        - Packing a dive bag
    e. Confined water training. [If confined water training is planned, give the time, date and location

Note to Student

In general, this is not an equipment repair course. Only professionally trained equipment repair technicians should repair life support equipment and diving instruments. Working on equipment of this nature may jeopardize your safety and possible void the manufacturer's warranty.

4. Certification
    a. Upon successful completion of the course, the PADI Equipment Specialist certification card is awarded.
    b. Certification means that you will be able to:
        - Decide which diving equipment maintenance procedures you can do and which should be left to professionals.
        - Properly care for and maintenance your diving equipment
        - Apply for the rating of Master Scuba Diver if you are a PADI Advanced Open Water Diver (or have a qualifying certification from another organization) and a PADI Rescue Diver (or have a qualifying certification from another organization) with certification in four other PADI Specialty ratings.
5. Class requirements
    a. Cost of course [Be sure to explain all course costs]
    b. Equipment needs
    c. Materials needed for the course
    d. Attendance requirements
6. Administration
    a. Complete paperwork Enrollment form, Standard Safe Diving Practices Statement of Understanding, PADI Medical Statement, Liability Release and Assumption of Risk. [The PADI Student Record File contains all of these forms. Using it makes completing course paperwork easy and convenient.]

B. The principles of equipment selection and care.

Note to Instructor

Some of the material outlined here is presented in the PADI Open Water Diver course. Consequently, cover this material as a quick review, focusing on equipment care, maintenance and storage.

Learning Objectives.

By the end of this session, you will be able to:

- ***Make equipment selection based on the three criteria given.***
- ***Prepare new equipment for use.***
- ***Care for and properly store diving equipment.***

1. The Completely Equipped Diver — A properly equipped recreational scuba diver will use the following equipment on nearly every dive:
   a. Mask, snorkel and fins
   b. Exposure protection
   c. Weight system
   d. Scuba system
      - Cylinder, primary and alternate air source
      - Buoyancy control device
      - Instrumentation to monitor air supply, depth and time. A means of monitoring direction is optional, but highly recommended
   e. Knife or tool
   f. Dive tables or dive planning device
   g. Log book
   h. Slate
2. Equipment selection.
   a. Never compromise safety for the sake of economy
   b. Let comfort be the most important selection criteria, next to safety — but realize that comfort is an important contributing factor to safety
   c. Never overlook the importance of service
      - Follow the manufacturer's recommended procedure
      - Is the dealer authorized to perform necessary service?
      - Does the dealer have the parts and facilities necessary to do so?
      - Is comparable service available in areas you will visit or later move to?

3. Preparing new equipment for use
    a. Remove waxy, preservative coating
    b. Mark equipment for easy identification
4. Equipment care and storage
    a. Rinsing
        - Removes salt and sediment; inhibits oxidation or corrosion
        - Use warm, fresh water — not under high pressure.
    b. Drying
        - Air dry only — do not use artificial heat.
        - Dry away from direct sunlight, but in well-ventilated area.
    c. Storage
        - Store items away from sunlight, pollution and ozone.
        - Store rubber items unfolded and unbent.
        - Do not store clear silicone and black rubber items next to one another (pigment transfer).
        - Store exposure suits on broad hangers.
        - For extended storage, place rubber items in plastic bags.

C. Masks, snorkels and fins

Note to Instructor

Some of the material outlined here is presented in the PADI Open Water Diver course. Consequently, cover this material as a quick review focusing on equipment selection.

Learning Objectives.

By the end of this session, you will be able to:

- ***State the materials commonly used for modern mask and snorkel construction.***
- ***Identify the new styles of masks.***
- ***Explain how to use defogging solution.***
- ***State the type of construction used to make modern diving fins.***
- ***Choose fins based on fit, type of diving being done and personal preference.***
- ***Assemble a spare parts kit and explain its value.***

1. Masks
    a. Materials
        - Silicone or neoprene rubber

- Silicone costs approximately 40 percent more — but lasts 300 percent longer.
- Clear silicone allows more light to enter — but may be a disadvantage when peering into dark holes

b. New styles [Show examples]

c. Defogging solution

- Prevents fogging caused by moisture in breath, perspiration
- More aesthetically pleasing than spitting
- How to use: [Demonstrate] works best when applied to face plate while it is still dry.

2. Snorkels

a. Materials

- Modern snorkels are made from a combination of silicone and plastic; use of neoprene is now uncommon.

b. New styles [show examples]

3. Fins

a. Materials

- Most modern fins use composite construction — thermoplastic blades and neoprene foot pockets.
- Older design fins are usually injection-molded neoprene.
- Thermoplastic/composite construction benefits — lighter weight, greater efficiency, greater ease of learning.
- Choice of colors

b. Choosing the right fins

- Divers who own both full-foot and adjustable fins will be prepared for the widest range of conditions and activities.
- Adjustable fins are preferable when: 1) diving in strong currents, 2) carrying bulky equipment that increases drag and 3) having to wear wet suit boots because of water temperature or the need to walk across rough surfaces.
- Full-foot fins may be adequate under all other conditions and desirable when: 1) snorkeling, 2) having to travel with minimal luggage and 3) having to do extensive surface swimming.
- Factors to keep in mind when selecting fins include: 1) wear wet suit boots when trying on adjustable fins, 2) avoid fins that are too tight or too loose, 3) fin pocket should come all the way up to the point at which the ankle joins the foot, 4) you should be able to adjust

straps without difficulty and 5) you should be able to get the straps of adjustable fins over the heel of your boots without excessive difficulty.

- Blade design. Ribs add rigidity, stability; direct flow. Vents reduce resistance to movement in some designs. Flexible channels direct water flow and reshape themselves on the upstroke or downstroke.

Note to Instructor

At this time, consider conducting the following demonstrations and workshop activities: 1) general care and maintenance of masks, snorkels and fins; 2) assembling a spare parts kit. These activities are described at the end of the outline.

D. Exposure suits

Learning Objectives.

By the end of this session, you will be able to:

- ***Compare the purpose of body suits, wet suits and dry suits.***
- ***Compare the operational principle of wet suits and dry suits.***
- ***Name the material use to make wet suits.***
- ***Compare chemically blown and nitrogen-blown neoprene.***
- ***Name the four types of material used to make dry suits and explain the benefits and drawbacks of each.***
- ***Choose a dry suit based on the features listed.***
- ***Explain why it is important to seek specialized dry suit training prior to using this type of suit for the first time.***
- ***Choose an exposure suit base on local water temperature, underwater activity level, average depth of dives, average length of exposure and topside weather.***
- ***List three exposure suit accessories and explain their use.***

1. Purpose and function
   a. Reduce heat loss
   b. Provide abrasion protection
   c. Provide coverage from exposure to sun
2. Body suits
   a. Purpose
      - Provide abrasion and exposure protection without insulation.
      - May be worn under wet suits to make donning wet suits easier.
      - Can be used as a fashion accessory.

b. Materials
    - Virtually all body suits are made from Lycra®
c. Styles
    - Zippered — easy donning
    - Criss-cross — snuggest fit
d. Features
    - Thumb loops —holds the body-suit sleeve in place while donning wet suit.
    - Stirrups — holds body-suit leg in place while donning wet suit.

