UG 6073 - TECHNICAL ASPECTS OF DIVING AND DIVING EQUIPMENT

MARK CANEY

WORKING FROM HOME?

UNIT TOPICS

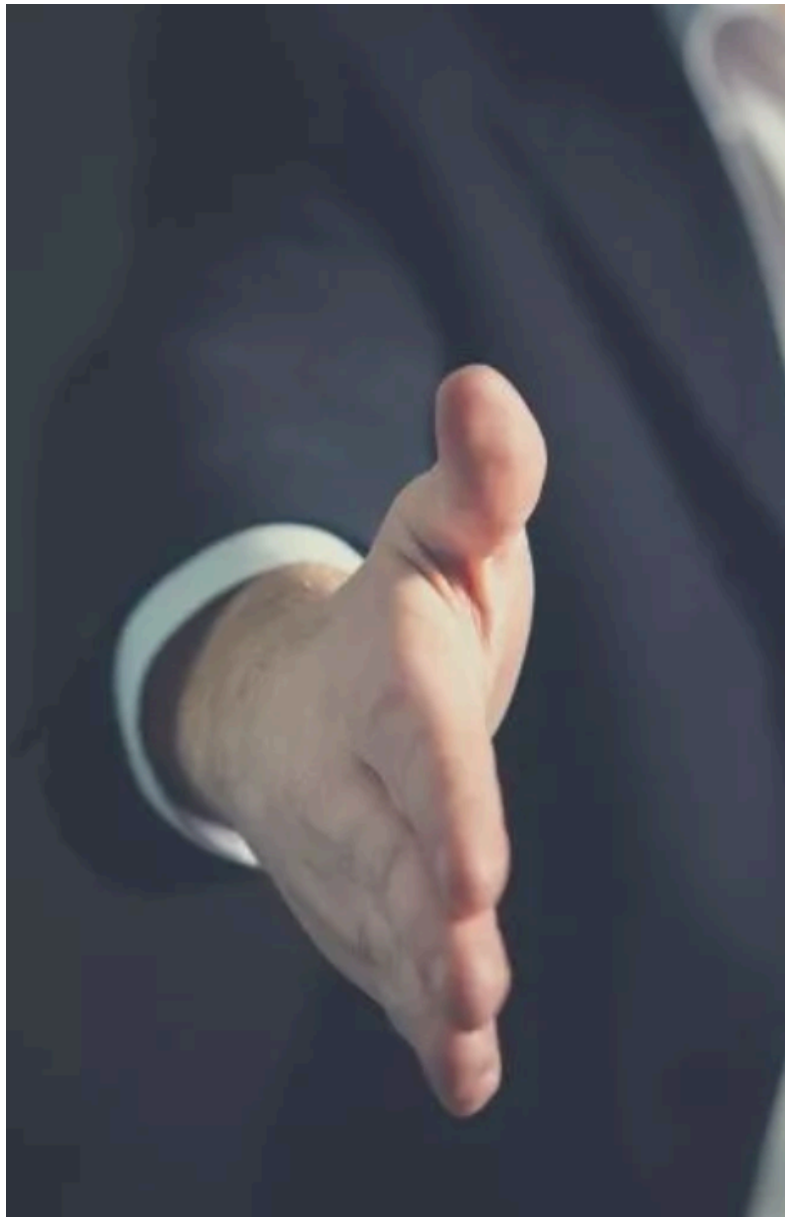
- Systematically understand and define how an advanced diver is able to perform a wide range of tasks related to underwater gear.
- Comprehensively identify the benefits of using scuba gear to go underwater to inspect, repair, remove or install equipment and structures.
- Comprehensively identify the benefits of using a variety of power and hand tools and be able to conduct tests or experiments, photograph structures or marine life.

