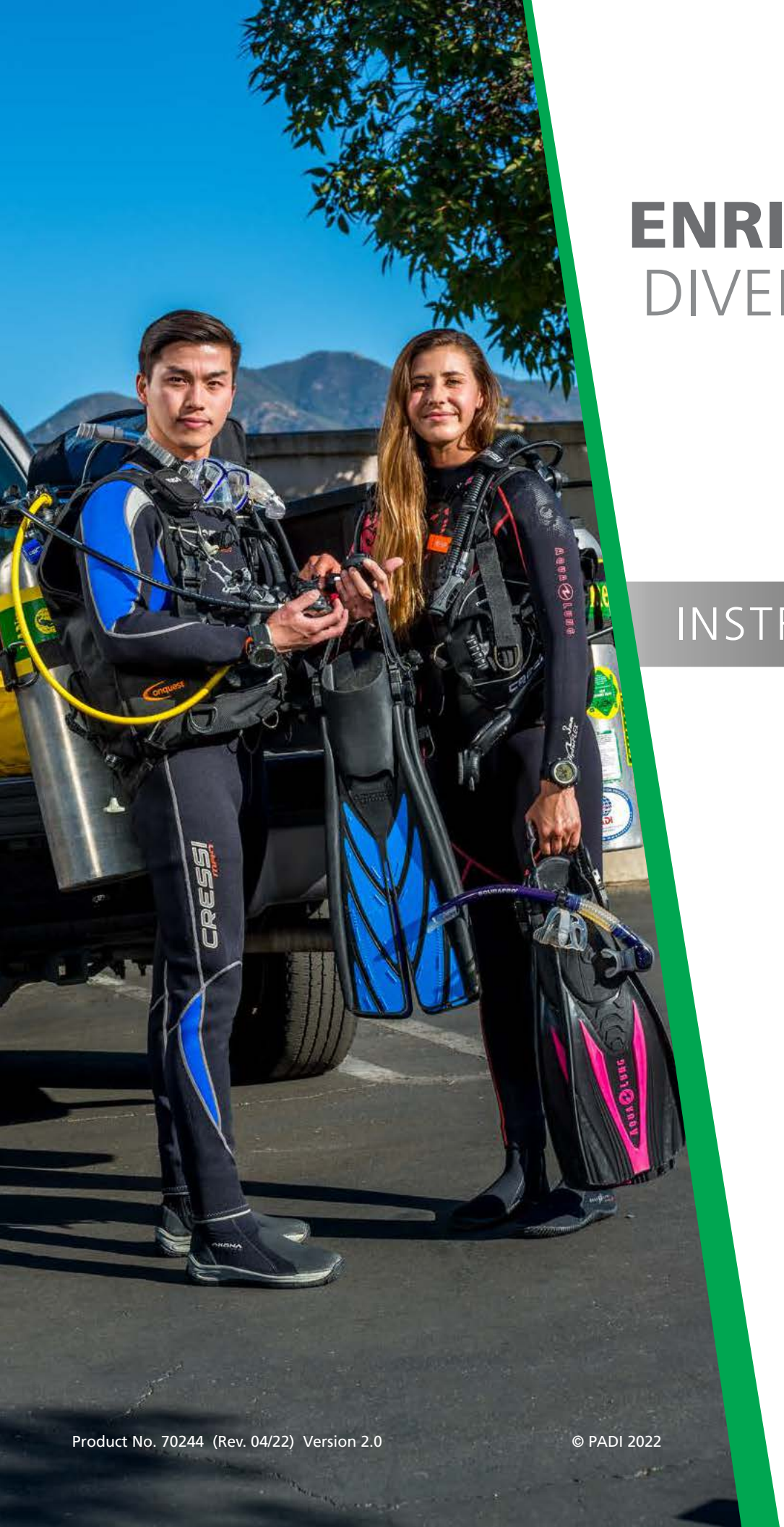

ENRICHED AIR DIVER

INSTRUCTOR GUIDE

Product No. 70244 (Rev. 04/22) Version 2.0

PADI

PADI Enriched Air Diver
Specialty Course Instructor Guide

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INTRODUCTION

This section includes suggestions on how to use this guide, an overview of course philosophy and goals, a flow chart to show you how course components and materials work together for success, and ways you can organize and integrate student diver learning.

How to Use this Guide

This guide speaks to you, the PADI Enriched Air Diver Instructor. The guide contains three sections: the first contains standards specific to this course; the second contains knowledge development presentations; and the third covers practical application sessions, the open water dives/open water dive simulations. All required standards, learning objectives, activities, and performance requirements specific to the PADI Enriched Air Diver course appear in **boldface**. **The boldface assists you in easily identifying those requirements that you must adhere to when you conduct the course.** Items not in boldface print are recommendations for your information and consideration. General course standards applicable to *all* PADI courses are located in the General Standards and Procedures section of your PADI *Instructor Manual.*

Course Philosophy and Goals

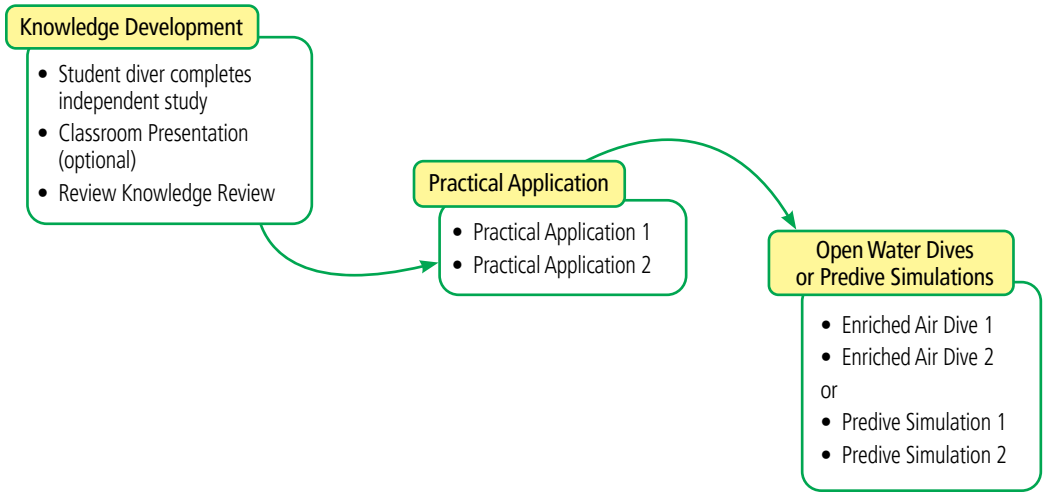
This course is designed to qualify recreational divers to use enriched air ("nitrox") for no stop recreational diving with an enriched air (EANx) compatible dive computer. The program addresses computer-assisted diving while using enriched air with 22 percent to 40 percent oxygen to monitor no stop limits and oxygen exposure.

The best way to learn the procedures for diving enriched air nitrox and to apply them is by doing it. This *course philosophy* therefore is to allow students to learn how to plan and organize enriched air dives by doing so in hands-on experiences. Student divers will apply the knowledge they gain by interacting with *Enriched Air Diver eLearning,* or by reading the PADI *Enriched Air Diver Manual* and watching the companion video, followed by practical application sessions in which they practice the procedures for obtaining and analyzing enriched air. They follow this with at least two open water dives, or two sessions that simulate the predive planning for open water enriched air dives.

Course Flow Options

Course Flow Options provides a look at how knowledge development and confined water and/or surface practice sessions support open water dives. When possible, it's preferable to have student divers complete PADI *Enriched Air Diver eLearning* or the PADI *Enriched Air Diver Manual,* including the Knowledge Review, before participating in the open water dives. However, you may allow divers to complete the first open water dive prior to doing so by conducting the Dive Today briefing and conducting the dive following the Dive Today standards.

The PADI Enriched Air Diver course consists of two practical applications. Practical Application 1 must precede Enriched Air Dive 1 or Predive Simulation Exercise 1, and Practical Application 2 must precede Enriched Air Dive 2 or Predive Simulation Exercise 2. You may combine both practical applications into a single session, but the combined session must precede Enriched Air Dive 1 or Predive Simulation Exercise 1.



SECTION ONE

Course Standards

This section includes the course standards, recommendations and suggestions for conducting the PADI Enriched Air Diver course.

Note to Instructor

Local laws and regulations may prohibit, restrict or otherwise affect the use of enriched air. It is the instructor's responsibility to conform to laws in force in the local area. Contact your PADI Regional Headquarters for more information about laws or regulations that may affect teaching this course.

Standards at a Glance

Topic	Course Standard	
Minimum Instructor Rating	**PADI Enriched Air Instructor**	
Prerequisites **Minimum Age**	**PADI Open Water Diver or qualifying certification, or enrollment in the PADI Open Water Diver course and PADI Enriched Air Diver course concurrently** **12 years**	
Ratios	**Open Water: 8:1**	
Site, Depths and Hours	**Depth: A PO_2 of 1.4 bar/ata for the blend used, or 18 metres/60 feet for Open Water Divers/Open Water Diver students – whichever is shallowest.** **Open Water Dives: Two dives or Predive Simulation Exercises** Hours Recommended: 18	
Materials	**Instructor:** • **PADI Enriched Air Diver Course Instructor Guide** • **PADI *Enriched Air Diver eLearning* or *Manual* and *Enriched Air Diving* video** • **Oxygen analyzer** • **Dedicated EANx cylinder, decals, contents stickers, fill log pages**	**Student Diver:** • **PADI *Enriched Air Diver eLearning* or *Manual* and *Enriched Air Diving* video** • **EANx compatible dive computer** • **Dedicated EANx cylinder**
Maximum Oxygen Content	**40%**	

Instructor Prerequisites

To qualify to teach the PADI Enriched Air Diver course, an individual must be a Teaching status PADI Open Water Scuba Instructor or higher. PADI Instructors may apply for the PADI Enriched Air Instructor Specialty rating after completing a Specialty Instructor Training course with a PADI Course Director, or by providing proof of experience and applying directly. For further detail, reference the Professional Membership section of your PADI *Instructor Manual.*

Note to Instructor

Individuals who are not certified as PADI Enriched Air Divers or have a qualifying certification may complete the PADI Enriched Air Diver course concurrently with the PADI Enriched Air Instructor Specialty Training course. After completing the course, they are certified as PADI Enriched Air Divers and complete the instructor requirements after making 10 or more dives for experience. They may then submit their instructor applications.

Student Diver Prerequisites

To qualify for the PADI Enriched Air Diver course, an individual must:

1. **Meet one of the following:**
   - **Be certified as a PADI Open Water Diver or have a qualifying certification from another training organization,**
   - **Be a PADI Open Water Diver course student taking the PADI Enriched Air Diver course concurrently.**
2. **Be at least 12 years old.**

Supervision and Ratios

The PADI Enriched Air Diver course emphasizes the theoretical and operational considerations involved with using an enriched-air compatible computer for enriched air diving. Mastery of the learning objectives is demonstrated during knowledge development assessment, practical application sessions and open water dives. Because the key skills and procedures one learns to dive EANx take place prior to a dive, you have the option of using predive simulation exercises in place of actual training dives should circumstances require it.

A Teaching status PADI Enriched Air Diver Specialty Instructor must be present and in control of all activities.

The student diver-to-instructor ratio in open water is a maximum eight students per instructor (8:1).

It is recommended that during training dives, a PADI Instructor or certified assistant accompany Enriched Air Diver students. Indirect supervision is acceptable for certified

divers using enriched air dive computers when the instructor has personally supervised the divers setting their computers with the correct blend. Certified divers who have successfully completed the Knowledge Development and the Practical Application may also be indirectly supervised. **Uncertified divers (Open Water Diver students) must be directly supervised by a PADI Enriched Air Specialty Instructor.**

If Dive 1 is conducted deeper than 18 metres/60 feet, the Enriched Air Instructor must directly supervise at a ratio no greater than 8:1.

Site, Depths, and Hours

Site

Choose sites with conditions and environments suitable for completing requirements. Ideally, select sites familiar to student divers.

Depths

The maximum depth for training dives is 30 metres/100 feet, the depth at which a diver reaches a PO_2 of 1.4 bar/ata for the blend used, or 18 metres/60 feet for Open Water Divers/Open Water Diver students – whichever is shallowest.