3. Wet suits
    a. How wet suits work:
        - Insulation — reduce heat loss through radiation and conduction, low-density neoprene foam is a poor conductor of heat.
        - Retarded circulation — water trapped next to skin absorbs heat only until a state of thermal equilibrium is attained. So long as this water is not displaced by colder water from outside the suit, little additional heat loss will take place.
    b. Type of materials
        - Wet suits are made from *closed-cell* neoprene foam.
        - Unlike a sponge (which is made from an *open-cell* material), neoprene does not absorb water.
    c. Construction
        - Gas bubbles form in chemically blown neoprene foam due to a chemical reaction.
        - Nitrogen-blown neoprene is infused with gas bubbles injected under pressure.
        - Modern neoprene has chemical softeners added to is to increase flexibility; this less-dense neoprene tends to be somewhat more buoyant.
    d. Thickness
        - Neoprene ranges in thickness from 2.5mm/1/16 in to 7mm/3/8 in.
        - 5mm/1/4 in neoprene is generally required in water below 24°C/70°.
    e. Linings
        - Reasons for linings
        - Types — nylon, plush, Lycra
    f. Styles
        - Shorty styles

- One-piece jumpsuit styles
- Two-piece (Farmer John) wet suit styles

g. Features
- Features or options that increase warmth — attached hoods, wrist and ankle seals, spine pads and custom fit.
- Features or options that increase durability — knee pads, bent knees, elbow pads.
- Features or option that increase convenience — pockets, entry zippers.

Note to Instructor

Explain how wrist and ankle zippers are a trade-off between convenience and increased water circulation, as well as on zipper construction; mention that the need for such zippers has largely disappeared due to availability of more flexible neoprene.

- Features that improve appearance – use of color and finished edges and seams.

4. Dry suits

a. Purpose
- Dry suits keeps divers surrounded with a layer of air, a more effective insulator than neoprene foam.
- Dry suits prevent or minimize contact with water, which is among the most effective of all insulators.
- Dry suits provide the most effective exposure protection available in water between 24°C/75°F and freezing.

b. Materials
- Neoprene foam dry suits — require thinner or no undergarments; have buoyancy; are more form-fitting; weigh more; cost more; are more buoyant and lose their watertight integrity faster.
- Coated fabric dry suits — may be rubber-coated fabric or urethane-coated nylon. These suits have no built-in insulation of their own; are not buoyant if flooded; cost less if made from urethane-coated nylon; are more difficult to repair and are bulkier, but are easier to don. Worn with undergarments.
- Crushed neoprene dry suits — has characteristics of both other types. These suits are extremely durable, cost more and are more resistant to suit-material compression. Worn with undergarments.

- Vulcanized rubber dry suits — extremely durable, no suit compression and like the coated fabric suits, they have no built-in insulation of their own and are not buoyant if flooded. Worn with undergarments.

c. Features
   - Fit —dry suits are never as snug-fitting as wet suits. Nevertheless, it is important to get a dry suit that is properly matched to body size. Some dry suits have a modified torso section for better fit.
   - Custom fit — a few dry suit models may be custom-made to accommodate people with unusual dimensions.
   - Zippers — dry suit zippers are essentially the same as those used in space suits. These zippers require special care and maintenance and may be mounted in different locations on the suit.
   - Seals — may be latex or neoprene. Neoprene seals may not be as soft, as comfortable or work as well as latex seals, unless carefully made and used correctly. Neoprene seals may be repaired; latex seals require replacement.
   - Boots — may be hard-soled or latex; the latex ones must be worn inside conventional wet suit boots. Divers may need to use fins with larger foot pockets when diving with dry suit boots.
   - Hoods — may be attached or not.
   - Undergarments — may be made from a variety of materials. Should draw moisture away from body. Provide the majority of insulation needed for dry suit diving.
   - Inflation and deflation mechanisms — may be BCD-type or separate inflation and deflation mechanisms. The inflation device is almost always chest-mounted. The deflation device may be chest- or arm-mounted and may contain an overpressure relief device. Controls should be easy to use with gloved hands.

d. The pros and cons of dry suits.
   - Being warm and dry generally beats being cold and wet.
   - Dry suits are warmer underwater; may be too warm in some circumstances.
   - Out of the water, dry suit divers are: 1) more resistant to wind chill and 2) more susceptible to overheating.
   - Dry suits require frequent buoyancy adjustments.
   - Dry suits are more expensive.

- Dry suits tend to leak during surf entries and long surface swims.
- It is a bit more difficult to surface swim in a dry suit.
- Divers typically need to increase the amount of lead weight when using a dry suit.

Note to Student

Dry suit diving requires specialized training beyond the scope of this course. Before attempting to dive with a dry suit for the first time, seek expert instruction.

5. Choosing the right exposure suit.
   a. Water temperature
      - This is the starting point in the suit-selection process.
      - Be sure to account for other factors such as depth, activity level, etc.
      - When in doubt, risk being too warm rather than too cold.

   b. Depth
      - Neoprene-foam wet suits lose insulating ability on descent; at 30 metres/100 feet, such a suit may only provide a quarter of the insulation it did at the surface.
      - Water often gets colder as one descends. Consequently, deeper dives require warmer suits.
      - Only dry suits are relatively unaffected by changes in depth, due to the wearer's ability to maintain a constant suit volume; dry suits may be the only practical choice for deep dives in cold water.

   c. Activity level
      - Exercise generates significant body heat.
      - More active divers need less insulation and may appreciate the lack of bulk a lighter-weight suit may provide.
      - Less active divers need more insulation.

   d. Length of exposure
      - Longer dives require warmer suits.
      - Repetitive dives may not give divers sufficient opportunities to rewarm between dives and may also require warmer suits.

   e. Weather
      - Warm weather may require divers to don warm suits later or remove them earlier.

- In cold weather, wind chill may make even the warmest wet suits feel cold out of the water.

f. Additional factor

- Divers may experience water of the same temperature differently from one another, based on what they are already accustomed to.