KNOWLEDGE AND SKILLS OBJECTIVES FOR STUDY UNIT

- Systematically understand and define how an advanced diver is able to perform a wide range of tasks related to underwater gear.
- Comprehensively identify the benefits of scuba gear to go below the surface of the water to inspect, repair, remove or install equipment and structures.
- Comprehensively identify the benefits of a variety of power and hand tools and how they may be used to conduct tests or experiments, photograph structures or marine life.
- Assess a sound maintenance programme for scuba gear.
- Understand the basic construction and operation of the main items of equipment used in a dive business.
- Demonstrate that maintenance has been performed including the completion and retention of these records, under the guidance of a Diving Safety Officer

SESSION OVERVIEW

- Self-introductions
- Introducing your instructors
- Administration
- Diving equipment



SELF INTRODUCTIONS

- Your name
- Nationality/where you are from
- Diving qualifications
- Why you enrolled on this program

SUBJECT TUTORS

- **Mark Caney**, Industry Relations & Training Executive for PADI Worldwide.
- **Maurizio Chines**, Head Underwater Works and Commercial Diving Activities, Saipem SpA . Former Director of Italian Navy Diving School, ComSubIn, La Spezia, Italy.
- **Richard Somerset**, Territory Director at PADI Europe Middle East and Africa.

MARK CANEY

- Owner of a dive centre in the Mediterranean for ten years
- Worked for PADI for over 25 years
- Leader of 1987/1988 East Africa Expedition
- Chairman of Project AWARE in Europe, Middle East and Africa region
- Three times President, European Underwater Federation
- President, World Recreational Scuba Training Council
- General Secretary, RSTC Europe
- President, Rebreather Training Council
- Chairman of the Combined Rebreather Industry Standards Alignment Group (CRISAG)
- Designated diving expert to ISO
- Chairman of the Diving Medical Screen Committee
- Author of Dolphin Way

ADMINISTRATION

- If you have a question, please ‘raise your hand’
- You can also use the chat feature for messages
- These sessions will usually be recorded
- Resources
- Need your names, email addresses and dates of birth – send to **mark.caney@padi.com**

DIVING EQUIPMENT

PADI EQUIPMENT SPECIALTY COURSE

- **The theory, principles and operation of diving equipment**
- **Routine, recommended care and maintenance procedures, and equipment storage**
- **Common problems with equipment and recommended professional maintenance procedures**
- **Simple suggestions for comfortable equipment configurations and an introduction to new equipment**

Note: in general, this is not an equipment repair course. Only professionally trained equipment repair technicians should repair life support equipment and diving instruments.

MASKS, SNORKELS AND FINS

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.*

MASKS AND SNORKELS

Masks
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.