Hours

The PADI Enriched Air Diver course includes two practical application sessions and two open water dives/predive simulations that may be completed in one day. The minimum number of recommended hours is 18. If a training dive will be at night, it's recommended that students have prior night diving experience or direct supervision.

Materials and Equipment

Instructor

- **PADI Enriched Air Diver Course Instructor Guide –** No other outlines may be used when conducting this course.
- **PADI *Enriched Air Diver eLearning* or *Manual***
- **PADI *Enriched Air Diving* video** (included in eLearning)
- **Enriched Air Diver Exam and answer sheets** (for manual users)
- **Liability Release and Assumption of Risk for Enriched Air (Nitrox) Diving (10078)** (where legally permitted)
- **Oxygen analyzer** (at least one available for student use during practical applications and before training dives)

- **Enriched air fill log pages**
- **Contents stickers/tags for enriched air cylinders**
- **Dedicated EANx cylinder with appropriate markings as required by local community standard and/or regulations**
- Specialty Diver certificates
- Enriched Air Diver chevron
- Student Record File
- Oxygen Clean/Not Oxygen Clean cylinder decals

Student Diver

- **PADI *Enriched Air Diver eLearning* or *Manual***
- **PADI *Enriched Air Diving* video** (Students must view this video, but do not necessarily have to own personal copies. eLearning contains the video.)
- **Liability Release and Assumption of Risk for Enriched Air (Nitrox) Diving (10078** – required for dives only, not simulations.)
- **EANx compatible dive computer – defined as a dive computer that calculates adjusted no stop (no decompression limits) and oxygen exposure for differing blends of enriched air**

> **Note to Instructor**
> Students may make the training dives using an air-only computer as described in Section Three, but they must have access to an EANx compatible computer to meet the setting, predive scroll and other performance requirements related to using it.

- **Dedicated EANx cylinder with appropriate markings as required by local community standard and/or regulations**

The PADI Enriched Air Diver course may not be conducted using closed or semiclosed circuit scuba.

See the General Standards section of the PADI *Instructor Manual* for other instructor and student equipment requirements and/or recommendations that apply to training dives.

Predive Simulation Exercise Option

It's recommended that you conduct Enriched Air Dives 1 and 2 whenever possible. However, when logistics don't allow, you have the option to conduct predive simulation exercises instead. The critical objectives of the Enriched Air Diver Specialty course are both learned and applied out of the water, and center around the physical procedures of gas analysis (and related use of logs and contents stickers) and setting an EANx dive computer appropriately before a dive, and using its predive scroll to determine no stop limits for the

planned depths. Therefore, the performance requirements for the dive can effectively be addressed in a predive simulation, which can be presented in conjunction with practical applications 1 and 2.

Note to Instructor

As with any PADI course, be mindful of local dive industry practices or regulations that supersede PADI standards when teaching the PADI Enriched Air Diver course. Contact your PADI Regional Headquarters if you have questions regarding any that may apply to your area.

Practical Applications

The PADI Enriched Air Diver course consists of two practical applications: Practical Application 1 introduces student divers to analyzing enriched air nitrox, confirming cylinder markings and setting enriched air dive computers. Practical Application 2 allows student divers to go through the processes of obtaining enriched air from a blending facility, and to get a direct overview of how operations blend enriched air nitrox. The following standards apply to the practical applications:

1. **Practical Application 1 must precede Enriched Air Dive 1 or Predive Simulation Exercise 1, and Practical Application 2 must precede Enriched Air Dive 2 or Predive Simulation Exercise 2.** You may combine both into a single session; if you choose to do so**, the combined session must precede Enriched Air Dive 1 or Predive Simulation Exercise 1.**
2. **Practical Application 2 must be conducted at an enriched air fill station* where you can take students through the actual process of obtaining an enriched air fill.**

Note to Instructor

The definition of "enriched air fill station" is any accepted location open to the general public that provides enriched air for enriched air certified divers. This could include dive boats or dive centers that obtain enriched air from another source as a regular service for enriched air divers. Some locations that are not open to the general public, but that follow the accepted enriched air fill procedures described in this course and/or accepted in the local diving community may also qualify. This could include enriched air fill stations supporting scientific operations or university dive programs. For more information about whether a particular facility qualifies as an enriched air fill station for the purposes of this course, contact your PADI Regional Headquarters.

Dive Today

You can introduce EANx diving in a way that gets the diver in the water quickly, using enriched air and an enriched air compatible computer.

To participate in Dive Today, the diver must:

- **Be at least 12 years old.**
- **Complete and sign the Liability Release and Assumption of Risk for Enriched Air (Nitrox) Diving** (where legally permitted). **The diver must also complete and sign other required documents as listed in the General Standards and Procedures section of the PADI *Instructor Manual* and/or other forms required by your local PADI Regional Headquarters.**

You may conduct Enriched Air Dive 1 prior to beginning knowledge development. To apply this option with the PADI Enriched Air Diver course, divers must:

1. **Be certified PADI Open Water Divers or have a qualifying certification from another training organization; exceptions allowed for divers participating in this program during Open Water Dive Four of the PADI Open Water Diver course.**
2. **Successfully complete Practical Application 1 prior to Enriched Air Dive 1.** (This is easily conducted as part of the predive briefing.)
3. **Listen to your Dive Today (see Section Two) as outlined for Enriched Air Dive 1, with the divers demonstrating mastery and understanding**. The Dive Today briefing applies to all student divers who have not completed the knowledge development.
4. **Be personally observed by you to verify that they set their computers to the correct blend.**

At the instructor's discretion, the dive credits for those who continue on in the course.

Assessment Standards

For eLearners, check the diver's eRecord to verify successful of completion of *Enriched Air Diver eLearning,* including Knowledge Review and Exam. Administer the Enriched Air Quick Review in person and review any missed questions until mastery is achieved.

To assess knowledge of divers using the manual, have divers complete the Enriched Air Diver Knowledge Review (located in the Appendix of this guide and in the *Enriched Air Diver Manual)* and review missed questions until they demonstrate adequate knowledge. Administer the Enriched Air Diver Exam. Student must either score 100 percent initially on the exam, or score 75 percent or higher and have each question missed explained until mastery is achieved.

The student diver must demonstrate accurate and adequate knowledge during the open water dives and must perform all skills (procedures and motor skills) fluidly, with little difficulty, in a manner that demonstrates minimal or no stress.

Concurrent Training

Training dives may be integrated with other PADI course dives. When teaching the PADI Open Water Diver and Enriched Air Diver courses concurrently, it's recommended that you include the Enriched Air Dives. Open Water Diver course divers who have completed Open Water Dives 1, 2 and 3 may complete Enriched Air Dive1 combined with Open Water Dive 4 (see Combining Open Water Diver and Enriched Air Diver Training Dives), followed by Enriched Air Dive 2. Instead of enriched air training dives, Open Water Diver course student divers may perform the predive simulation exercises. In either case, the Enriched Air Diver certification is issued only after the Enriched Air Diver course requirements are met and after the student diver becomes a certified PADI Open Water Diver.

Combining Open Water Diver and Enriched Air Training Dives

The combined Open Water Training Dive 4/Enriched Air Dive 1 option gives you the opportunity to introduce enriched air computer assisted diving to PADI Open Water Diver students as part of their final training dive for the PADI Open Water Diver course. If successfully completed, the dive may be credited toward both courses and certifications, at instructor discretion.

The following standards apply to this option:

1. **The instructor must be a PADI Enriched Air Instructor.**
2. **The student must have successfully completed Open Water Training Dives 1-3.**
3. **The dive must be made using an enriched air compatible dive computer as described in the equipment requirements.**
4. **The instructor must give the Dive Today briefing as outlined for Enriched Air Dive 1, with students demonstrating mastery and understanding.** (See Enriched Air Dive 1 in Section Three.) You may combine this briefing with the other aspects of the Open Water Dive 4 briefing.
5. **Students must successfully complete Practical Application 1 prior to Enriched Air Dive 1.**

Note to Instructor

Practical Application 1 introduces the student diver to gas analysis and setting enriched air dive computers, and is easily conducted as part of the predive briefing.

6. **The student must complete and sign the Liability Release and Express Assumption of Risk for Enriched Air (Nitrox) Diving** (where legally allowed) prior to the dive. This is in addition to, not in place of, the other releases and documents required.
7. **Students must be directly supervised according to the ratios in the PADI Open Water Diver course.**
8. **The maximum depth is 18 metres/60 feet, or the depth at which the blend reaches a PO_2 of 1.4 ata/.bar, whichever is less.**

Note to Instructor

The PADI Enriched Air Diver course materials, including this guide, reflect the dive community convention of using atmospheres (ata – atmospheres absolute) to express partial pressures. Those in metric system areas may treat pressures in ata as bar. Although technically there's a slight difference between a bar and an atmosphere, the difference isn't significant within the pressure range that applies to diving, and it is customary to treat them as the same.

Schedule Options

The following lists some of the possible sequences for the PADI Enriched Air Diver Specialty course:

Dive Today Sequence

Practical Application 1 (during dive briefing)
Dive Today briefing
Enriched Air Dive 1
Knowledge Development (with manual and video, or eLearning)
Prescriptive Review
Practical Application 2
Enriched Air Diver Exam or Quick Review for eLearners
Enriched Air Dive 2

Integrated Sequence

Knowledge Development (with manual and video, or eLearning)
Practical Application 1
Prescriptive review
Enriched Air Dive 1
Practical Application 2
Enriched Air Diver Exam or Quick Review for eLearners
Enriched Air Dive 2

Predive Simulation Sequences

Knowledge Development (with manual and video, or eLearning)
Prescriptive review
Practical Application 1
Predive Simulation Exercise 1
Practical Application 2
Enriched Air Diver Exam or Quick Review for eLearners
Predive Simulation Exercise 2

Certification Requirements and Procedures

The instructor who conducts the student diver's final training session certifies the diver. The instructor certifying the diver must ensure that all certification requirements have been met.

Links to Other Courses

Divers who successfully complete Enriched Air Dive 1 may receive credit for an Adventure Dive toward the PADI Advanced Open Water Diver or Adventure Diver certifications. The Enriched Air Diver Adventure Dive conducted during the PADI Advanced Open Water Diver course may count as the first dive toward this specialty at your discretion.

Divers may credit the specialty certification toward the PADI Master Scuba Diver rating

SECTION TWO

Knowledge Development

Conduct

Student divers complete independent study by interacting with PADI *Enriched Air Diver eLearning,* or by reading the PADI *Enriched Air Diver Manual* and watching the PADI *Enriched Air Diving* video. Use these knowledge development presentations to prescriptively address student diver misconceptions, or to provide clarification on certain points of interest.

If there is a need for instructor-led presentations, such as when the *Enriched Air Diver eLearning* or *Manual* does not exist in a language student divers understand, use the following teaching outline to cover the knowledge development learning objectives and course content. The Enriched Air Diver Knowledge Review (located in this guide's Appendix) must be completed and reviewed before the diver is certified.

I. Introduction

Note to Instructor

Have staff introduce themselves and provide a bit of background. Have student divers introduce themselves and explain why they are interested in enriched air diving.

A. Course Goals

The goals of this program are to enable you to:

1. Plan and make no stop dives using an enriched air compatible dive computer and primarily enriched air nitrox blends containing 22 to 40 percent oxygen, remaining within accepted computer or dive table and oxygen exposure limits.
2. Obtain and care for equipment used in enriched air diving.
3. Manage and avoid possible enriched air hazards.
4. Use an enriched air compatible dive computer to apply the benefits of enriched air for recreational diving.

B. Course Overview and Schedule

Note to Instructor

Discuss the course sequence, assignments, meeting times, places and other information about all class, practical application sessions and training dives. Build excitement about the course, particularly the training sessions and dives.

C. Costs, Equipment Requirements and Paperwork

Note to Instructor

Explain all costs, equipment requirements and logistical details as necessary. Reconfirm prerequisites if appropriate, ensure all paperwork is completed – see Section One, and Paperwork and Administrative Procedures, General Standards, PADI Instructor Manual. Collect outstanding fees.