6. Exposure suit accessories

a. Hoods

- Hoods reduce the tremendous heat loss that can occur through the head and are important in water below 21°C/70°F.
- Wet suit hoods may be attached to: 1) wide (cold-water) bibs, 2) sleeveless vests (chicken vests) and 3) wet suit jackets.
- Some hoods have face seals or other special features.

b. Gloves

- Lightweight gloves — provide abrasion protection only. Good for water above 21°C/70°F. May be designed for special purposes like game taking.
- Wet suit gloves have five separate fingers; are generally made from 3mm/1/8 in neoprene for better flexibility; may have special closures to ease donning or to ensure a better seal around wrist; and work best in water above 10°C/50°F.
- Wet suit mitts have only three fingers so that less-used fingers warm each other; are generally made from 5mm/1/4 in neoprene for better insulation; are not easy to use; but may be the only effective way of keeping hands warm below 10°C/50°F.

c. Boots

- Virtually all models now have hard wrap-around soles; may have side-entry zippers.

Note to Instructor:

At this time, consider conducting the following demonstrations and workshop activities: 1) general care and maintenance of exposure suits; 2) minor exposure suit repairs. These activities are described at the end of the outline.

E. Buoyancy control devices (BCDs)

Learning Objectives.

By the end of this session, you will be able to:

- ***Identify the two basic types of BCDs based on bladder construction.***
- ***Identify the four styles of BCDs***
- ***Choose a BCD based on the features given.***
- ***Care for and maintain a BCD using the 10 recommendations given.***

1. Purpose of the BCD
   a. Provide comfortable support for surface swimming and resting.
   b. Allow divers to adjust for changes in buoyancy underwater.
2. BCD materials and construction
   a. Double-bladder BCDs
      - Have separate inner bladder and outer shell.
      - Outer shell protects the bladder; inner bladder holds air.
      - Are easier to repair
      - Outer shell tends to occupy the same volume underwater, whether the inner bladder has air or not — consequently, this style may create considerable drag.
   b. Single-bladder BCDs
      - Outer shell holds air; no separate inner bladder.
      - Very streamlined underwater
      - Slightly more difficult to repair, depending on the type of damage.
3. BCD Styles
   a. Front-mounted
      - Oldest design; best suited for snorkeling
   b. Back-inflation
      - First integrated BCD; some models have a built-in weight system
      - All buoyancy is behind the diver.
      - Excellent for surf entries, underwater photography, easy to remove in an emergency.
   c. Jacket-style
      - Third-generation BCD; combines the features of front- and back-mounted BCDs.
      - Air over shoulders fulfills little function on surface.
   d. Advanced design (ADV)

- Latest development in BCD design.
- Buoyancy is concentrated along the back and under the arms where is does the most good.
- Shoulder adjustments ensure snug fit. Quick-release shoulder fastenings mean quick removal in an emergency.

4. BCD features
    a. Large-diameter inflation-deflation hose
    b. Low-pressure and oral inflation mechanisms
    c. Manual deflation valve — optional
    d. Auxiliary inflation — optional
    e. Overpressure relief valve
    f. Integrated backpack and tank band
    g. Cummerbund-style waistband — optional
    h. Internal baffling
    i. Pockets
    j. Hose retainers
    k. Accessory rings
    l. Some have a CO2 cartridge
5. BCD care and maintenance
    a. BCDs must be rinsed thoroughly with fresh water following every dive.
    b. If possible, rinse your BCD with the regulator still attached to the cylinder and the air on; this will enable you to reinflate the BCD with air during the rinsing process.
    c. Use a gentle stream of fresh, warm water to rinse the BCD; a forceful stream can lodge particles in valves and valve seats.
    d. Soak the BCD in fresh water overnight before rinsing if it cannot be rinsed soon after the dive.
    e. Rinse the exterior of the BCD first.
    f. Turn the BCD upside down and drain any water that has entered during the dive through the inflation hose or dump valve.
    g. Fill the BCD with a cup or more of fresh water, then reinflate so that it is nearly full.
    h. Turn the BCD over repeatedly so that the fresh water rinses all interior surfaces.
    i. Drain the fresh water from the BCD.
    j. Store the BCD partially inflated.

Note to Instructor

At this time, consider conducting the following demonstrations and workshop activities: 1) general care and maintenance of BCDs; 2) checking a BCD for leaks. These activities are describe at the end of the outline.

F. Weight systems and weights

Learning Objectives.

By the end of this session, you will be able to:

- ***State the purpose of a weight system***
- ***Identify the four basic styles of weight systems.***
- ***Determine how much weight is needed for a particular dive and equipment setup.***
- ***Set up a weight belt for use on a dive.***

1. The purpose of weight systems and weights
   a. Lead weights are used to offset divers' natural buoyancy and the buoyancy of their exposure suits.
2. Weight system materials and construction.
   a. Most weight belts are made from five cm/four in nylon webbing.
   b. Neoprene or other materials may be used to make weight pockets that may be attached to this belt.
   c. A few weight belts may be made from neoprene; such belts are inherently depth compensating.
   d. Quick-release buckles may be made from stainless steel, plated brass or, more commonly, plastic.
   e. Weight systems integrated into backpacks are typically made from plastic.
3. Weight system styles
   a. Standard weight belts
      - Consist only of the nylon or neoprene strap and a quick-release buckle.
      - The strap is threaded through the weights themselves.
   b. Shot-filled belts and integrated backpacks
      - Shot-filled weight systems have a special compartment that is designed to be filled with lead shot.
      - Shot-filled belts are comfortable to use.
      - It may be difficult to change weight in certain shot-filled weight systems.
   c. Weight belts and BCDs with weight pockets.
      - Pockets may accept conventional weights or shot-filled pouches.

- Weights are easy to change.
- Comfortable to wear

4. Weight styles
   a. Shape — block, hip (curved) or bullet
   b. Threading — conventional (two slots) or bullet-style (straight through)
   c. Coating — protective plastic coating or plain lead
5. Weight belt features
   a. Quick-release buckle
      - Conventional — most commonly used
      - Wire buckle — easy to fasten and release; hard to adjust and may be snagged by snap hooks and similar objects.
      - Special — depth-compensating or unique design
   b. Depth compensation
      - May be the elastic portion of a strap or built into the buckle
6. Weight belt setup and use
   a. How much weight?
      - Enough to float at eye level with an empty BCD and a half-lungful of air; no more, no less
      - Changes in exposure suit, salinity or tank configuration may require changes in weight

Note to Student

It is not recommended that you underweight yourself on deeper dives. Being too buoyant in shallow water interferes with slow rates of ascent and the ability to make safety stops. This is especially important on deeper dives.

   b. Setting up the weight belt
      - Divide weights equally on each side
      - Men tend to be most comfortable with weights worn forward on hips; most women prefer weights to be farther back.
      - Allow space for cylinder in back
      - Keep weights away from the buckle so that they do not interfere
      - Allow 15-20 cm/6-8 in of strap to protrude through conventional quick-release buckles
      - Use weight retainers to keep weights from slipping; this is vital with bullet-style weights.
      - Trim non-buckle end so it is round.