Snorkels

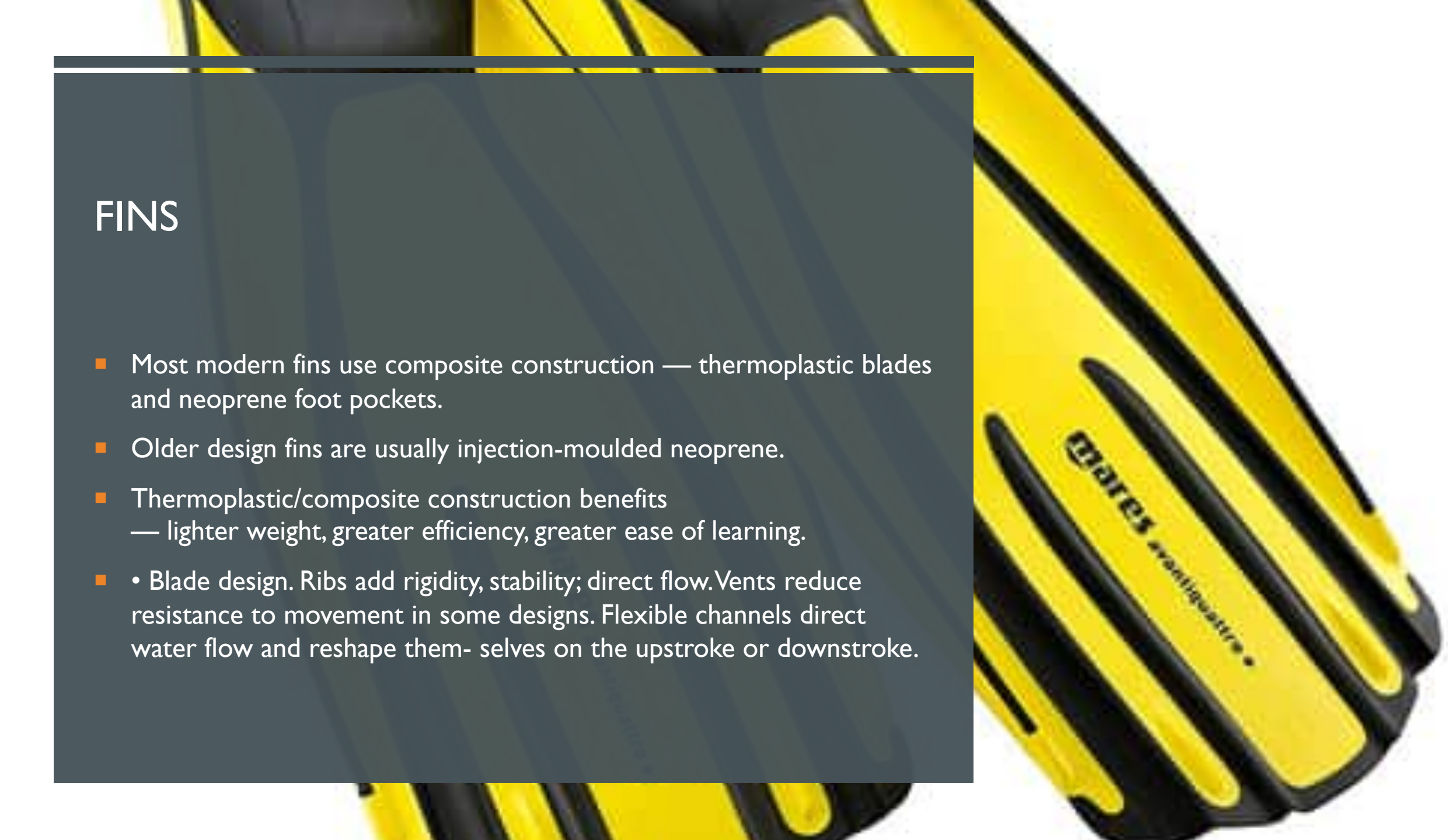
- Modern snorkels are made from a combination of silicone and plastic; use of neoprene is now uncommon.





FINS

- Most modern fins use composite construction — thermoplastic blades and neoprene foot pockets.
- Older design fins are usually injection-moulded neoprene.
- Thermoplastic/composite construction benefits
  — lighter weight, greater efficiency, greater ease of learning.
- • Blade design. Ribs add rigidity, stability; direct flow. Vents reduce resistance to movement in some designs. Flexible channels direct water flow and reshape them- selves on the upstroke or downstroke.