D. Performance Requirements and Certification

1. To qualify for any PADI certification, you must meet specific performance requirements.
    a. You pay for the course, but must earn the certification.
    b. Performance-based learning is objective – a student either meets a requirement or not; your instructor is not arbitrary in assessing performance.
2. Although you must meet all performance requirements, having difficulty does not mean you will be unsuccessful.
    a. You take a course to learn – making mistakes and needing time to master knowledge and skills is part of learning.
    b. You may pick up some things quickly and others slowly; what matters is that you demonstrate mastery – not how long it takes.
    c. You move on at the pace you learn – you may need extra dives or other practice.
3. Upon successfully completing this course, you'll receive the PADI Enriched Air Diver specialty certification.
4. Certification means that you've completed all performance requirements and are trained to:
    a. Make and plan no decompression computer-assisted enriched air dives within the oxygen limits you learn in this course, and while using an enriched air dive computer.
    b. Purchase or rent cylinders, regulators, EANx computers and other equipment for using enriched air with up to 40 percent oxygen.
    c. Obtain fills for appropriate enriched air cylinders to a maximum of 40 percent oxygen.
    d. Apply for the PADI Master Scuba Diver rating 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 and 50 logged dives.

II. Advantages and Disadvantages of Diving with Enriched Air and Enriched Air Dive Computers

Learning Objectives

By the end of this section, you should be able to answer the following questions:

1. **What is "enriched air?"**
2. **What is the primary benefit of using enriched air?**
3. **How does using enriched air affect no stop limits?**
4. **Why is it too simplistic to say enriched air is safer than air when diving well within air no stop limits?**
5. **How does using enriched air affect narcosis when diving?**
6. **What are three advantages of using an enriched air dive computer for enriched air diving?**

1. What is "enriched air"?

A. Let's first define what enriched air is.

1. Air consists of approximately 79 percent nitrogen and 21 percent oxygen. Enriched air has been enriched with oxygen, so it has more than 21 percent oxygen. Enriched air is any nitrogen/oxygen gas blend with more than 21 percent oxygen.
2. Enriched air is also often called *nitrox,* which includes nitrogen/oxygen mixes with less than 21 percent oxygen These are used by commercial divers to reduce oxygen exposure when remaining under pressure for days at a time. For clarity, the terms *enriched air* or *enriched air nitrox* are preferred for the gas blends recreational divers use.
3. You'll be learning to use enriched air from 22 percent to the maximum 40 percent oxygen recommended for recreational diving, with an enriched air dive computer. You'll also be introduced to using blends from 41 percent to 60 percent oxygen, which are common in some recreational semiclosed circuit rebreathers.
4. Enriched air nitrox is abbreviated EANx, followed by the percent of its oxygen content. For example, EANx36 is 36 percent oxygen, remainder (64 percent) nitrogen. In conversation you would say "EANx36," "Enriched Air 36," "Enriched Air Nitrox 36" or "Nitrox 36."
5. Much of the training you learn in this course relates to the higher oxygen content. Higher oxygen content poses some possible but readily managed risks related to equipment and fire, and oxygen toxicity in your body.

2. What is the primary benefit of using enriched air?

B. The primary benefit of enriched air is to extend your no stop limits beyond those of normal air. This has several advantages:

1. It extends your allowable bottom time.
2. It reduces any need to "push" (near) the air no stop limits.
3. It reduces your overall nitrogen load from multiple dives.

3. How does using enriched air affect no stop limits?

C. Enriched air extends your no stop limits in this way:

1. Our bodies absorb nitrogen while breathing air under pressure. Enriched air replaces some of the nitrogen you would breathe underwater with oxygen, so you absorb less nitrogen than you would for the same dive breathing normal air. Our bodies metabolize and otherwise absorb the extra oxygen, so within limits, it doesn't pose any DCS problems.
2. This means you have longer no decompression limits (more no stop dive time) for a given depth than you do using air. How much longer depends on how much oxygen is in the enriched air. Some examples comparing the no stop times for various depths with air, EANx32 and EANx36 (based on the RDP decompression model).

Depth	Air NoD limit	EANx32 NoD limit	EANx36 NoD limit
18 metres	56 min	95 min	125 min
22 metres	37 min	60 min	70 min
50 feet	80 min	155 min	220 min
80 feet	30 min	45 min	55 min

3. Diving with an EANx computer, the increase in useable no stop time tends to be even greater because your computer credits you for slower nitrogen absorption when you ascend to a shallower depth. Ascending to a shallower depth (multilevel profile) rather than spending the entire dive at the same depth is typical in many recreational diving situations.
4. Based on U.S. National Oceanic and Atmospheric Administration (NOAA) tests, U.S. Navy tests dating back more than 50 years, and 20 years field experience by scientific divers, plus field experience in hundreds of thousands of dives, the no decompression limits for enriched air are considered as reliable as those used in normal air tables and dive computers.
5. Although enriched air reduces your exposure to nitrogen, it increases your exposure to oxygen, which has its own concerns. Fortunately, your EANx dive

computer simplifies managing oxygen exposure, which you'll learn more about shortly.

6. Depending upon the dive depth and your breathing rate, you may still find dives limited by your enriched air supply rather than no stop limits.
    a. For single dives, you'll probably find enriched air's extended no stop times most beneficial in the 18 metre/60 foot to 30 metre/100 foot range. Shallower, the dive is usually limited by air supply, not by no decompression time.
    b. However, making repetitive dives, you'll find enriched air often substantially increases your dive time.

4. Why is it too simplistic to say enriched air is safer than air when diving well within air no stop limits?

D. Because you absorb less nitrogen using enriched air, you might expect that using enriched air within normal air no stop limits would substantially improve your safety. However, it's too simplistic to say that enriched air is "safer" than air because it overlooks at least two important issues.

1. As just mentioned, higher oxygen levels create a potential hazard that hardly exists in air diving. It's easy to manage your oxygen exposure, but it undeniably adds a bit of risk that doesn't exist with air.
2. The decompression illness (DCI incidence rate is already so low that it is unlikely that simply reducing nitrogen can produce a meaningful risk reduction.
3. Used properly, both air and enriched air have impressive safety records. but it wouldn't be accurate to say one is "safer" than the other.
4. Safety stops, avoiding factors that predispose you to DCI (such as dehydration, smoking, excessive alcohol consumption), staying well within limits and following other safe diving practices are the most effective ways of making a meaningful reduction in your DCI risk.
5. Since conservative dive practices call for staying well within limits, make your dives with your computer always showing an ample margin before your reach a no stop limit.
6. Some divers claim they feel better after a dive with enriched air. It is probably a psychological effect more than any real physical benefit.

5. How does using enriched air affect narcosis when diving?

E. Enriched air and narcosis

1. Although enriched air has less nitrogen than air does, it is not thought to reduce narcosis compared to air.
2. This is because in theory and in test dives, oxygen has been found to be about as narcotic as nitrogen.

3. The current thinking then, is that air and enriched air have about the same potential for narcosis. Plan your dive accounting for narcosis just as you would using air.

6. What are three advantages of using an enriched air dive computer for enriched air diving?

F. Although you can dive enriched air nitrox with special tables, today most divers use EANx compatible dive computers. These computers offer three important advantages:
   1. They combine the advantages of enriched air with multilevel diving for the most no stop time possible, especially when making two or more repetitive dives.
   2. Most models will or can be set to alert you if you accidentally exceed the maximum depth for your gas blend (more about maximum limits shortly).
   3. They simplify diving planning and execution by calculating both your oxygen exposure and your allowable no stop time, and warn you if you near the limits of either.

III. Equipment for Enriched Air Diving

Learning Objectives

By the end of this section, you should be able to answer the following questions:

1. **What is the primary concern regarding enriched air and scuba equipment?**
2. **What are the requirements and recommendations for scuba equipment (other than cylinders) used with enriched air with up to 40 percent oxygen?**
3. **Why does enriched air diving require a dedicated cylinder?**
4. **What color coding, stickers (decals) and tags should an enriched air cylinder have?**
5. **What are the two primary concerns associated with filling enriched air cylinders, and how are they avoided?**
6. **Why should only qualified, reputable enriched air blenders fill enriched air cylinders?**
7. **What is the potential hazard of improper enriched air filling procedures?**
8. **What should you do if an enriched air cylinder or oxygen-service equipment is used with standard compressed air?**
9. **How do you identify qualified enriched air blenders and enriched air service?**
10. **What are the two most commonly used blends of enriched air?**

1. What is the primary concern regarding enriched air and scuba equipment?

A. The primary concern regarding enriched air and dive equipment is the potential for fire when in contact with a gas blend that has a high oxygen content.
   1. Pure oxygen and high oxygen mixes can cause materials to burn more readily, even at normal temperatures. This raises the risk of combustion.

2. High oxygen content may also cause equipment to deteriorate rapidly.To manage this concern, apply the following guidelines to all scuba equipment you will use with enriched air nitrox, except the cylinder.

2. What are the requirements and recommendations for scuba equipment (other than cylinders) used with enriched air with up to 40 percent oxygen?

B. The common guideline in diving is that standard scuba regulators, BCDs, SPGs and alternate air sources may be used for enriched air blends up to 40 percent.
   1. This guideline, originally based on recommendations, standards and field experience by NOAA, the US Navy and the US National Institute of Safety and Health, has been in use by thousands of divers for more than a decade with a good record. However:
      a. Some areas have laws and regulations that require some or all equipment used with enriched air be cleaned to oxygen service specifications. This means it has been cleaned, lubricated and otherwise prepared to the standard required for use with pure oxygen.
      b. Local practice may include markings or tags indicating that the equipment has been serviced for enriched air use and/or to oxygen service specifications.
      c. Most scuba equipment manufacturers have recommendations and/or specific modifications for using their equipment with enriched air. Some state that their equipment shouldn't be used for enriched air.
      d. In some areas, such as Europe, standards or regulations require a special valve and regulator on enriched air equipment (M26x2). A standard air regulator will not fit on such enriched air cylinders, and the enriched air regulators will not fit on standard air cylinders.
   2. Gas mixes with more than 40 percent oxygen (more common in technical diving and with recreational semiclosed-circuit rebreathers) require the equipment to meet oxygen service specifications in all cases.
   3. Use of oxygen compatible lubricants, o-rings and other materials during servicing is generally recommended.
   4. Equipment should be serviced at least annually, preferably by a scuba technician qualified to work on enriched air equipment, and/or as specified by the manufacturer. Have your equipment inspected and recleaned (if necessary) if it is exposed to anything other than water (such as oil, lubricants not recommended by the manufacturer, etc.) between annual servicing.

3. Why does enriched air diving require a dedicated cylinder?

C. Enriched air requires a cylinder dedicated specifically to use with enriched air for two reasons:

1. For safety, it's important that no one accidentally confuse an enriched air cylinder for a standard air cylinder. The cylinder must be clearly marked (more about markings in a moment).
2. One method of blending enriched air requires putting pure oxygen in the cylinder. This is called partial pressure blending. If partial pressure blending with pure oxygen will be used, the cylinder and valve must meet oxygen service standards even when the final enriched air blend will have less than 40 percent oxygen.

4. What color coding, stickers (decals) and tags should an enriched air cylinder have?

D. Enriched air cylinders have standardized stickers and/or tags and color coding generally agreed upon and accepted by the broad international dive community. These markings assure that you can readily identify an enriched air cylinder, determine its contents, and determine whether the cylinder can be used for partial pressure blending.

Note to Instructor

It's recommended you have examples of the following decals/stickers to show students during this discussion.