G. Cylinders

Learning Objectives.

By the end of this session, you will be able to:

- ***Compare the two materials used to manufacture diving cylinders.***
- ***Compare the styles and features of diving cylinders.***
- ***Identify the meaning of all eight possible cylinder markings.***
- ***Explain why an aluminum cylinder should not be heated to "bake on" a coating.***
- ***Identify the six different types of valves available to recreational divers.***
- ***State three ways to prevent moisture from entering a diving cylinder.***
- ***State the purpose of a burst disk.***
- ***Explain how to handle a scuba cylinder.***
- ***State how often a cylinder must be visually inspected and pressure (hydrostatically) tested.***
- ***State the four situations in which a cylinder should always be pressure tested.***

1. Cylinder materials
   a. Steel
      - Harder than aluminum; less susceptible to damage from impact.
      - Heavier and more compact than aluminum; divers using steel cylinders require less weight than divers using aluminum cylinders of comparable size.
      - More susceptible to corrosion damage.
      - Less susceptible to galvanic action between cylinder and valve.
      - Must be galvanized for exterior corrosion protection.

   b. Aluminum
      - Most popular material for construction of cylinders
      - Aluminum oxide forms its own protective barrier, making aluminum cylinders almost impervious to common scuba cylinder corrosion.
      - More susceptible to damage from heat or impact.
      - More susceptible to damage from galvanic action between cylinder and valve.
      - Larger and more buoyant than comparable steel cylinders.

   c. Cylinder markings
      - Government approval
      - Metal type

- Working pressure
- Serial number
- Manufacturer identification
- Hydrostatic test date (month/year)
- Hydrostatic tester's mark
- "+ " symbol (steel)

2. Cylinder styles and sizes

Note to Instructor

Refer to comparison chart in the PADI Encyclopedia of Recreational Diving. *Make appropriate comments regarding cylinder election based on body size and activity. Indicate when — if ever— double cylinders are appropriate for local specialty diving activities.*

3. Cylinder Features
   a. Coatings
      - Galvanized coating required on steel cylinders
      - No cylinder should be coated internally
      - Aluminum cylinders generally coated with epoxy although no coating is really required to prevent corrosion.
      - Heating a painted aluminum cylinder to *bake on* a coating is hazardous; it reduces cylinder strength and may lead to explosions. Care should always be taken not to expose aluminum cylinders to elevated temperatures.
      - Mesh coverings are available to protect cylinder finish

   b. Valve types. [Use a valve that can be disassembled for demonstrations purposes — this will help the students understand this discussion.]
      - Single vs. twin-cylinder manifolds and valves
      - Dual vs. single-orifice valves
      - Reserve and nonreserve valves

   c. Burst disks
      - Prevents over-filling or rupture due to excessive internal pressure.
      - Activated by pressure, not heat

   d. O-rings
      - All cylinders have two: one in the cylinder neck and one in the valve orifice.

4. Scuba cylinder care and maintenance
   a. Proper handling
      - Valves are easily damaged; avoid anything that may cause impact.

- Avoid leaving cylinders standing upright by themselves in high-traffic areas.
- Transport cylinders either lying on their sides and blocked to prevent rolling or standing upright in cylinder racks.

b. Valve care and maintenance
   - Rinse under on/off valves with fresh water after use.
   - Turn valve on slowly, all the way on and then back slightly.
   - Turn valve off gently. Turning a valve off forcefully will cause damage to the seat.

c. Preventing moisture from entering
   - Never completely empty a scuba cylinder; always leave some pressure inside to help prevent moisture from entering.
   - Avoid getting water droplets between the valve orifice and filling whip when the cylinder is being refilled.
   - Fill only from compressor installations with adequate moisture removal systems.

d. Regular cylinder inspection and testing

Note to Instructor

The following information covers the US only; change as needed for other countries.

- Internal and external visual inspection by a trained professional is required at least once a year; more frequently if cylinders receive heavy use or if damage is suspected.
- Pressure (hydrostatic) testing is required once every five years; sooner if conditions indicate.

Note to Instructor

Review the list of situations indicating a need for immediate pressure testing of a cylinder. (See PADI Encyclopedia of Recreational Diving.*)*

6. What is a Hydrostatic test?
   a. The term *hydro* is short for hydrostatic test.
   b. The test is conducted under the jurisdiction of the D.O.T. (Department of Transportation).
   c. The test measures the strength of the cylinder walls under special pressurize conditions.
      - A cylinder is filled with water then placed inside a water-filled, high-pressure chamber.

- Water pressure inside the cylinder is then increased to five thirds of its maximum working pressure.
- This causes the cylinder to expand slightly.
- Cylinder expansion causes the water outside the cylinder to be displaced.
- The displaced water is measured in collecting tubes.
- If the cylinder's expansion is within acceptable limits, it passes the test. If it fails, it may not be refilled.

Note to Instructor

At this time, consider conducting the following demonstrations and workshop activities: 1) how to fill a scuba cylinder; 2) how a such a cylinder is visually inspected; 3) visiting a hydro facility. These activities are described at the end of the outline.

H. Regulators

Learning Objectives.

By the end of this session, you will be able to:

- ***State the purpose of a regulator.***
- ***Identify five common materials used in constructing regulators.***
- ***Identify the only "style" of regulator used by today's divers.***
- ***State the purpose of both the first and second stages of a regulator.***
- ***Describe how the first and second stage of a regulator functions.***
- ***Explain the difference between a balanced and unbalanced regulator.***
- ***Choose a regulator based on the stated features., availability of convenient service, personal test and performance test data.***
- ***Perform regulator care and maintenance by following the seven recommendations listed.***
- ***State the five situations in which a regulator should always be professionally serviced.***

1. The purpose of regulators
   a. Divers can't breathe air that is any more than 0.14 bar/2 psi above or below ambient (surrounding) pressure; this is why long snorkels do not work.
   b. Breathing air that is even slightly above or below ambient pressure is difficult and exhausting.
   c. Scuba regulators take high-pressure air from a diver's scuba cylinder and supply this air — on demand (when the diver consciously or unconsciously inhales) at exactly ambient pressure.
   d. Modern scuba regulators form the heart of a multicomponent system that generally includes:
      - A primary second stage

- An alternate air source
- A BCD low-pressure inflation mechanism
- A submersible pressure gauge (SPG) and attached instrument console.