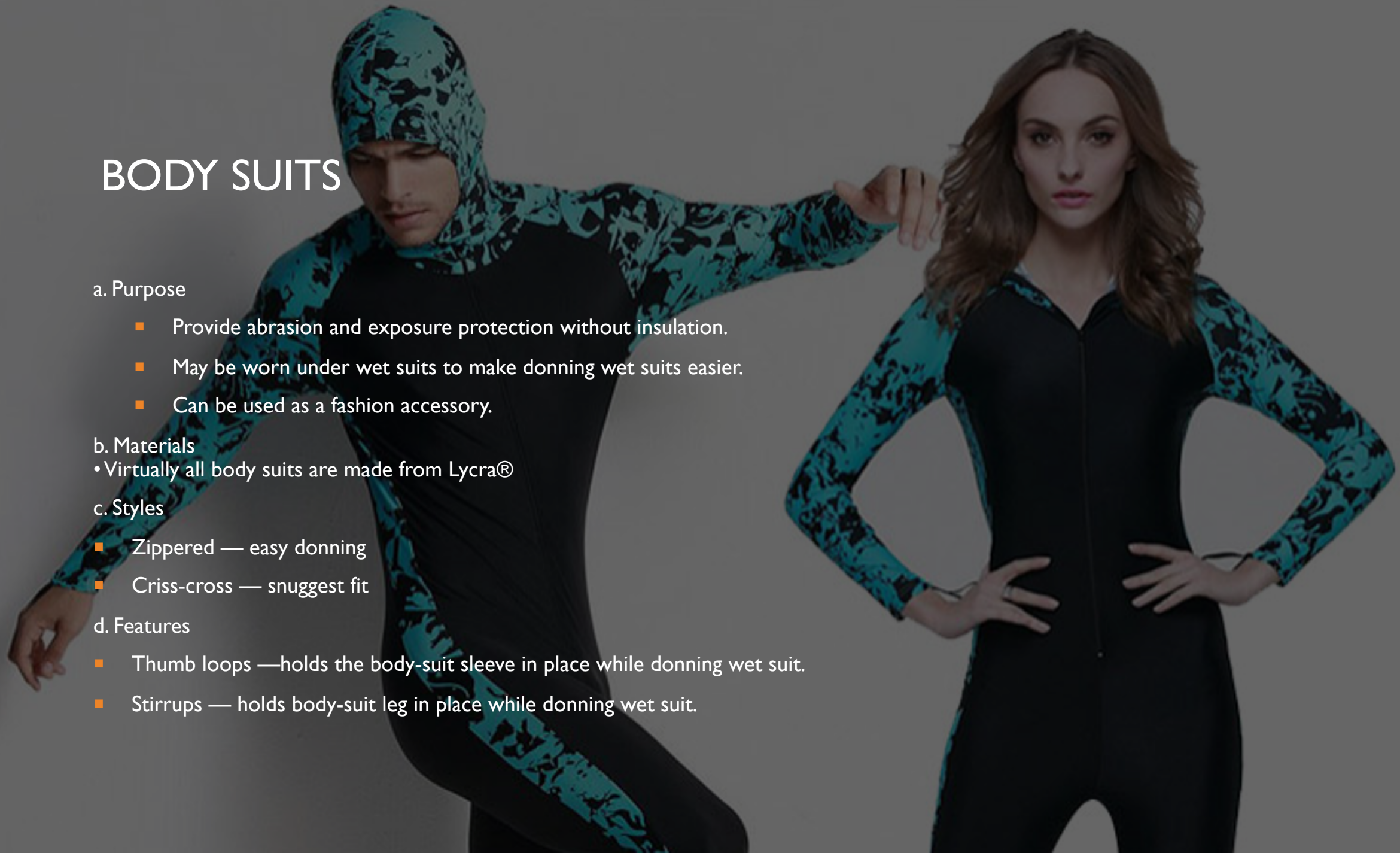


EXPOSURE SUITS

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.*

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.

WETSUITS

- How wet suits work
- 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.
- 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.
- Thickness
  - Neoprene ranges in thickness from 2.5mm to 7mm.
  - 5mm neoprene is generally required in water below 24°C°.
- Linings

DRYSUITS

- 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.
- 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 com- pression. 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.

DRYSUITS

- 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.
- Seals — may be latex or neoprene.
- Boots — may be hard-soled or latex; the latex ones must be worn inside conventional wet 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.