1. Yellow cylinders should have a 10-centimetre/4-inch green band around the cylinder shoulder with yellow or white lettering reading Enriched Air, Enriched Air Nitrox, Nitrox, or a similar designation.
2. Non-yellow cylinders should have a 15-centimetre/6-inch band around the cylinder shoulder. The top and bottom of this band should be a yellow 2.5-centimetre/1-inch band, with the center 10 centimetres/4 inches green. The green portion should have yellow or white lettering reading Enriched Air, Enriched Air Nitrox, Nitrox, or a similar designation.
3. Enriched air cylinders should have a dated visual inspection sticker (decal) as would a standard air cylinder.
4. The cylinder should have a sticker (decal) or stamp stating the cylinder does or does not meet oxygen service standards. (Sometimes this is part of the visual inspection sticker, but more commonly it is a separate decal because visual inspection and oxygen service are separate maintenance issues.)
5. Enriched air cylinders should have a contents sticker (decal) or permanent tag.
    a. This sticker/tag should, at a minimum, list the oxygen content of the blend the cylinder currently holds, the fill date, the maximum depth for the blend, and the name of the person who analyzed the oxygen content to verify the blender's analysis (this should be the diver who will use the cylinder).

   b. Stickers are replaced and tags rewritten when you have the cylinder refilled. Do not remove the sticker or erase the tag after using the cylinder (the blender will do this when you have the cylinder refilled).
   c. If a permanent tag is used, the cylinder's serial number is often on it to prevent accidentally getting switched to another cylinder.

6. Although these are the broadly accepted markings, in some areas local laws and regulations set differing or additional requirements.
   a. Some areas have recommendations or requirements that an enriched air cylinder be used within a given period, such as within 30 days of filling, and that the cylinder be marked accordingly.
   b. In other areas, standard air cylinders are stamped AIR ONLY, highlighting the need for a dedicated EANx cylinder
   c. In Europe, for example, EANx cylinders have a white shoulder with a black stripe; generally the rest of the entire cylinder is white.

Note to Instructor

Describe any enriched air cylinder markings, configurations or needs unique to the local area.

5. What are the two primary concerns associated with filling enriched air cylinders, and how are they avoided?

E. There are two primary concerns associated with filling enriched air cylinders.
   1. Fire/explosion hazard. Some substances readily burn or combust in the presence of high oxygen concentrations. This includes trace hydrocarbons (lubricants) that may be found in standard compressed air.
   2. Trace lubricants may accumulate over time in a compressed air cylinder, raising the potential for fire or explosion hazard if the cylinder is exposed to high oxygen percentages.

Standard compressed air from a conventional fill station should never be put into an enriched air cylinder. Enriched air should never be put into a conventional scuba cylinder.

F. The amount of oxygen in an enriched air blend affects your no stop time and oxygen exposure.
   1. If the percent of oxygen varies by more than one (1) percent from your desired blend, then your oxygen exposure, the maximum allowable dive depth and no stop limits will be affected (more about this later). Your computer will adjust, but this may affect the dive you had planned.
   2. Blending must be done accurately, with the gas properly analyzed by the blender, and then by you.

6. Why should only qualified, reputable enriched air blenders fill enriched air cylinders?

G. To manage these concerns, enriched air cylinders should only be filled by reputable, qualified enriched air blenders.
   1. Qualified blenders have the proper equipment for producing oxygen compatible air and minimizing contamination of equipment that must remain in oxygen service and/or enriched air service.
   2. Qualified blenders have the special training required to produce enriched air blends and confirm their accuracy.
   3. Qualified blenders follow the operational procedures and maintain the records necessary when you obtain a fill.
   4. You'll learn more about qualified blenders shortly.

7. What is the potential hazard of improper enriched air filling procedures?

H. Attempting to blend enriched air without following proper filling procedures can be hazardous because it raises the risk of fire/combustion.
   1. Trace lubricants in standard compressed air pose a combustion risk in the presence of pure oxygen. Putting pure oxygen in a standard cylinder and/or filling it from a conventional scuba air fill station in an attempt to make enriched air presents a high fire/explosion hazard.
   2. Therefore, never fill an enriched air cylinder that's cleaned and serviced for oxygen service with standard compressed air.

8. What should you do if an enriched air cylinder or oxygen-service equipment is used with standard compressed air?

I. If an enriched air cylinder, or any oxygen service rated equipment, is accidentally used with standard compressed air, or an enriched air fill system that is not oxygen clean, it must be serviced and cleaned by to oxygen service standards before being exposed again to more than 40 percent oxygen. Failure to service and clean it poses the hazards of explosion or fire.
   1. To use air in an oxygen service-rated enriched air cylinder, have it filled with oxygen compatible air by a qualified enriched air blender. The fill is treated as enriched air in all respects, including marking it as EANx21 – enriched air with 21 percent oxygen – analyzing the contents and completing all records.
   2. Enriched air cylinders that are not oxygen service rated may be used for premixed enriched air blends with up to 40 percent oxygen only. They may be filled from standard air sources by a qualified enriched air blender (it will be labeled as EANx21), but should *never* have pure oxygen or enriched air with more than 40 percent oxygen put into them at any time.

9. How do you identify qualified enriched air blenders and enriched air service?

J. You can identify qualified enriched air blenders and service by checking for the following:

1. Gas quality verification – The operation should be able to show regular analysis of the air it uses for enriched air blending. This air should meet local standards for oxygen compatible air.
2. Proper procedures, cylinder markings, analysis and record keeping – A lack of these may indicate the operation isn't qualified or prepared to properly support enriched air diving.
3. 3. Documentation – The operation and/or individuals working there should be able to show evidence of training, such as the PADI Gas Blender certification, and/or credentials from another institution like the Compressed Gas Association, government agencies such as NOAA or other recognized public or private bodies.

Note to Instructor

Tell students about credentials relevant to enriched air blending and service in the local areas.

10. What are the two most commonly used blends of enriched air?

K. Although this course qualifies you to use enriched air blends with 22 to 40 percent oxygen, there are two standard blends you'll use most of the time: EANx32 and EANx36.

1. These were first put into common use by NOAA in the US. Many enriched air fill stations store these because of their utility and popularity within recreational diving.
2. If you request a blend other than EANx32 or 36, you may have to wait for the blend to be made. Some enriched air stations supply only EANx32 and 36.

IV. Oxygen Exposure

Learning Objectives

By the end of this section, you should be able to answer the following questions:

1. **What is meant by oxygen partial pressure?**
2. **How does exposure to increased oxygen partial pressure affect allowable dive time?**
3. **What are the maximum and contingency oxygen partial pressure limits?**
4. **What is the primary hazard of exceeding the oxygen exposure limits?**
5. **What six signs and symptoms may precede a convulsion caused by oxygen toxicity?**
6. **What should you do if you experience any symptoms of oxygen toxicity?**
7. **How do you use an EANx compatible dive computer to manage oxygen exposure and remain within accepted limits?**
8. **What should you do if you accidentally exceed the oxygen exposure limits for your computer?**

1. What is meant by oxygen partial pressure?

A. You measure the concentration of oxygen you're breathing with an enriched air blend at various depths as oxygen partial pressure. Oxygen partial pressure refers to the pressure exerted by the oxygen part of the gas, not the nitrogen part, hence the name partial pressure.

1. Partial pressure is usually expressed in atmospheres (usually abbreviated ata for atmospheres absolute), or as bar.
    a. As you recall, an atmosphere is equal to the pressure of the air surrounding us at sea level.
    b. Oxygen partial pressure is sometimes abbreviated PO_2, or O_2 p.p., so you might see a reference, for example, of PO_2 0.21 ata.
    c. Although there is a slightly technical difference, for diving purposes 1 bar and 1 atmosphere are considered equal.
2. Mathematically, you determine the oxygen partial pressure by multiplying the percent of oxygen in the enriched air by the depth pressure in atmospheres/bar absolute. The deeper you dive, and the more oxygen in your enriched air blend, the higher the oxygen partial pressure.
    a. For example, if you dive to 10 metres/33 feet using EANx40, what is the partial pressure? At 10 metres/33 feet, the pressure is 2 bar/atmospheres, (1 of air and 1 of water). 40 percent oxygen x 2 ata = 0.80 ata or bar oxygen partial pressure.
    b. Don't worry, you're not going to be doing a lot of math because your dive computer does this for you. But, you need to understand where oxygen partial pressure numbers come from and what they mean because they are the basis for oxygen exposure limits.

Note to Instructor
Depending upon the students' certification levels and experience, you may wish to review the basic discussion on pressure and atmospheres from Section One of the Open Water Diver course.

2. How does exposure to increased oxygen partial pressure affect allowable dive time?

B. When diving with air within recreational diving limits, oxygen exposure is not an issue. Due to its higher oxygen content, with enriched air it can be a significant issue. You must use your dive computer to control your oxygen exposure to remain within accepted limits.
   1. The high oxygen partial pressures you experience with enriched air must be kept within limits to avoid oxygen toxicity, which can be a serious hazard. The higher the partial pressure, the less time you can safely be exposed to it.
      a. Your EANx dive computer will track your oxygen exposure much as it tracks your remaining no stop time.
      b. Stay within the oxygen exposure limits your computer displays during the dive as well as within the no stop dive limits it provides.

3. What are the maximum and contingency oxygen partial pressure limits?

C. Oxygen exposure is based on partial pressure, not depth. In the previous example, the oxygen partial pressure is 0.80 ata at 10 metres/33 feet using EANx40. Using EANx36, you have the same partial pressure (0.80 ata/bar) at 12 metres/40 feet. Your oxygen exposure is the same for both dives.
   1. The *maximum* oxygen partial pressure for enriched air diving is 1.4 ata/bar. You will learn to plan your dives so that you do not exceed the depth at which a given EANx blend reaches 1.4 ata/bar.
      a. 1.4 ata is the maximum because it keeps you well within established oxygen limits appropriate for recreational diving. Planning your dive within 1.4 ata/bar partial pressure also gives you a margin for error.
      b. Some evidence suggests that as oxygen partial pressure exceeds the 1.3 to 1.4 ata/bar range, oxygen may begin to act like nitrogen with respect to bubble formation; staying within 1.4 partial pressure reduces the likelihood of problems with this. Some individuals retain carbon dioxide, which may contribute to oxygen toxicity, and tests show a 1.4 ata/bar limit reduces the concern with this.
      c. If your planned dive depth would exceed 1.4, either switch to an enriched air blend with less oxygen or plan a shallower dive. The higher the oxygen content, the shallower the depth at which you reach 1.4. (More about this later.)

2. The *contingency* oxygen partial pressure limit is 1.6 ata/bar. Avoid planning dives with a partial pressure this high, because there is no room for error. Partial pressures between 1.4 and 1.6 should be considered a margin for error only. Divers have had oxygen toxicity near 1.6 while exerting themselves.
   a. Set your computer so the maximum oxygen partial pressure it allows is 1.4. Most computers will let you do this or are preset for this limit. Almost all models alert you if you exceed the limit you set. Some computers display your current PO_2 throughout the dive, whereas others only alert you if you exceed the maximum. Your instructor and/or the manufacturer literature can give you specifics on the settings and warnings for your specific computer.
   b. Exceeding accepted safe oxygen limits either by going to a depth that exceeds 1.4 with the blend you're using, and/or by disregarding the oxygen exposure limits provided by your computer, poses an unnecessary risk of oxygen toxicity.

4. What is the primary hazard of exceeding the oxygen exposure limits?

D. Exceeding oxygen limits can cause central nervous system oxygen toxicity (CNS toxicity).
   1. CNS toxicity may cause a diver to convulse. Convulsions are not usually harmful in themselves, but underwater the diver is almost certain to lose the regulator and drown. This is the primary serious hazard of exceeding oxygen limits – a fatal accident.
   2. Warning signs and symptoms may precede a CNS convulsion, but most of the time CNS convulsions occur without warning. If they occur, signs and symptoms don't typically appear instantly. They usually appear gradually and worsen over time.

5. What six signs and symptoms may precede a convulsion caused by oxygen toxicity?

E. Warning signs and symptoms, if they do occur, include:
   1. Visual disturbances, including tunnel vision
   2. Ears ringing
   3. Nausea
   4. Twitching or muscle spasms, especially in the face
   5. Irritability, restlessness, euphoria or anxiety
   6. Dizziness

F. Some divers remember these signs and symptoms by remembering the acronym VENTID – Vision, Ears, Nausea, Twitching, Irritability and Dizziness.

6. What should you do if you experience any symptoms of oxygen toxicity?

G. If you experience any of these symptoms, end the dive by beginning a normal ascent immediately. There is no need for a rapid or panicked ascent; just start up immediately at a normal, safe rate.