2. Materials and construction of regulators. [To show students the various parts of a regulator, use a disassembled regulator during the following discussion.]
   a. Common materials used in constructing regulators include:
      - Chrome-plated brass — easily machined and resists corrosion
      - Stainless steel — a harder metal that is highly resistant to corrosion; good for internal moving parts such as pistons
      - Neoprene or silicone O-rings — to form seals between internal chambers
      - Nylon and Teflon® — good for high-pressure valve seats
      - Neoprene and silicone — use for diaphragms, exhaust valves and tees, and similar mechanisms
      - Plastics — becoming increasing popular in second stages; reduces weight and, consequently, jaw fatigue
3. Regulator styles
   a. The only *style* of regulator commonly in use today is the two-stage, single-hose regulator.
      - First stage reduces air to an intermediate pressure (ambient pressure plus 100-150 psi, depending on the first stage setting).
      - The second stage reduces intermediate pressure to ambient pressure automatically, whenever the diver inhales.
4. Regulator features
   a. First stage options
      - Pressure-sensing mechanism — piston or diaphragm
      - Valve type — balanced or unbalanced

Note to Instructor

At this point, review and discuss how regulator first stages function. Disassembled or cutaway regulator first stages can be used to further clarify first-stage function.

      - Connector type — conventional yoke or high-pressure DIN fitting
      - High- and low-pressure port options — port placement, thread size

- Environmental sealing — keeps contaminated or cold water from entering internal compartments of the first stage; helps prevent sediment buildup and cold-water freeze-up.
- Large-capacity hoses — increase reservoir of air available to the second stage

b. Second stage options
- Style — may be conventional or side-exhaust; side-exhaust second stages work *either-side-up,* which is why some divers prefer them as alternate-air-source second stages; some second stages have their purge button behind instead of in front.
- Type — conventional downstream and pilot valve

Note to Instructor

At this point, review and discuss how regulator second stages function. Disassembled or cutaway regulator second stages can be used to further clarify second-stage functions.

- Adjustment — some second stages have a manual adjustment which, if screwed in, causes the regulator to require greater effort to breathe; this may be a temporary expedient to resist free-flowing under certain conditions, however, divers should never increase regulator breathing resistance without reason

5. Choosing the right regulator
   a. The availability of close, convenient service is perhaps the most important factor in the regulator selection.
      - Being *in tune* has more overall effect on regulator performance than almost any combination of design features.
   b. If possible, divers should try a regulator under the most realistic conditions possible prior to purchasing it.
   c. Performance tests, such as those done by the US Navy, may be an interesting source of comparison; however, the Navy does not test all the factors that recreational divers should take into consideration when purchasing a regulator.
   d. Due to their ability to deliver greater airflow over a wider variety of cylinder pressures and depths; most experts recommend the purchase of regulators with balanced first stage valves, or whose unique design features offer highly comparable performance.
6. Regulator care and maintenance
   a. Maintenance

- Regulators must be rinsed thoroughly with fresh water following every dive.
- If possible, rinse the regulator while it is still attached to the cylinder and while the air is still on; otherwise, rinse it with the dust cap securely in place.
- Use a gentle stream of fresh, warm water to rinse the regulator; a forceful stream can lodge particles in valves and valve seats.
- Soak the regulator in fresh water overnight if it cannot be rinsed soon after the dive.
- Keep second stages lower than the first stage while rinsing; do not press the purge button while rinsing.
- Allow your regulator to dry thoroughly before you store it.
- Store the regulator without sharp bends in the hose. Hose protectors help prevent hose damage.

b. Regulator service

- Regulators require regular professional services.

Note to Instructor

Review when regulators need professional service. (See PADI Encyclopedia of Recreational Diving.*)*

- Regulator service involves complete disassembly, cleaning, inspection of parts, replacement of worn or damaged parts, reassembly and adjustment to factory specifications (demonstrated later).

Note to Instructor

At this time, consider conducting the following demonstrations and workshop activities: 1) care and maintenance of regulators; 2) demonstration of a regulator overhaul. These activities are described at the end of the outline.

I. Alternate air sources

Learning Objectives.

By the end of this session, you will be able to:

- ***State the purpose of an alternate air source.***
- ***Identify the six styles of alternate air sources and compare the pros and cons of each — alternate-air-source second stages, alternate-air-source inflators, pony bottles, dual-regulator valves, self-contained ascent bottles and buoyancy devices with air bottles.***

1. The purpose of alternate air sources
    a. Alternate air sources are designed to fulfill one or both of the following functions:
        - To enable one diver to share air with another, without both divers having to pass a single second stage back and forth.
        - To enable an out-of-air diver to make an independent, breathing ascent regardless of whether or not there is another diver in the vicinity who can assist.
2. Alternate-air-source styles. [Allow students to handle and try as many different styles of alternate air sources as possible.]
    a. Alternate-air-source second stages (octopuses).
        - Is the most commonly used system.
        - Easily understood by other divers.
        - May be set up and used in a variety of ways (donor may give either primary or secondary second stage to out-of-air diver).
        - Good only for sharing air with other divers; is of no value if the donor is the one who is out of air.
        - Such a system may not perform adequately if the donor is also low on air or if the regulator first stage lacks adequate capacity.

Note to Instructor

At this point, review and discuss the current recommendations for the configuration and use of alternate-air-source second stage systems.

    b. Alternate-air-source inflators
        - Combine the extra second stage and low-pressure inflator; they simplify the regulator system by reducing the total number of hoses by one.
        - The donor is generally limited to only being able to give his primary first stage to an out-of-air diver; alternate-air-source inflators can usually only be used by the person wearing them.
        - In all other respects, these units are subject to the same advantages and disadvantages of conventional alternate-air-source second stages.
    c. Pony bottles
        - Small, auxiliary cylinders mounted alongside the diver's main cylinder(s).
        - Have their own separate regulators.
        - Increased weight, complexity, bulk and expense compared to conventional octopus system.