BUOYANCY CONTROL DEVICES (BCDS)

- *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.*

BCD PURPOSE AND CONSTRUCTION

- Purpose of the BCD
  - Provide comfortable support for surface swimming and resting.
  - Allow divers to adjust for changes in buoyancy underwater.
- BCD materials and construction
  - 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 under- water, whether the inner bladder has air or not — consequently, this style may create considerable drag.
  - 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.

BCD STYLES

- Front-mounted
  - Oldest design; best suited for snorkelling
- 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.
- Jacket-style
  - Third-generation BCD; combines the features of front- and back-mounted BCDs.
  - Air over shoulders fulfils little function on surface.
- 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.

BCD FEATURES

- Large-diameter inflation-deflation hose
- Low-pressure and oral inflation mechanisms
- Manual deflation valve — optional
- Auxiliary inflation — optional
- Overpressure relief valve
- Integrated backpack and tank band
- Cummerbund-style waistband — optional
- Internal baffling
- Pockets
- Hose retainers
- Accessory rings
- Some have a CO2 cartridge

BCD CARE AND MAINTENANCE

- BCDs must be rinsed thoroughly with fresh water following every dive.
- 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.
- Use a gentle stream of fresh, warm water to rinse the BCD; a forceful stream can lodge particles in valves and valve seats.
- Soak the BCD in fresh water overnight before rinsing if it cannot be rinsed soon after the dive.
- Rinse the exterior of the BCD first.
- Turn the BCD upside down and drain any water that has entered during the dive through the inflation hose or dump valve.
- Fill the BCD with a cup or more of fresh water, then reinflate so that it is nearly full.
- Turn the BCD over repeatedly so that the fresh water rinses all interior surfaces.
- Drain the fresh water from the BCD.
- Store the BCD partially inflated.

WEIGHT SYSTEMS AND WEIGHTS

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.***

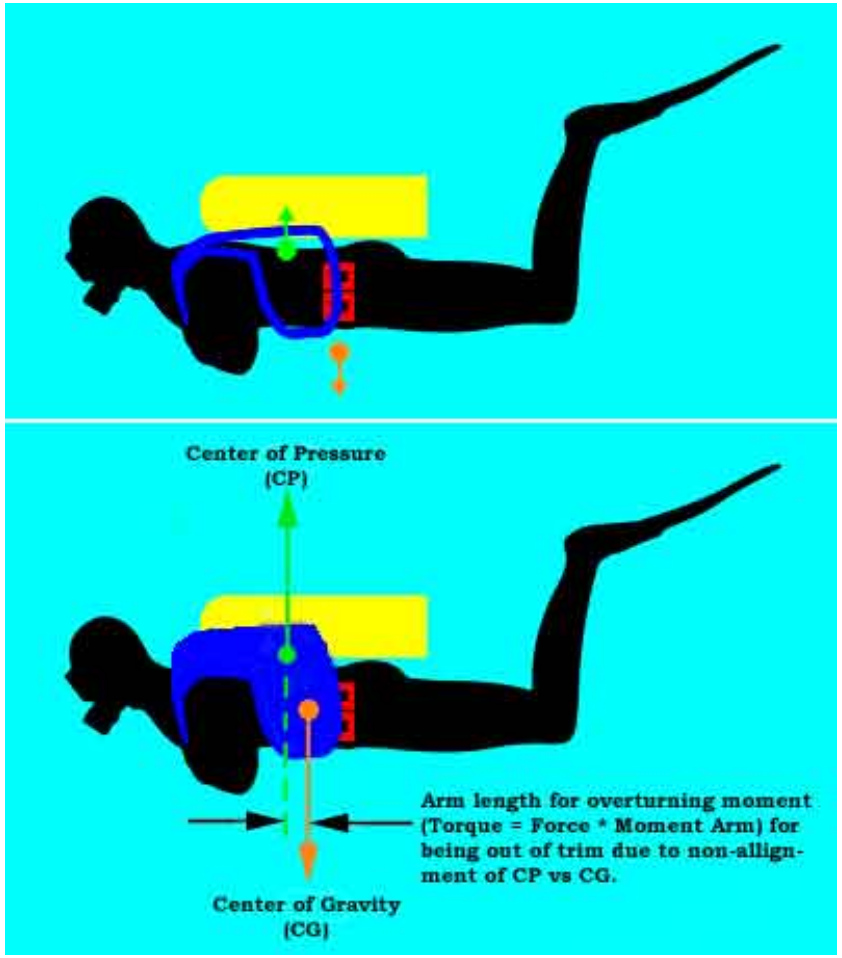
WEIGHT SYSTEM MATERIALS AND CONSTRUCTION.