1. During a penetration dive, ascending immediately may not be possible; abort the dive and ascend as soon as possible. For recreational penetration dives, it's best to keep your oxygen partial pressure very low, or to simply use air.
2. Heavy exercise is thought to predispose you to CNS toxicity, and should be avoided, especially if you near or will near oxygen exposure limits. This is especially a concern if your dive accidentally exceeds 1.4 ata/bar. Again, staying well within limits gives you a margin for error and reduces your risk. If you find yourself exerting heavily, stop and rest, or even end the dive if necessary.
3. Some drugs, including the decongestant pseudoephedrine (found in Sudafed™ and other products), are CNS exciters and may predispose you to CNS toxicity. It's generally recommended that divers avoid decongestants when diving anyway (because they may wear off during the dive, leading to a reverse block). If you're taking a prescription, be sure to consult with a physician knowledgeable in diving medicine before using the drug while diving (with air or enriched air).
4. Carbon dioxide accumulation in the body is thought to predispose you to oxygen toxicity. It's important to breathe continuously (do not skip breathe) to avoid retaining carbon dioxide. If you experience headaches after a dive, as a precaution consult a physician familiar with diving to make sure you don't retain carbon dioxide.
5. It is easy to manage oxygen exposure by staying well within the limits of your EANx dive computer and by planning your dives so you're well within the 1.4 partial pressure limit. Enriched air diving within these limits has an excellent safety record. But, you should be aware that failing to stay within oxygen limits can be life threatening.

Note to Instructor

Because people vary in their physiology, no dive table or dive computer can guarantee that oxygen toxicity will not occur, even within accepted limits. Oxygen is a very unforgiving gas. Oxygen toxicity convulsions underwater on scuba can cause you to drown! Dive well within oxygen limits.

6. You may also hear references to pulmonary oxygen toxicity, which results from effects to the lungs due to prolonged exposure to high oxygen partial pressures.
   a. Exposures of several hours long are necessary to develop pulmonary oxygen toxicity, and are highly unlikely when making enriched air no stop recreational dives within your computer limits.

b. Symptoms include burning in the throat and chest, coughing and shortness of breath.
c. Pulmonary oxygen toxicity is more of a concern in technical and commercial dives that require long decompression stops using pure or high amounts of oxygen (50 percent or more).
d. Nonetheless, you should discontinue diving for a few days if you experience symptoms that could indicate pulmonary oxygen toxicity; symptoms normally resolve quickly, though you should consult a physician if symptoms are severe or prolonged.

7. How do you use an EANx compatible dive computer to manage oxygen exposure and remain within accepted limits?

H. Your dive computer will assist you in managing oxygen exposure.
1. Set your dive computer for a maximum oxygen partial pressure of 1.4 ata/bar. (Your instructor and/or the manufacturer instructions can explain how to do this with your specific model. This is usually something you only do once.)
2. Set the computer for the EANx blend you are using for the dive. (More about this shortly).
3. Activate your computer's scroll mode. The computer will show you the no decompression limits for depth in progressive increments (3 metres/10 feet typically). With most models, the deepest depth displayed is the deepest depth you can reach without exceeding 1.4 ata/bar. (Some models display this based on 1.6 ata/bar, in which case use the table below to find the maximum depth.)
   a. Besides scroll mode, some models display the maximum depth when you set the blend.
   b. See the manufacturer's instructions for specifics for the computer you're using.
   c. Regardless of how it's displayed, note this depth, because exceeding it would take your oxygen partial pressure above 1.4 and pose a serious risk of oxygen toxicity.
4. Your EANx dive computer tracks your oxygen exposure, including surface interval credit, throughout the diving day much as it tracks your exposure to nitrogen. See your instructor and/or the manufacturer literature for specifics on how it determines and displays limits and remaining dive times.
   a. For repetitive dives, in scroll mode many computers show you either the no decompression limit or the oxygen exposure time remaining – whichever is shorter (usually no decompression limit).
   b. Many computers also display your oxygen exposure status as a graph or other indicator is surface mode.

c. In recreational, no decompression diving, oxygen exposure rarely limits you unless you spend a lot of time at a depth near the 1.4 bar/ata PO2 limit. Nonetheless, you need to monitor your exposure because it can limit your dive.

Maximum and Contingency Depth Table

Blend	Maximum Depth (1.4)	Contingency Depth (1.6)
29%	38 m/126 ft	45 m/149 ft
30%	37 m/121 ft	43 m/143 ft
31%	35 m/116 ft	42 m/137 ft
32%	34 m/111 ft	40 m/132 ft
33%	32 m/107 ft	38 m/127 ft
34%	31 m/103 ft	37 m/122 ft
35%	30 m/99 ft	36 m/118 ft
36%	29 m/95 ft	34 m/114 ft
37%	28 m/92 ft	33 m/110 ft
38%	27 m/89 ft	32 m/106 ft
39%	26 m/85 ft	31m/102 ft
40%	25 m/83 ft	30 m/99 ft

Note: Blends with 28% oxygen or less are not shown because they have maximum depths deeper than the 40 metre/130 foot depth limit for recreational diving.

5. It's recommended that you have a surface interval of at least one hour between enriched air dives whenever possible, especially if you exceed more than 50 percent of your computer's allowable exposure. This is believed to further reduce the likelihood of oxygen toxicity.
6. If your planned dives may cause you to approach or exceed oxygen exposure limits, switch to an enriched air with less oxygen and/or plan your dives shallower.

8. What should you do if you accidentally exceed the oxygen exposure limits for your computer?

I. If you accidentally exceed the maximum oxygen exposure limits for your computer, ascend slowly, make a safety stop and end the dive. Do not dive for 24 hours, or as stipulated by the computer manufacturer.

Note to Instructor

Because different computers display oxygen exposure differently, logging oxygen exposure after a dive depends upon the dive computer. Some display percent of oxygen exposure used, and some show simple bars on a graph. Therefore, the exposure to record in your log book may be precise, or more general based upon how the computer provides the information.

V. Oxygen Analysis and Obtaining Enriched Air Fills

Learning Objectives

By the end of this section, you should be able to answer the following questions:

1. **Who must personally verify the analysis of the oxygen content in an enriched air cylinder before it is used?**
2. **What are the procedures for analyzing enriched air?**
3. **What is the standard of practice for the accuracy of enriched air analysis?**
4. **What cylinder marking should you check to compare your analysis against?**

1. Who must personally verify the analysis of the oxygen content in an enriched air cylinder before it is used?

A. Enriched air is analyzed by the blender after blending. Nonetheless, the diver who will be using a cylinder of enriched air must also personally verify the oxygen analysis of the cylinder.
   1. Normally, this means that you will analyze the cylinder contents yourself using an oxygen analyzer.
   2. In some instances, another qualified person may perform the analysis with you watching and reading the oxygen content from the analyzer personally.

B. *Do not dive with a cylinder of enriched air if you have not personally verified its contents. There are no exceptions.*
   1. If the cylinder contains an enriched air blend different from what you believe it to be, you may face a substantial risk of DCS or drowning (due to oxygen toxicity).
   2. Personally checking is an important safety principle that reduces risk by providing a double check of the initial analysis, verifying that the cylinder has been correctly marked as containing that blend, and confirming that the cylinder wasn't accidentally confused with another.
   3. Remember that it's your personal safety on the line: Know what gas blend you're diving.

C. Avoid the possibility that someone else uses and refills an enriched air cylinder without your knowledge, or that the cylinder you analyzed isn't accidentally confused with another, between your analysis and when you dive.
   1. Keep the cylinder some place where it won't accidentally be used by someone else.
   2. If there's ever any doubt or question about the cylinder's contents, or whether cylinders may have been confused, reanalyze the contents.
   3. It's a good practice to reanalyze your cylinder contents just before the dive, even if you analyzed it earlier.

2. What are the procedures for analyzing enriched air?

D. You present your PADI Enriched Air Diver certification to the blending station and choose the enriched air blend you would like to use (availability may vary). You next confirm the percentage of oxygen and nitrogen in the blend.
   1. You need to know this to set your EANx compatible computer for the oxygen content.
   2. You must tell the computer the correct percentage of oxygen for it to be able to calculate your oxygen exposure, no stop limits and emergency decompression (should it be required).

E. Oxygen analyzers differ from make to make in their use, so consult the manufacturer's instructions. A suitable analyzer should read in increments of 0.1% (a tenth of a percent) or less. However, the following steps generally apply to using all oxygen analyzers:
   1. Always begin by calibrating the analyzer, and recalibrate the analyzer any time it has been turned off and then back on.
      a. When possible, it is best to calibrate the analyzer using 100 percent oxygen as well as air, and/or a known enriched air blend, but you can also calibrate using air only with most analyzers and have sufficient accuracy.
      b. Adjust the analyzer (see manufacturer guidelines) to read 20.8 to 21 percent oxygen while reading air. (Check the manufacturer specifications for calibrating the particular analyzer.)
   2. The flow into the analyzer must be the same for the enriched air as for the calibrating air.
      a. Too high a flow may make the analyzer read too high an oxygen figure. For most analyzers, the flow rate should be less than four litres per minute.
      b. For some analyzers, you open the cylinder valve slightly and allow the gas to flow through. Others use flow restrictors that connect to the low-pressure hose on your regulator for greater accuracy.

c. It is best to calibrate from a cylinder of compressed air, though it is acceptable to calibrate some analyzers using the surrounding ambient air (follow manufacturer guidelines).
d. Don't recalibrate the analyzer using room air if you've been analyzing a lot of cylinders indoors because there may be residual oxygen around the sensor. Humidity can also affect analyzer readings. If you've been analyzing several cylinders or in a highly humid area, calibrate using a cylinder of compressed air.

3. After calibrating, flow enriched air through the analyzer at the same rate (a substantially different rate may reduce the accuracy of the analysis.) The analyzer displays the percentage of oxygen, usually to a tenth of a percent (e.g. 32.1%).

Note to Instructor

It's recommended that you open enriched air cylinder valves slowly. This avoids the heat associated with rapid pressure change, and helps further minimize potential fire concerns.

a. Enriched air partial pressure blended in your cylinder may need time to mix evenly before analyzing (depends upon blending method).
   i. You can speed this process by rolling the cylinder back and forth.
   ii. Premixed EANx and other blending methods don't require waiting.
   iii. Consult the blender if you have any questions about whether the blend is ready to be analyzed.
b. Store the analyzer in the driest environment possible because moisture affects the accuracy of the analysis. Don't blow into the sensor because your breath has moisture.
c. The analyzer sensor uses a consumable chemical and must be replaced periodically.
   i. Sensors last one to five years, but should be replaced even sooner if the analyzer fails to perform within given tolerances (see manufacturer literature).
   ii. Sensors may last longer when stored in sealed plastic bags.
d. If in doubt about analyzer accuracy for any reason, compare the unit against one or more other units known to be accurate and/or against a known gas blend; consult the manufacturer as necessary. Don't use an analyzer with doubtful accuracy.

3. What is the standard of practice for the accuracy of enriched air analysis?

F. The standard of practice for enriched air analysis is plus or minus one percent.
   1. Minor variations (less than one percent) between the blender's analysis and yours are normal, but a substantial variation should be confirmed by using another analyzer.

2. Most enriched air computers use one-percent increments. Round up or down to the closest whole percent (e.g., round 31.2 percent to 31 percent and 31.8 percent to 32 percent), unless the computer manufacturer literature has a different recommendation.

4. What cylinder marking should you check to compare your analysis against?

G. After analyzing the blend, follow these steps:
   1. Confirm that your name, the actual gas blend analysis (yours) and the blend's maximum depth are marked correctly on the cylinder contents sticker or tag.
   2. Sign the dive operation's enriched air fill log, which typically lists the cylinder number, the gas blend, the blend's maximum depth and your name. (If the operation brings the cylinders to the dive site for you, they will usually have a fill log to sign with them.)
   3. Secure the cylinder where it will not be confused with other divers' cylinders.
   4. After the dive, leave the contents sticker or tag in place. The blender uses this to confirm the residual blend inside, and will replace these. It's acceptable to write "used" or "empty" on the sticker or tag, however.

H. Different areas and dive operations may have some variations on analysis procedures. To summarize, though, the key points are:
   1. Be sure you *personally* verify the oxygen analysis of the enriched air blend.
   2. Set your EANx computer to the closest one percent (unless the manufacturer states otherwise).
   3. Be sure the cylinder is marked with your name, the EANx blend and blend's maximum depth.