- May be used in much the same way as a conventional alternate-air-source second stage to share air with another diver.
- May be used by an out-of-air diver to make a breathing ascent without the assistance of another diver.
- Usually provide sufficient air for a slow ascent and a safety stop.

d. Dual-regulator manifolds and valves
   - Allow two separate regulators to share the same single or dual-cylinder air supply.
   - Allow the air supply to a free-flowing regulator to be turned off without affecting the air supply to the remaining regulator.
   - By using two separate first stages, such a system is less susceptible to freeze up or become unable to supply sufficient air to two divers at depth.
   - Less heavy, bulky and expensive than a pony bottle system; however, it does not allow an out-of-air diver to make an independent breathing ascent.
   - Most commonly used in cave and cavern diving.

e. Self-contained ascent bottles
   - Has its own built-in regulator and on/off valve.
   - May be refilled after use.
   - May be passed to other divers; however, doing so is of little value unless the other diver understands the function, use and limitations of such a system.

f. Buoyancy devices with an air bottle.
   - BCD with small, built-in, high-pressure air bottle.
   - Common in Europe
   - BCD fulfills regulator function in reducing air to ambient pressure.
   - Diver breathes through BCD mouthpiece.
   - Tricky to use; requires previous practice and even specialized instruction.
   - Users risk infection from bacteria growing in the BCD.
   - Similar in use and limitations to self-contained ascent bottles.

J. Instrumentation

Learning Objectives.

By the end of this session, you will be able to:

- ***Outline nine pieces of information that may be helpful to have during a dive.***
- ***Compare pressure-sensing devices — bourdon tube, spiral tube and electrical transducer.***
- ***Compare digital and analog instruments.***
- ***Compare wrist- and console-mounted instruments.***
- ***Compare integrated and separate instruments.***
- ***State the six types of instrumentation available to divers.***
- ***Compare capillary, open bourdon-tube, oil-filled, diaphragm and digital depth gauges.***
- ***Compare the two types of underwater timers — watches and automatic timers.***
- ***State the purpose of diving computers.***

1. The purpose of diving instrumentation
   a. Divers must have a means of monitoring:
      - Depth and time
      - Cylinder pressure
   b. It may be extremely helpful to have additional information on:
      - Direction.
      - Water temperature.
      - Approximate dive time remaining (based on air consumption or the no decompression limits).
      - Maximum depth reached.
      - Number of dives in the past 12 hours.
      - Current bottom time or bottom time of the previous dive.
      - Current surface interval or length of the last surface interval.
      - Whether it is safe to fly
      - Length of any required emergency decompression stops.
2. Instrumentation design and construction
   a. Bourdon and spiral tubes are commonly used in mechanical depth and pressure-measuring devices.
   b. Pressure-sensitive transducers are commonly used in electronic depth, time and pressure-measuring devices.
3. Instrumentation styles

Note to Instructor

It would be extremely helpful to have several examples of different instrument systems and types available during the discussion that follows

a. Digital (electronic) vs. analog (mechanical)
   - Digital instruments are smaller and (reportedly) more accurate, but cost more and need batteries.
   - Analog instruments are larger, cost less and may not be as precise.
   - Many digital instruments mimic an analog display.

b. Wrist- vs. console-mounted
   - The wrist is a good place to mount instruments that are used only occasionally or that need protection from dangling and banging against bottom, such as computers.
   - Some divers have a clear preference as to whether they want their compasses wrist- or console-mounted.
   - There is a limit to how many separate instruments can conveniently go on the wrist.
   - When wearing a full wet suit and gloves, it may be impractical to mount any instruments on the wrist.

c. Integrated vs. separate
   - Integrated instrument systems are usually more compact
   - Separate instruments can be serviced or replaced individually, without putting an entire system out of commission.

4. Types of instrumentation

a. Submersible pressure gauge (SPG)
   - May be mechanical (analog) or electronic (digital or with analog pictograph).
   - Last 35 Bar/500 psi usually color-coded; this is generally the least accurate region on mechanical gauges.
   - Swivel connection prone to leakage; this is generally not serious.

b. Depth gauge
   - Capillary gauges work on Boyle's law; accurate in shallow water if properly calibrated; susceptible to sediment and trapped air bubbles.
   - Open bourdon-tube gauges allow outside water to enter tube; not common prone to clogging unless internal mechanism is Teflon coated.

- Oil-filled are most common mechanical gauges; flexible case forces internal oil inside bourdon-tube mechanism.
- Diaphragm gauges: diaphragm activates series of gear, springs and levers; considered very accurate.
- Digital gauges are usually integrated with other instruments; extremely accurate in most cases.
- Most newer gauges are equipped with maximum-depth indicators.
- Some gauges are adjustable for higher altitudes.
- Few gauges are 100 percent accurate; however, manufacturers have published tolerances that their gauges must remain within.

c. Timers
- Underwater watches come in a variety of styles and have many different features; may be used for nondiving purposes as well.
- Automatic timers eliminate the need to remember to set timer at the beginning and end of dives and surface intervals; original mechanical timers logged bottom time only; newer electronic models monitor bottom time, surface interval and dive number.

Note to Instructor

Elaborate at this point on the features of the available watch and timer samples.

d. Compasses
- All underwater compasses are mechanical at this time.
- Compasses will have either a rotating bezel or index marks.
- Many compasses can be read from the top or side.
- Compasses should be marked in degrees as well as cardinal points, be easy to read and not be prone to *needle trapping*.

e. Thermometers
- These optional instruments provide nice-to-know information.
- May be mechanical or electronic.

f. Computers
- These electronic instruments automatically track depth, bottom time and surface interval and compare this information with either a nitrogen-absorption algorithm or a standardized table (like the U.S. Navy tables).

- Algorithm models track sufficient data to compute safe no decompression limits for multilevel dives, thus permitting greater bottom time.
- A wide variety of models and features are available.
- Computers may be used in addition to, but not as a replacement for dive tables to help you plan your dive.

Note to Instructor

Elaborate at this point on the considerations involved in diving with computers.

K. Diving accessories

Learning Objectives.

By the end of this session, you will be able to:

- ***Identify the need for, and use of, the various accessory diving equipment items listed.***

1. Diving knives and tools
   a. May enable the diver to cut, pry, hammer or measure underwater.
   b. The ability to cut is an important safety feature in case the diver becomes entangled.
   c. A wide variety of sizes, types and features are available.
   d. Care and maintenance
      - Always rinse with fresh water.
      - Remove the knife from its sheath for drying.
      - Sharpen the knife as needed with a sharpening stone.
      - Check straps (if applicable) for wear.
2. Plastic dive tables and dive planners
   a. Enable divers to preplan dives to stay within no decompression limits.
   b. PADI-distributed Recreational Dive Planners are the only ones currently available that were developed specifically for recreational divers.
   c. The eRDPML™ permits the planning of multilevel dives and serves as a good backup for dive computers.
3. Log books
   a. Allow divers to record dive data that is otherwise easily forgotten.
   b. A great place to record the dates of equipment servicing. Also, record serial numbers of various pieces of equipment in the log book.

c. Provide required proof-of-experience for leadership-level training and participation on certain dives (especially at resorts).

d. The log should record a minimum of date, location, depth, time and buddy/divemaster/instructor signature.

e. PADI Deluxe Logs meet all these criteria.