- Most weight belts are made from five cm/four in nylon webbing.
- Neoprene or other materials may be used to make weight pockets that may be attached to this belt.
- A few weight belts may be made from neoprene; such belts are inherently depth compensating.
- Quick-release buckles may be made from stainless steel, plated brass or, more commonly, plastic.
- Weight systems integrated into backpacks are typically made from plastic.

SETTING UP A 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 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.

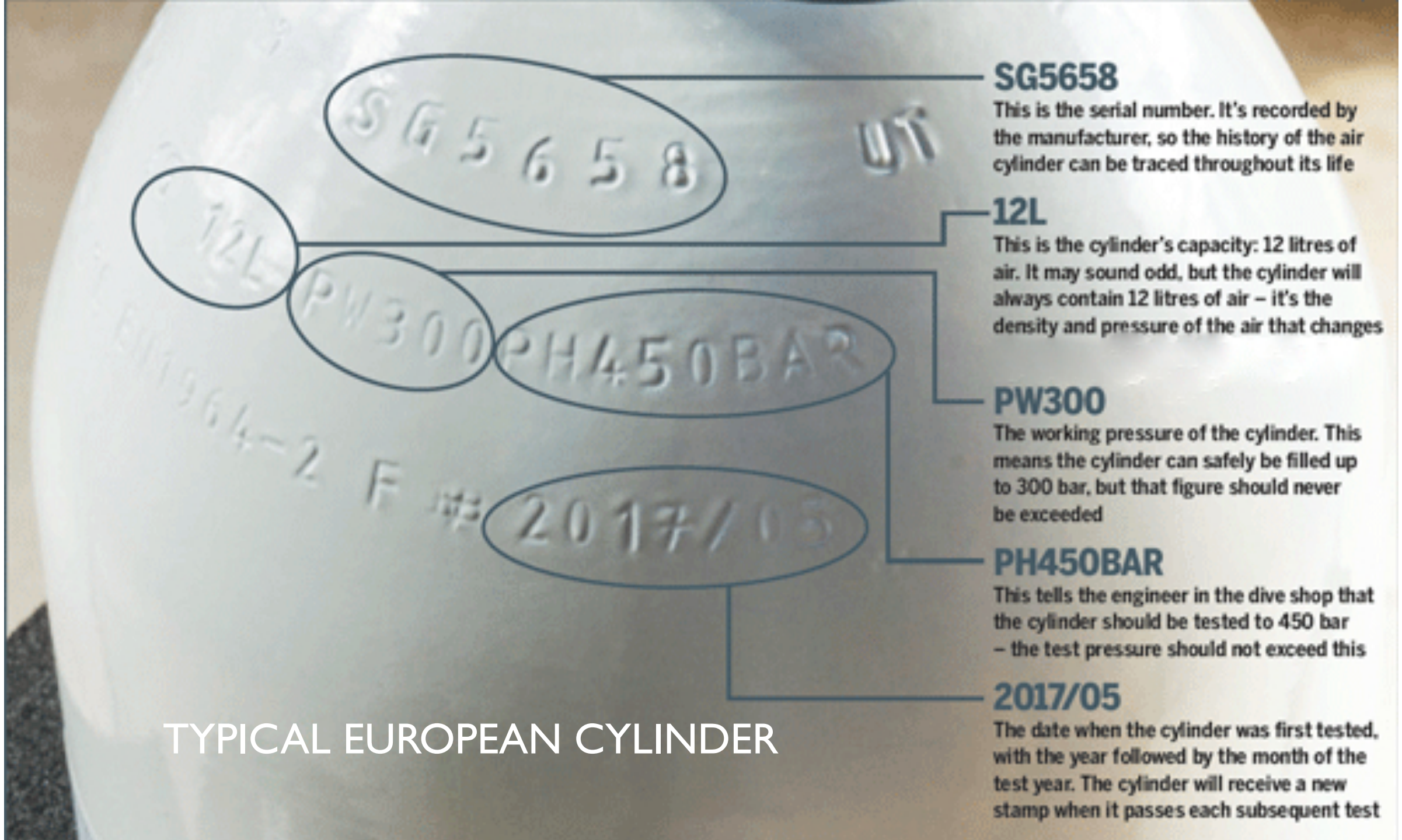
It is not recommended that you underweight yourself on deeper dives. Being too buoyant in shallow water interferes with slow rates of ascent and the ability to make safety stops. This is especially important on deeper dives.