VI. Guidelines for Diving with Enriched Air Dive Computers

Learning Objectives

By the end of this section, you should be able to answer the following questions:

1. **What four guidelines apply to diving with an enriched air dive computer?**
2. **How do you set your enriched air dive computer?**
3. **What happens if you forget to set your enriched air computer before a dive?**
4. **What should you do if your enriched air dive computer fails during a dive?**

1. What four guidelines apply to diving with an enriched air dive computer?

A. When diving an enriched air dive computer, follow these guidelines:
   1. Know the EANx blend's maximum depth and stay shallower by watching the depth display. Remember to plan your dive and dive your plan. Use the maximum depth warning as a secondary alert.

2. As you already learned as an Open Water Diver, stay well within limits. With EANx, this means the no stop and oxygen exposure limits. Watch both the no stop and oxygen exposure displays on your computer. If you begin to near a limit, ascend until your computer displays a longer limit. Stay that shallow or shallower for the remainder of the dive.
3. Each diver should have an individual enriched air dive computer set for the blend the diver is using.
    a. Variations in depths as well as any variations in the blends will result in differences in the no stop times and oxygen exposure the computers calculate.
    b. As you would when diving air, stay within the limits of whichever buddy's computer gives the most conservative readings.
4. Make safety stops and follow all other conservative safe diving practices.

2. How do you set your enriched air dive computer?

B. As previously discussed, before you dive with an enriched air computer you must set it for the oxygen percentage you found when you analyzed your gas blend.
    1. How you set your computer varies with the model, but is generally a matter of entering a "set" mode and scrolling the blend percentage to the correct number and locking it in. (Your instructor and/or the manufacturer instructions explain how to do this with your specific model. You do this before each dive and you will practice setting your EANx computer as part of this course.)

3. What happens if you forget to set your enriched air computer before a dive?

C. If you forget to set the blend, some computers will either go into an error mode or default to a worst-case mode that calculates assuming 50 percent (or even 100 percent) oxygen and 79 percent nitrogen (an impossible mix, but yields very conservative numbers).
    1. Other computers remain set for the last blend you used until you change it.
        a. It's common to dive the same blend for multiple dives, and you should reset your computer if you change blend.
        b. Keeping the blend set avoids unnecessary resetting when diving the same EANx for multiple dives. Some of these types will go into an error or warning mode if you don't dive for 12 to 24 hours and then forget to set the blend, but not all models.
    2. If set for air, virtually all enriched air computers will stay set for air from one dive to the next without entering the error mode.
    3. See the manufacturer literature for information about setting the enriched air blend and error functions for your particular computer. Remember that failing to have your computer set for the EANx blend raises the risk of DCS or oxygen toxicity.

4. What should you do if your enriched air dive computer fails during a dive?

D. Dive computers are very reliable, and failures are very rare. Nonetheless, if your computer fails during a dive, immediately ascend, make a safety stop at 5 metres/15 feet for three minutes or longer and end the dive.
   1. Some divers wear a backup (second) EANx computer so they can continue diving, even in the unlikely event of a failure.
   2. Another option is to keep a written record of EANx blends, maximum depth, bottom times and surface intervals. If your computer fails (during or between dives), you can use tables to calculate your no stop limits and oxygen exposure for subsequent dives. (Explain to students that you can teach them how to use tables if they are interested.)
   3. If you weren't wearing a backup computer and tables are not an option, do not dive for at least 12 hours (or longer if specified by the manufacturer) before resuming with a working dive computer or tables.

E. If you do not have an enriched air-compatible computer, you can still dive EANx using an air-only computer.
   1. Stay within the computer limits as you would breathing air. The advantage of enriched air in this situation that you can get closer to the computer's no stop limits and not be "pushing" them (though you should still stay reasonably within limits and not dive to them).
   2. Air-only computers do not track your oxygen exposure. You can accommodate this one of two ways:
      a. Option 1: Use the Equivalent Air Depth and Oxygen Exposure Tables to determine your maximum depth for the blend and to track your oxygen exposure based on the maximum depth you reach during each dive.

Note to Instructor
Explain to students that you can teach them to use these tables if they're interested.

      b. Option 2: Alternatively, you keep your oxygen exposure within accepted limits and stay above the maximum depth if you:
         i. Use an EANx blend with 32% or less oxygen.
         ii. Limit your depth to 30 metres/100 feet.
         iii. Stay within your computer's no decompression limits.
         iv. Limit your total dive time for the entire day to 160 minutes.
   3. Option 2 is obviously more limiting than Option 1, but far simpler to apply and adequate for many diving situations.

VII. Diving Emergencies and Enriched Air

Learning Objectives

By the end of this section, you should be able to answer the following questions:

1. **What action should you take if a diver convulses underwater?**
2. **What action should you take if a diver is suspected of having decompression illness after a dive using enriched air?**

1. What action should you take if a diver convulses underwater?

A. If a diver convulses underwater (due to oxygen toxicity or for any other reason), the generally recommended action is to handle the emergency as you would for an unresponsive diver underwater.

1. Hold the diver's mouthpiece in (if still retained). Do not attempt to replace it if it is out of the diver's mouth.
2. Immediately surface the diver, establish ample positive buoyancy for yourself and the victim, and check for breathing.
3. Call for assistance as needed and available, and begin inwater rescue breaths if the victim isn't breathing. Take the diver to the boat or shore, and help remove the diver from the water.
4. Once out of the water, check for a heart beat and breathing. If these are absent, begin/continue rescue breaths and/or CPR. In any case, contact emergency medical care. If the diver is breathing, begin first aid for DCI as a precaution.
5. Even if apparently fully recovered, the diver should be examined by a physician.
6. This recommendation is based on the US Navy procedures, which the Divers Alert Network (DAN) defers to in this situation because there's been little study of this in recreational diving.
7. Some experts recommend that if a diver's mouthpiece is in place, to hold it there and begin the ascent only after the convulsion subsides. After the convulsion ends, bring the diver immediately to the surface. This recommendation is based on the possibility that a convulsing diver may hold his breath.
8. In any case, the primary concern is getting the diver to the surface to prevent drowning, and so you can begin first aid and get help.

2. What action should you take if a diver is suspected of having decompression illness after a dive using enriched air?

B. If a diver is suspected of having decompression illness after an enriched air nitrox dive, administer oxygen and first aid, and obtain emergency help exactly as you would if the diver had been diving using air.

1. If possible, inform emergency personnel and the recompression facility of the diver's time and depth, that the diver was using enriched air nitrox, and what the blend was.
2. In a DCI emergency, if you run out of emergency oxygen before you can get a breathing patient into emergency medical care, have a responsive patient breathe any enriched air available from an appropriate scuba regulator. While not as beneficial as 100 percent oxygen, enriched air has more oxygen than air and may help. It certainly won't hurt.
3. There is at least one equipment manufacturer that makes a system that allows an unresponsive diver to breathe enriched air from a scuba cylinder should it be necessary after running out of emergency oxygen.

Dive Today Briefing

Note to Instructor

The Dive Today briefing provides the basic information necessary for divers to make a supervised recreational enriched air nitrox dive using an EANx dive computer. Give the Dive Today briefing (see below) in addition to the general briefing for Enriched Air Dive 1.

The Dive Today briefing may follow, precede or be combined with gas analysis and Practical Application 1. Avoid overwhelming student divers with too much detail beyond what's outlined – students will get the detail when they complete the Knowledge Development. Emphasize the need to stay within oxygen limits.

I. Benefits of Enriched Air Nitrox

A. Enriched air nitrox increases your allowable no stop dive time by reducing the amount of nitrogen you breathe underwater. It does this by replacing some of the nitrogen with oxygen. Since you breathe less nitrogen, you have longer no decompression limits.

B. The increased no stop time can be substantial, especially when making repetitive dives.

C. Your enriched air dive computer combines the advantages of enriched air diving with multilevel diving, giving you the maximum no stop time possible. It also simplifies planning and executing the dive.

D. Over the last decade, hundreds of thousands of dives have shown that enriched air has an impressive safety record when divers follow proper procedures.

II. Issues with Enriched Air Nitrox

A. The added oxygen in enriched air nitrox presents potential problems you don't have diving with air. Enriched air diving procedures are straightforward, and were created to manage these problems.
   1. Oxygen toxicity is not a concern diving air within recreational limits, but it is with EANx because it has more oxygen.
   2. Part of the dive plan includes determining the maximum depth for the blend you're using. The higher the oxygen content, the shallower the maximum depth. We'll do that together, and you will make the dive well within the depth limit.
   3. Exceeding this maximum depth can cause a convulsion underwater, which can cause you to drown. Take this very seriously – within accepted limits enriched air has proven itself very safe to dive with, but it is very unsafe if you neglect or disregard the limits.
   4. You want to avoid heavy exertion underwater with enriched air, because it can increase oxygen toxicity concerns. If you find yourself exerting heavily during the dive, slow down and rest. End the dive if necessary.
   5. By staying within the limits of the dive plan, oxygen toxicity is *highly* unlikely. As a precaution, be aware of the following oxygen toxicity symptoms: tunnel vision, ringing in your ears, nausea, facial twitching, irritability and dizziness. If you experience any of these, signal your buddy and end the dive immediately.

B. It's important to personally verify the oxygen percentage of the enriched air you use on a dive.
   1. This is why you personally analyze the gas and sign the fill log that attests to it.
   2. The oxygen content is needed to set your enriched air computer and to determine the maximum depth.

C. There are special concerns regarding the higher oxygen content of enriched air nitrox with regard to equipment. You'll learn about these later in the course.

D. This dive does not qualify you to use enriched air nitrox without supervision. You need to successfully complete the entire course and be certified as a PADI Enriched Air Diver.

III. Frequently Asked Questions

Why doesn't using enriched air nitrox produce a meaningful safety benefit when used within air limits?

It doesn't because the decompression illness (DCI) incidence rate is already so low that simply reducing nitrogen isn't likely to produce a meaningful risk change. Statistical estimates suggest that using enriched air within normal air limits only reduces mathematical risk a fraction of a percent. The DCI incident rate is estimated as 0.004 percent (one in 25,000 dives) to 0.001 percent (one in 100,000 dives); if you cut that by half (which is very unlikely), the best you could do is reduce incidence 0.002 percent. Used properly, both air and enriched air have impressive safety records. Following safe diving practices such as making safety stops, avoiding dehydration, etc., appears to be a far more effective way of making a meaningful safety improvement in diving.

Which references discuss the narcotic qualities of oxygen?

Among PADI materials, *The Encyclopedia of Recreational Diving* discusses it extensively in section five, The Physiology of Diving. For a more extensive discussion, look to Bennett and Rostain's Inert Gas Narcosis, chapter 9.2 in the 5th Edition of Bennett and Elliott's *Physiology and Medicine of Diving*, available from Best Publishing, Flagstaff, Arizona. Online, the Rubicon Foundation has many papers on the subject you can download.

Why don't our local cylinders have the green and yellow bands shown in the course materials?

The green and yellow band that says "Enriched Air" or similar is part of the identification convention accepted by the broad international dive community. However, in some areas local laws and/or practices differ from these conventions. In such cases, the local regulation or practice applies.

SECTION THREE

Practical Applications, Open Water Dives and Predive Simulations

Conduct (Practical Applications)

The PADI Enriched Air Diver course consists of two required practical applications. Practical Application 1 introduces student divers to analyzing enriched air nitrox, confirming cylinder markings and setting enriched air dive computers. Practical Application 2 allows student divers to go through the processes of obtaining enriched air from a blending facility, and to get a direct overview of how operations blend enriched air nitrox.

General Considerations

It is preferable to conduct Practical Application 2 at an enriched air fill station*, where you can take students through the actual process of obtaining an enriched air fill.

The emphasis in these practical applications is on the hands-on learning and practicing requesting, analyzing, verifying the cylinder decals/tags and completing and signing the fill log.

Sequence Options

Practical Application 1 may be conducted in the field before the dive, or during knowledge development when discussing oxygen analysis. It may also be combined into a single session with Practical Application 2, and conducted while orienting students to obtaining fills at an enriched air blending station. You may also make it part of the predive briefing for Enriched Air Dive 1 and have students analyze the actual cylinders they'll be using.