4. Slates

   a. Enable divers to communicate easily underwater.

   b. Enable divers to carry dive plan and contingency information with them underwater.

   c. May allow recording of dive data for later transfer to log book.

   d. For recording navigational information and drawing maps.

   e. Cleaning and use of underwater pencils.

5. Equipment bags and carrying systems

   a. Allow organized transportation of many loose, separate equipment items.

   b. Helps protect against damage, loss.

   c. May be suitable for long-term storage of some equipment items.

   d. A wide variety of models, styles and sizes are available.

6. Dive flag and float

   a. Warns boaters and others that divers are underwater.

   b. A float provides additional surface support and storage for game and similar items that divers don't wish to carry with them underwater.

   c. Enables divers to establish an ascent and descent line for deeper dives.

   d. Required by law in many areas. [Record local laws here:]

      _____

      _____

      _____

   e. A wide variety of models, styles and sizes are available.

Note to Instructor

At this time, consider conducting the following demonstrations and workshop activities: 1) how to properly pack a dive bag for travel; 2) setting up a divers' float system. These activities are described at the end of the outline.

L. Specialty diving equipment

Learning Objectives.

By the end of this session, you will be able to:

- ***Identify the need for, and use of, the various specialty diving equipment items listed.***

Note to Instructor

During this discussion, encourage students to enroll in other PADI Specialty courses to learn more about specialty diving equipment.

1. Underwater lights
   a. Types
      - Primary — a diver's main light for night, wreck or cavern diving.
      - Backup — in case the primary light fails; a diver switches to this light and ascends (a must for all night and wreck divers).
      - Chemical — in the event of catastrophic light failure, these provide sufficient light to read instruments, see ascending bubbles and to be seen by other divers.
2. Battery types
   a. Rechargeable batteries are good for primary lights that receive frequent use; they burn intensely for 1-2 hours before losing their charge and may be less expensive than constantly purchasing new batteries.
   b. Nonrechargeables are good for backup lights or casual primary light use; they stand more abuse and burn for up to 10 hours or more (getting gradually dimmer as they burn).
3. Primary lights
   a. Usually powered by the equivalent of several D cells
   b. Have a larger lens
   c. Come in variety of models, styles and features
   d. Wide angle of coverage with little or no "hot spot" in the center is generally preferred by most divers.
4. Backup lights
   a. Typically powered by the equivalent of two-five C-cells
   b. Small lens
   c. Usually have narrow beam
   d. Compact size makes them good for looking into holes on daylight dives.

5. Underwater imaging systems
    a. Photo systems
        - Available in 110mm, 35mm and disk formats
        - May be housed or self-contained
        - Underwater strobes provide necessary artificial light.
    b. Movie and video systems
        - Movie housings available for 8mm, 16mm and 35mm cameras.
        - Video housings available for most compact cam-corders.
        - High-intensity lights bring back natural colors.
6. Hunting and collecting equipment
    a. Spears
        - Pole spears; simple, easy to use
        - Band guns; powerful, easier to aim
        - Pneumatic guns; complex but compact
    b. Abalone irons
        - May include a gauge for measuring abalones
    c. Game-holding devices
        - Fish stringers are used to carry speared fish.
        - Mesh bags can fulfill several functions.
        - Special lobster bags are less likely to get tangled on the lobster's spines; may have a one-way opening.
    d. Slurp guns and nets
        - Used for collecting live fish
7. Search and recovery tools
    a. Marker buoys help pinpoint location of lost objects or mark search area.
    b. Metal detectors can help find objects buried under sand and sediment.
    c. Lift bags are used to raise objects of 7 kilograms/15 pounds or more safely to the surface.
8. Other specialty diving equipment
    a. The Scuba Sextant helps divers record multileg compass courses; invaluable for mapmaking and search and recovery.
    b. Reels allow cavern and wreck divers to navigate safely back to their exit point; can be used for a number of other activities as well.
    c. Diver propulsion vehicles enable divers to easily cover long distances.

V. Recommended Demonstration and Practical Workshop Activities

A. Care and maintenance of masks, snorkels and fins

1. Describe need
    a. Proper care prolongs equipment life.
    b. Helps prevent damage deterioration
2. Demonstrate procedures
    a. Proper rinsing, drying and storage procedures. Show students how to prepare silicone masks, snorkels and fins prior to storage (remind students not to use petroleum-based lubricants on diving equipment).
    b. How to use mask defog solution. Follow manufacturer's recommendations.
    c. Show students how to check mask and fin straps for wear and rot. Explain when and how to change straps.

B. Assembling a spare parts kit

1. May be all that prevents diver from missing out on a dive
2. Show students a well assembled spare parts kit. Spare part kits are available prepackages or can easily be assembled from individual components. The following spare parts should be placed in a sturdy waterproof container:
    a. Extra straps — for fins, mask and snorkel keeper
    b. Assorted O-rings
    c. Regulator high-pressure port plug
    d. Silicone lubricant
    e. Personal medication
    f. Exposure suit cement
    g. Exposure suit patching material
    h. Large needle and nylon or Dacron tread
    i. Nylon tie-wraps
    j. Extra buckle for weight belt or backpack
    k. Assorted tools (jeweler's screwdriver set, Phillips and standard screwdrivers of various sizes, small pair of pliers, four- to six-inch crescent wrench)
    l. Waterproof plastic tape

C. Minor repairs to exposure suits

1. Describe need
    a. Proper care prolongs exposure suit life.
    b. Helps prevent damage deterioration
    c. Assure your warmth on each dive

2. Care and maintenance of exposure suits
    a. Demonstrate how to properly rinse an exposure suit.
    b. Demonstrate how to lubricate dry suit or wet suit zippers.
    c. Demonstrate how to properly hang an exposure suit for drying and for storage.
    d. Show students commonly used wet suit hangers and conditioners and shampoos. Explain that suits should not be placed in dryers.
    e. Follow manufacturer's recommendations.
3. Demonstrate how to perform minor exposure suit repair
    a. Demonstrate how to repair a tear or rip in neoprene. Pay particular attention to proper gluing methods.
    b. Demonstrate how to find a leak in a dry suit (if dry suits are used locally).
    c. Demonstrate how to patch a leak in a dry suit (if dry suits are used locally).
    d. Follow manufacturer's recommendations.