CYLINDERS

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 aluminium 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.*



SG5658

This is the serial number. It's recorded by the manufacturer, so the history of the air cylinder can be traced throughout its life

12L

This is the cylinder's capacity: 12 litres of air. It may sound odd, but the cylinder will always contain 12 litres of air – it's the density and pressure of the air that changes

PW300

The working pressure of the cylinder. This means the cylinder can safely be filled up to 300 bar, but that figure should never be exceeded

PH450BAR

This tells the engineer in the dive shop that the cylinder should be tested to 450 bar – the test pressure should not exceed this

2017/05

The date when the cylinder was first tested, with the year followed by the month of the test year. The cylinder will receive a new stamp when it passes each subsequent test

TYPICAL EUROPEAN CYLINDER

REGULATORS

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.*

ALTERNATE AIR SOURCES

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***
  - ***buoyancy devices with air cylinders.***

INSTRUMENTATION

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 analogue 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.*

DIVING ACCESSORIES & SPECIALTY DIVING EQUIPMENT

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

- ***Identify the need for, and use of, the following:***
  - ***Knifes/tools***
  - ***DSMB***
  - ***Underwater lights***
  - ***Lift Bags***

UNDERWATER LIGHTS

- 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.
- Battery types
  - 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.
  - Non-rechargeable batteries 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).

ACCESSORIES

- Search and recovery tools
  - Marker buoys help pinpoint location of lost objects or mark search area.
  - Metal detectors can help find objects buried under sand and sediment.
  - Lift bags are used to raise objects of 7 kilograms or more safely to the surface.
- Dive flags and DSMBs
  - Warns boaters and others that divers are underwater.
  - A float provides additional surface support and storage that divers don't wish to carry with them underwater.
  - Enables divers to establish an ascent and descent line for deeper dives and allows the boat to find them.
  - Required by law in many areas.