Practical Application 1 must precede Enriched Air Dive 1 or Predive Simulation Exercise 1, and Practical Application 2 must precede Enriched Air Dive 2 or Predive Simulation Exercise 2. You may combine both into a single session; if you choose to do so, **the combined session must precede Enriched Air Dive 1 or Predive Simulation Exercise 1.**

Practical Application 1

Performance Objectives

By the end of Practical Application 1, student divers should be able to:

1. **Demonstrate how to use an oxygen analyzer to determine the oxygen content in an enriched air blend. Be able to analyze enriched air repeatedly within the accepted one percent tolerance required for enriched air use.**
2. **Demonstrate how to verify cylinder content data, including maximum depth, and sign the fill log.**

I. Suggested Sequence

A. Analyze enriched air

1. Show students how to analyze enriched air with one or more analyzers and flow restrictors (multiple types are recommended, as available).
2. Remind students that the analyzer must be able to read within 0.1 percent to be used with enriched air.
3. Emphasize calibrating the analyzer with dry air (from a cylinder, not room air in a humid climate), and maintaining the same flow with the enriched air as with the calibrating air to avoid inaccuracy.
4. After your demonstration, have students practice using different analyzer systems (as available) and on different cylinders. All students should *personally* analyze one or more cylinders as well as watch each other.
5. After your demonstration and their practice, students should be able to analyze enriched air repeatedly within the accepted one percent tolerance required for enriched air use.

B. Confirm the information on the contents sticker or tag.

1. Student divers should confirm that the cylinder is properly marked in addition to the contents sticker or tag with required color markings, their name and the maximum depth for the blend.

C. Setting a dive computer

1. Depending on how you schedule the course, students may not yet have learned to set their computers for EANx and then determine maximum depth.
   a. If this is the case, you may provide them with the maximum depths for their blends.
   b. If conducting Practical Application 1 as part of the predive briefing for Enriched Air Dive 1, you may also use the opportunity to show them how to set their EANx-compatible computers' maximum oxygen partial pressure, the EANx blend, and how to use the scroll mode to find the maximum depth.

c. You may show students how to use the Equivalent Air Depth Table or the Maximum and Contingency Depth Table in the PADI Enriched Air Diver Manual to find the maximum depth for their blends.

D. Practice completing and signing an enriched air fill log

1. Depending upon logistics, these can be practice log sheets (if practicing on cylinders they will not actually be diving) or the actual log (if analyzing the cylinder or cylinders they'll be using for the enriched air training dives).

Practical Application 2

Performance Objectives

By the end of Practical Application 2, student divers shoiuld be able to:

1. **Demonstrate the procedures for obtaining an enriched fill and/or renting an enriched air cylinder from an enriched air fill station.**

I. Suggested Sequence

A. Procedures for obtaining an enriched air fill.

1. Walk student divers through making the request.
2. Have divers analyze and verify the contents sticker (decal)/tag.
3. Make sure divers note the maximum depth.
4. Have divers complete and sign the station's enriched air fill log. You may use a dummy log if the cylinders will not actually be used by the students.
5. Continue until student divers can walk through the procedure, including gas analysis, without assistance.

B. Fill station orientation (optional)

1. Show students how the operation blends enriched air, cleans and services equipment for oxygen service and other enriched air related processes.
2. The operation's blender or other qualified person may conduct this orientation as appropriate.

Open Water Dives and Predive Simulations

Conduct (Open Water Dives and Predive Simulations)

It's recommended that you conduct Enriched Air Dives 1 and 2 whenever possible. However, when logistics don't allow, you have the option to conduct predive simulation exercises instead. The critical objectives of the Enriched Air Diver Specialty course are both learned and applied out of the water, and center around the physical procedures of gas analysis (and related use of logs and contents stickers) and setting an EANx dive computer appropriately before a dive, and using its predive scroll to determine no stop limits for the planned depths. Therefore, the performance requirements for the dive can effectively be addressed in a predive simulation, which can be presented in conjunction with Practical Application 1 and 2.

General Considerations

1. Enriched Air Dive 1 allows student divers to apply the basic concepts you present in the Dive Today briefing or that they learned in more detail during knowledge development. The emphasis is on predive planning and making the dive within the limits established during planning and assisted by their dive computers.
2. Assign logistical duties to staff and review emergency protocols.
3. The use of qualified assistants is highly recommended. Assistants can help keep track of buddy teams. An assistant at the surface can help with check-in and check-out procedures and be prepared to help in an emergency.
4. Following each diver's computer, the planned bottom time and depth should not exceed the no decompression limits, oxygen exposure limits or maximum depth (1.4 ata/bar PO_2) for the blend.
    a. Certified students may dive with indirect supervision.
    b. The instructor must personally supervise setting the computers and confirm they're set for the correct blend.
    c. Open Water Diver students who are combining Open Water Training Dive 4 with Enriched Air Dive 1 must be directly supervised following the depth limits and ratios of the Open Water Diver course.
    d. You may allow divers to use air-only (not EANx compatible dive) computers for the training dives. (See #9.) **However, students must still meet performance requirements by demonstrating how to set and use an enriched air compatible computer for dive planning.**
5. It's preferred, though not absolutely necessary, that divers in each buddy team use approximately the same enriched air blend. This gives them approximately the same

limits. Regardless, emphasize that the dive limits must be based on whichever diver nears a limit first – a diver with higher oxygen will have a shallower maximum depth and a diver with lower oxygen will have shorter no stop limits.

6. The combination of multilevel computer diving and enriched air diving means that gas consumption usually ends the dive instead of the no decompression limits. Although students should already be in the habit of watching their SPGs, it's doesn't hurt to remind them to monitor their cylinder pressures, not just no stop times.
7. **You must present the Dive Today briefing for Open Water Diver students, and for certified divers who have not completed the Knowledge Development Section.**
8. **Practical Application 1 must precede Enriched Air Dive 1 or Predive Simulation Exercise 1.** In Dive Today situations, this is easily accomplished by making Practical Application 1 part of the briefing and dive planning as student divers analyze their gas for the dive.
9. **If students will dive using air-only computers, the maximum allowable oxygen content is 32%, the maximum depth is 30 metres/100 feet (or shallower if a shallower limit applies) and their total dive time for the day may not exceed 160 minutes.**
10. **You may combine Predive Simulation Exercise 1 and 2, however two separate scuba cylinders filled with enriched air must be used.**

Enriched Air Dive 1/Predive Simulation Exercise 1

Performance Objectives

By the end of Enriched Air Dive 1 or Predive Simulation Exercise 1, student divers should be able to:

1. **Execute a dive within the no stop limits, maximum depth and oxygen exposure limits established by the instructor during predive planning.**

   or

2. **Plan a dive within the no stop limits, maximum depth and oxygen exposure limits established by the instructor.**

I. Enriched Air Dive 1

A. Environment: Open Water

B. Maximum Depth: Not to exceed no decompression limits/oxygen exposure limits/maximum depth (1.4 ata/bar PO_2) for the blend.

For student divers using air-only computers, maximum depth is 30 metres/100 feet (or shallower if a shallower limit applies).

II. Suggested Sequence

A. Dive Today Briefing

1. The Dive Today briefing provides the basic information necessary for divers to make a supervised recreational enriched air nitrox dive using an EANx dive computer prior to completing the course knowledge development.
2. If students have not completed the knowledge development either with the PADI *Enriched Air Diver eLearning* or *Manual*, give the Dive Today briefing (see the Appendix) in addition to the general briefing for Enriched Air Dive 1.

B. Briefing (in addition to Dive Today Briefing)

1. Evaluate dive site conditions.
2. Identify facilities at the dive site.
3. Explain interesting and helpful facts about the dive site, including bottom topography, bottom composition, depth range and points of interest (use a dive site map if appropriate).
4. Describe entry and exit techniques for the dive site.
5. **You and your staff watch and assist students in correctly setting their enriched air dive computers, confirming the settings. Remind students that if a computer fails during the dive, the team should immediately end the dive.**
6. **Have buddy teams confirm maximum depths and bottom times based on oxygen content.**
   a. To address conditions, logistics, diver experience and/or other considerations, you may also recommend a maximum dive depth shallower than the maximum based on oxygen content.
   b. Instructor may also recommend a dive time shorter than required by the no stop limits.
7. Have buddy teams plan their turn pressure, ascent pressure and reserve pressure for the dive based on gas supply limits.
8. **If students have completed the knowledge development and the Enriched Air Diver Exam, and are making the dive indirectly supervised, review the dive plan.**
9. Review the dive sequence and performance objectives.
10. Review communication and other emergency protocols as required by local regulations.

C. Predive Procedures

1. Have divers prepare all standard and specialized equipment.
2. Analyze enriched air if not using the cylinder from Practical Application 1 and/or for additional practice.
3. Prepare contingency 5 metre/15 foot stop air/enriched air supply, if appropriate.
4. Put on all equipment.
5. Review check-out/in procedure with surface support staff (as required).

D. Enriched Air Dive 1

1. Predive safety check – buddies confirm EANx-compatible dive computers for their individual blends
   a. Buddies conduct a predive safety check.
   b. Watch for and correct errors as appropriate.
2. Entry
3. Buoyancy check and proper weighting
4. Dive within planned depth and times, and well within dive computer limits (no stop limits and oxygen exposure limits) at all times.
5. Ascent
   a. Divers ascend at a maximum rate not exceeding 18 metres/60 feet per minute or according to a dive computer.
   b. Divers complete a safety stop for minimum three minutes at 5 metres/15 feet.
6. Exit
   a. Divers establish positive buoyancy at the surface.
   b. Divers exit the water appropriately for the environment, with assistance as necessary.

E. Post-dive Procedures

1. Check in with surface support staff (as required).
2. Divers stow equipment and exchange cylinders as appropriate. Remember to leave contents stickers/tags on the used cylinders for blender reference.
3. **Check the computers/gauges of indirectly supervised students to confirm they stayed within the dive plan.**

F. Debriefing

1. Provide positive reinforcement and assess performance.
2. Have student divers critique themselves on their performance. Add your observations as appropriate.
3. Log the dive (instructor signs log book/approves digital log).

Predive Simulation Exercise 1

A. Set Up

1. Ask divers to demonstrate predive equipment setup.
2. Have divers perform a blend blend analysis and label confirmation for an enriched air dive with a cylinder filled with enriched air.

B. Set Computer

1. Provide depth, time and gas supply, and have divers plan an EANx-computer dive based on the analyzed content of the scuba cylinder filled with enriched air.
   a. This includes divers setting their individual computers properly, determining maximum depths based on the oxygen content and scrolling the computer.
   b. Divers should also provide maximum depths and time limits that account for logistics and environmental variables you provide.

Enriched Air Dive 2/Predive Simulation Exercise 2

Performance Objectives

By the end of this dive, with little or no help, students should be able to

1. **Execute a dive within the no stop limits, maximum depth and oxygen exposure limits established by the instructor during predive planning.**

   or

2. **Plan a dive within the no stop limits, maximum depth and oxygen exposure limits established by the instructor.**

I. Enriched Air Dive 2

A. Environment: Open Water

B. Maximum Depth: Not to exceed no decompression limits/oxygen exposure limits/maximum depth (1.4 ata/bar PO_2) for the blend. For student divers using air-only computers, maximum depth is 30 metres/100 feet (or shallower if a shallower limit applies) and their total dive time for the day may not exceed 160 minutes.

C. Maximum gas blend: The maximum allowable oxygen content for Enriched Air Dive 2 is 40%. The student-instructor ratio is 8:1.

D. General knowledge development and Practical Application 2 must precede Enriched Air Dive 2.

II. Suggested Sequence

Note to Instructor
Enriched Air Dive 2 allows student divers to apply the basic concepts they learned during knowledge development and began practicing under instructor guidance in Enriched Air Dive 1. Students should be able to perform all required setup and planning steps nearly independently, with the instructor simply confirming and interceding only as necessary to prevent an error that could compromise safety.