D. Checking a BCD for leaks

1. Describe need
    a. To make sure the BCD is capable of holding air
2. Demonstration procedure
    a. Attach the BCD to the proper low-pressure hose on the regulator. Hook the regulator to a cylinder and turn on the air.
    b. Fully inflate the BCD and immerse it in a large tub of water.
    c. Inspect the following area for signs of escaping air bubbles:
        - Bag assembly (show double and single bag construction)
        - Accessories. Pockets, rings — anything attached to the BCD
        - Oral inflator inlet area
        - Low-pressure inflator. Check at point where hose from cylinder connects to inflator. Listen to inflator — is bag automatically inflating without the button being pushed?
    d. Add air with low-pressure inflator. Do parts work smoothly?
    e. Overpressure relief valves. Squeeze BCD for proper function.

3. Patching a BCD
    a. If a leak is detected in the BCD, have it professionally repaired. Unauthorized repairs on a BCD could jeopardize the integrity of the BCD and also void the manufacturer's warrantee.
    b. Emergency field repairs must only be done using the BCD repair kit recommended by the manufacturer. Follow all directions included in the kit.

E. Demonstrate how to fill a scuba cylinder

1. Show students how a cylinder's markings are read prior to filling.
2. Demonstrate how to fill a scuba cylinder.
    a. Explain why it is done in water. Allow students to feel the cylinder after it is filled.
    b. Discuss the type of compressor needed.
    c. Show students the compressor, its filtration system and if possible, a cascade air bank.

F. Visiting a hydrostatic test facility

Note to Instructor

The following demonstration of a cylinder inspection and regulator overhaul is intended to give students an appreciation of the amount of specialized knowledge, skills and tools required to perform these activities properly. It is not intended to give them the knowledge and skills required to carry out these procedures on their own

Consequently, students are to see a simplified demonstration of the procedure and not the detailed, step-by-step activities a trained technician might use in performing an actual inspection or overhaul.

Students are to be informed that what they are seeing leaves out many of the more detailed and tedious steps and that is does not occupy the several minutes or hours the actual procedure may require. They are to be reminded throughout that participation in this course does not qualify them to attempt cylinder inspections or any form of regulator repair on their own.

*These are instructor-led demonstrations **only,** not student participation workshops.*

G. Scuba cylinder inspection

1. Describe need
    a. Scuba cylinders may become damaged or corroded through normal use, despite the best of care.
    b. Without regular inspection, damage may continue until the cylinder can no longer be used.
    c. Detected early, corrosion and other forms of damage may often be treated.

d. Even when damage cannot be corrected, inspections allow dangerous cylinders to be taken out of service before they harm anyone.

2. Demonstration procedures
   a. The technician asks the cylinder owner if there have been any signs suggesting corrosion or other damage (review these signs with students).
   b. The technician inspects cylinder markings to make certain the cylinder is still within hydro.
   c. The old inspection sticker is removed.
   d. The cylinder boot (if there is one) is removed and external inspection is conducted to look for signs of corrosion, cracking or other damage (note special concerns regarding coated steel cylinders).
   e. The cylinder emptied of air, slowly, and then placed in a special vice and the valve is removed in a manner that minimizes the possibility of damage.
   f. The cylinder neck and threads are inspected for signs of cracking or galvanic action.
   g. An inspection light is lowered into the cylinder to look for signs of corrosion, contamination or other damage.
      - Explain to students that a light coating of rust in steel cylinders may be left alone, as tumbling or sandblasting to remove this coating may actually remove more metal than the corrosion has.
      - If pits are present, demonstrate how to measure depth to ensure that they do not exceed an acceptable depth.
   h. A dental mirror is used to inspect the inside of the neck for corrosion, cracks or pitting.
   i. If salt or other deposits are present inside the cylinder, explain or demonstrate how they are removed.
   j. Explain when and how cylinder valve is serviced.
   k. Lubricate cylinder-neck O-ring and replace valve.
   l. Replace the valve.
   m. Apply new inspection decal if cylinder passed.
   n. Refill the cylinder.

H. Regulator demonstrations

1. Care and maintenance
   a. Demonstrate how to properly rinse and store a regulator.
2. Describe the need for a regulator overhaul.
   a. Salt, sediment and corrosion may accumulate in any regulator through normal use, despite the best of care.

b. Neoprene and soft materials may deteriorate, whether the regulator has been used or not.

c. Springs may change tension with age, regardless of whether they have been used or not.

d. Valve seats may become indented, even when left unused.

e. Any regulator to which any or all of the above has occurred may not perform within manufacturer's specifications; this may make it harder to breathe from and dangerous to use.

f. An annual professional overhaul is strongly recommended.

3. Demonstrate overhaul procedures

a. The technician asks the regulator owner if there have been any signs suggesting poor performance or other damage (review these signs with students).

b. The technician inspects the regulator exterior for obvious signs of damage, deterioration or abuse.

c. The regulator is thoroughly disassembled.

d. All regulator components are thoroughly cleaned.

- Neoprene, plastic and similar components may be cleaned with soap and water or with an ultrasonic bath.
- Metal components may be acid-dipped or also cleaned with an ultrasonic bath.

e. After cleaning and drying, all parts are inspected for damage or wear.

f. Damaged or worn parts are set aside to be returned to the owner separately from the regulator.

g. New parts are placed in the regulator from parts inventory.

h. The regulator is reassembled and adjusted to manufacturer's specifications.

I. Packing a dive bag for travel

1. Describe need

a. Prevents broken equipment

b. Makes suiting up more efficient

2. Procedures

a. Lay equipment out in the sequence in which it is put on.

b. Start with fins, mask and snorkel (use mask box for added protection).

c. Continue to load the bag in the inverse order of donning.

d. As each piece is loaded, check it for proper operation, adjustment and completeness.

e. Do not load weight belt in bag.

f. Follow manufacturer's directions regarding altitude travel with diving instruments (they may need to be protected in a pressurized container).

J. Rigging a diving float and dive flag

1. Describe need
   a. Warning to boaters
   b. Drift diving
   c. Provides a reference line for descents and ascents with the option of attaching a spare air cylinder at 5 metre/15 feet for a safety stop.
   d. May hold accessory equipment dive lights, camera equipment, etc.
2. Demonstrate how to set up a diving float and dive flag for local environment.

VI. Optional Confined water Session

A. It is recommended, but not required, that students be given the opportunity to try out new, unfamiliar pieces of equipment in confined water during the course. The objectives of the session are:
   1. Encourage students to upgrade to newer equipment.
   2. Allow students to inexpensively try out new and unfamiliar pieces of equipment.
   3. Introduce students to equipment items that may make diving more enjoyable.

VII. Graduation and Certification Party