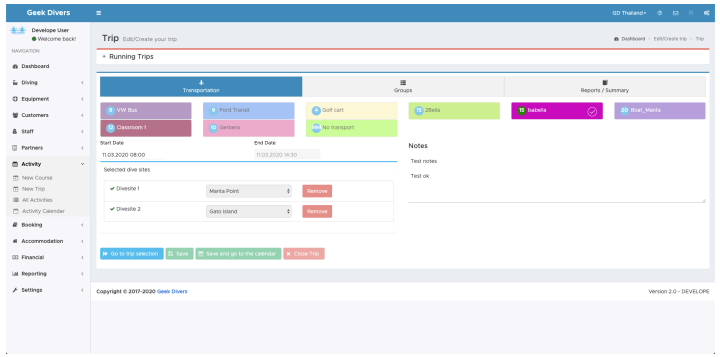
EQUIPMENT FOR RENT

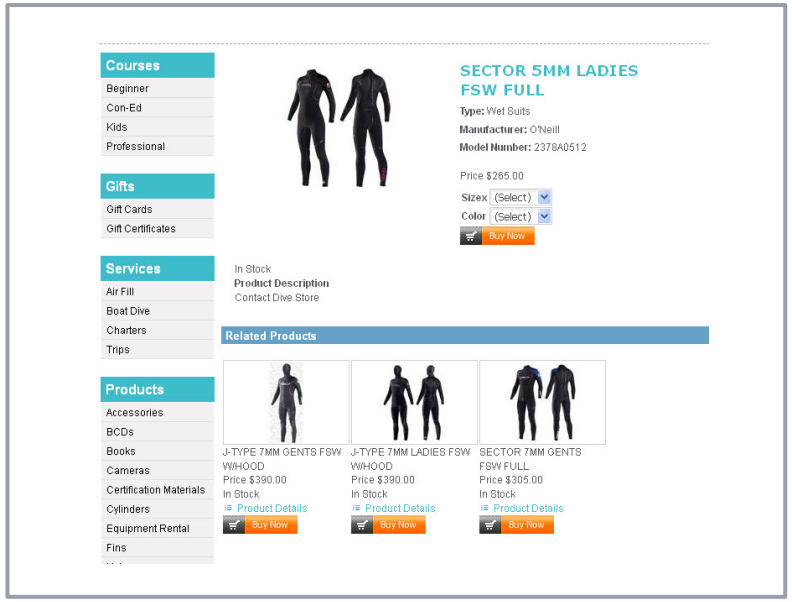
- Robust design
- Same model as much as possible
- Mark expensive items individually
- Sized items need to be marked
- Use colours for size indicators
- Containers for gear
- Storage for each diver's gear
- Check in/out protocol
- Take spare equipment to dive sites

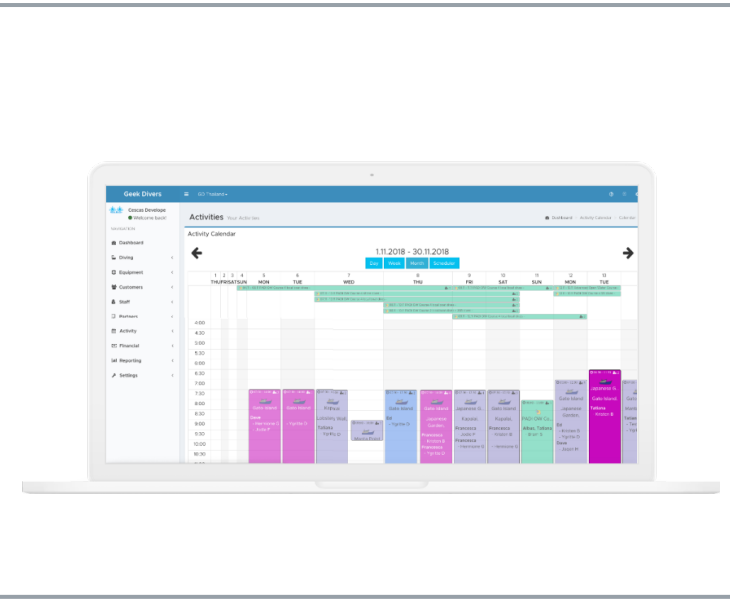
SERVICING AND REPAIR

- Items needing servicing need individual identification
- Service records on computer or paper
- Cylinders will need hydro and visual tests at intervals (usually, five-yearly & annually)
- Have a fault identification system
- Need a workshop
  - Wide range of usual tools
  - Manufacturer tools
  - O2 clean needs special precautions
  - Adequate spares

SERVICING & RENTAL RECORDS







SUMMARY

Dive equipment features

Rental equipment

Servicing and repair introduction

Recording systems for rental and servicing

QUESTIONS