A. Briefing

1. Evaluate dive site conditions.
2. Identify facilities at the dive site.
3. Explain interesting and helpful facts about the dive site, including bottom topography, bottom composition, depth range and points of interest (use a dive site map if appropriate).
4. Describe entry and exit techniques for the dive site.
5. Assign logistical duties to staff and review emergency protocols.
6. **Following each diver's computer, the planned bottom time and depth must not exceed the no decompression limits, oxygen exposure limits or maximum depth (1.4 ata/bar PO_2) for the blend.**
   a. Certified students may dive with indirect supervision.
   b. **You must personally supervise setting the computers and confirm they're set for the correct blend.**
   c. You may allow divers to use air-only (not EANx compatible dive) computers for the training dives. (See #9.) **However, students must still meet performance requirements by demonstrating how to set and use an enriched air compatible computer for dive planning.**
7. It's preferred, though not absolutely necessary, that divers in each buddy team use approximately the same enriched air blend. This gives them approximately the same limits. Regardless, emphasize that the dive limits must be based on whichever diver nears a limit first – a diver with higher oxygen will have a shallower maximum depth and a diver with lower oxygen will have shorter no stop limits.
8. The combination of multilevel computer diving and enriched air diving means that gas consumption usually ends the dive instead of the no stop limits. Although students should already be in the habit of watching their SPG, it doesn't hurt to remind them to monitor their cylinder pressures, not just no stop time.
9. **Have buddy teams confirm maximum depths and bottom times based on oxygen content.**

   a. To address conditions, logistics, diver experience and/or other considerations, you may also recommend a maximum dive depth shallower than the maximum based on oxygen content.
   b. Instructor may also recommend a dive time shorter than required by the no stop limits.
10. Have buddy teams plan their turn pressure, ascent pressure and reserve pressure for the dive based on gas supply limits.
11. Review the dive sequence and performance objectives.
12. Review communication and other emergency protocols as required by local regulations.

B. Predive Procedures

1. Have divers prepare all standard and specialized equipment.
2. Analyze enriched air if not using the cylinder from Practical Application 2 and/or for additional practice.
3. **You and your staff watch students correctly set their enriched air dive computers, confirming the settings.** They may consult their computer manufacturer instructions as needed. This may be repeated until students demonstrate mastery and can do so with little or no assistance from the instructor or staff.
4. **Assess and confirm maximum depths based on oxygen content determined by students.** To address conditions, logistics, diver experience and/or other considerations, you may set other time and depth limits the students must plan their dives within.
5. **Assess the dive plan for appropriateness.**
6. Prepare contingency 5 metre/15 foot stop air/enriched air supply, if appropriate.
7. Put on all equipment.
8. Review check-out/in procedure with surface support staff (as required).

C. Enriched Air Dive 2

1. Predive safety check – buddies confirm EANx-compatible dive computers for their individual blends
   a. Buddies conduct a predive safety check.
   b. Watch for and correct errors as appropriate.
2. Entry
3. Buoyancy check and proper weighting
4. Dive within planned depth and times, and well within dive computer limits (no stop limits and oxygen exposure limits) at all times.
5. Ascent

   a. Divers ascend at a maximum rate not exceeding 18 metres/60 feet per minute or according to a dive computer.
   b. Divers complete a safety stop for minimum three minutes at 5 metres/15 feet.
6. Exit
   a. Divers establish positive buoyancy at the surface.
   b. Divers exit the water appropriately for the environment, with assistance as necessary.

D. Post-dive Procedures

1. Check in with surface support staff (as required).
2. Divers stow equipment and exchange cylinders as appropriate. Remember to leave contents stickers/tags on the used cylinders for blender reference.
3. **Check the computers/gauges of indirectly supervised students to confirm they stayed within the dive plan.**

E. Debriefing

1. Provide positive reinforcement and assess performance.
2. Have student divers critique themselves on their performance. Add your observations as appropriate.
3. Log the dive (instructor signs log book/approves digital log).

Predive Simulation Exercise 2

A. Set Up

1. Ask divers to demonstrate predive equipment setup.
2. Have divers perform a blend analysis and label confirmation for an enriched air dive with a cylinder filled with enriched air. They should do this with little assistance from the instructor or staff.

B. Set Computer

1. Provide depth, time, and gas supply, and have divers plan an EANx-computer dive based on the analyzed content of the scuba cylinder filled with enriched air.
   a. This includes divers setting their individual computers properly, determining maximum depths based on the oxygen content and scrolling the computer.
   b. Divers should also provide maximum depths and time limits that account for logistics and environmental variables you provide.
   c. Confirm that student divers accomplish these appropriately, but they should be able to complete the dive planning, setup and setting the computers with little or no assistance from the instructor or staff.

APPENDIX

Enriched Air Diver

Knowledge Review

Complete this knowledge review to hand in to your instructor for review. If there's something you don't understand, have your instructor explain it to you. If you still don't understand, have your instructor explain it to you.

1. What is the primary benefit of using enriched air nitrox? What advantages does this provide?

2. How does using EANx affect narcosis while diving?

3. What is the primary concern regarding enriched air nitrox and equipment? What are recommendations for using equipment, other than cylinders, with enriched air with up to 40% oxygen? (Consider local regulations in your response, if appropriate.)

4. What is the potential hazard of improper enriched air filling procedures?

5. List the markings that, according to broadly accepted dive community practices, you should have on a scuba cylinder used for enriched air nitrox. Are these markings used everywhere?

6. What are the oxygen partial pressures of the maximum and contingency depth limits for a given enriched air blend? What is the primary hazard of exceeding oxygen limits? How do you avoid the hazard?

7. What signs and symptoms may precede a CNS convulsion? Do these always precede a convulsion?

8. Describe how to use an EANx compatible dive computer to remain within accepted oxygen exposure limits. What should you do if you accidentally exceed the oxygen limits ofyour computer?

9. Who must personally verify the oxygen analysis of a cylinder of enriched air? What is the procedure for doing this?

10. What should you do if your enriched air computer fails during a dive?

11. What should you do if a diver convulses underwater?

12. What should you do for a diver suspected of having decompression illness after an enriched air dive?

Student Diver Statement:

I've reviewed the questions and answers, and any I answered incorrectly or incompletely I have had explained to me and/or reviewed the material, so that I now understand what I missed.

Student Name _____

Signature _____ Date _____

Enriched Air Diver

Knowledge Review Answer Key

Note to Instructor

To assess knowledge, review the Knowledge Review student divers completed in their PADI *Enriched Air Diver Manual*. (Preferably do this prior to participating in inwater skills practice.) Prescriptively review answers to questions student divers may have missed, or have answered incorrectly or incompletely. Ensure student divers understand what they have missed.

1. What is the primary benefit of using enriched air nitrox? What advantages does this provide?

   The primary benefit is that it exposes you to less nitrogen. This has the advantages of longer allowable bottom times, less need to push the air no stop limits, and less overall nitrogen load when making multiple dives.

2. How does using EANx affect narcosis while diving?

   Because oxygen and nitrogen have similar narcotic properties, using nitrox doesn't reduce your narcosis. You should plan the dive accounting for narcosis just as you would with air.

3. What is the primary concern regarding enriched air nitrox and equipment? What are recommendations for using equipment, other than cylinders, with enriched air with up to 40% oxygen? (Consider local regulations in your response, if appropriate.)

   The primary concern is the high oxygen content, which can cause a fire or explosion. With equipment other than cylinders, the general recommendation is that you can use regular scuba equipment for EANx blends with up to 40% oxygen. However, local laws or regulations may require special cleaning or fittings; follow any that apply. (Answers related to local regulations will vary.)

4. What is the potential hazard of improper enriched air filling procedures?

   The potential hazard of improper enriched air filling procedures is a fire or explosion. Another concern is the correct percentage of oxygen in the blend.

5. List the markings that, according to broadly accepted dive community practices, you should have on a scuba cylinder used for enriched air nitrox. Are these markings used everywhere?

   1. **A band around the cylinder shoulder reading NITROX, ENRICHED AIR or the like. Yellow cylinders should have a 10-centimetre/4-inch green band. Non-yellow cylinders should have a 15-centimetre/6-inch band. The top and bottom of this band should be a yellow, 2.5 centimetre/1 inch band, with the center 10 cm/4 in of green.**

2. **A dated visual inspection sticker**
3. **A sticker indicating whether the cylinder is rated for oxygen service**
4. **A contents tag or decal (sticker) that lists the EANx blend, the diver's name, the fill date and the maximum depth of the blend.**

The markings are not used everywhere because local laws or practice may require different or additional markings.

6. What are the oxygen partial pressures of the maximum and contingency depth limits for a given enriched air blend? What is the primary hazard of exceeding oxygen limits? How do you avoid the hazard?

   The PO_2 of maximum depth limit for a particular blend is 1.4 ata/bar. The contingency limit is 1.6 ata/bar. The primary hazard of exceeding oxygen limits is drowning due to having a convulsion underwater. You avoid the hazard by remaining well within oxygen limits and shallower than the maximum depth.

7. What signs and symptoms may precede a CNS convulsion? Do these always precede a convulsion?

   The signs and symptoms are visual disturbances (including tunnel vision), ear ringing, nausea, twitch or muscle spasms (especially in the face), irritability, restlessness, euphoria or anxiety, and dizziness. They do not always precede a convulsion.

8. Describe how to use an EANx compatible dive computer to remain within accepted oxygen exposure limits. What should you do if you accidentally exceed the oxygen limits of your computer?

   To use an EANx compatible dive computer to manage oxygen exposure and remain within accepted limits, set the maximum oxygen partial pressure for 1.4. Set the computer for the EANx blend you're using. Scroll the computer no stop limits (or use a table) to find the deepest allowable depth within the 1.4 maximum limit. Stay above that depth by watching your depth – use the computer warning a secondary alert only. Stay well within the maximum oxygen exposure limits of your computer at all times, and when possible, allow at least an hour between dives. See the manufacturer for specifics about these settings and how your computer displays oxygen exposure. If you accidentally exceed the oxygen limits of your computer, ascend immediately, make a safety stop and surface. Do not dive again for 24 hours, or as recommended by the computer manufacturer.

9. Who must personally verify the oxygen analysis of a cylinder of enriched air? What is the procedure for doing this?

   The diver who will dive the cylinder must personally verify the oxygen analysis of the enriched air in it. The procedure is to use an oxygen analyzer. Calibrate the analyzer with air at a controlled rate using a flow restrictor or meter. Analyze the enriched air using the same flow. Compare your analysis with the analysis listed by the blender on the contents sticker or tag. Complete the fill station's fill log.

10. What should you do if your enriched air computer fails during a dive?

    If your enriched air computer fails during a dive, immediately ascend, make a safety stop at 5 metres/15 feet and surface. Do not resume diving for 12 hours, or as recommended by the computer manufacturer.

11. What should you do if a diver convulses underwater?

    If a diver convulses underwater, your priority is to get the diver to the surface. Treat the diver as an unresponsive diver. Hold the mouthpiece in if it's in the mouth, but don't waste time trying to replace it if it's not. Take the victim to the surface, establish ample buoyancy, check for breathing and call for help. Provide rescue breaths if the victim isn't breathing. Get the victim to the boat or shore and check for a pulse and breathing. Provide CPR as necessary while waiting for EMS. Some experts recommend that if the victim's mouthpiece is in place, hold it there and wait for the convulsion to subside before surfacing the victim.

12. What should you do for a diver suspected of having decompression illness after an enriched air dive?

    Follow the procedures just as you would for an air dive: Provide emergency oxygen and first aid/CPR as necessary, and contact EMS, DAN and/or other appropriate emergency services for the area. When possible, tell emergency personnel the particulars about the diver's dive profile, including depth, time and whether the diver was using a dive computer or tables and what the blend was. If you run out of oxygen before reaching emergency care, you can provide a breathing patient with enriched air available.

PADI Specialty Training Record

Enriched Air Diver

Instructor Statement

I verify that this student has satisfactorily completed all knowledge development training sessions and the Final Exam as outlined in the PADI Enriched Air Diver Specialty Course Instructor Guide. I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name _____ PADI # _____

Instructor Signature _____ Completion Date _____

Practical Application 1

I verify that this student has satisfactorily completed the Practical Application Session as outlined in the PADI Enriched Air Diver Specialty Course Instructor Outline including:

- Oxygen analysis
- Verifying cylinder content data
- Signing fill log

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name _____ PADI # _____

Instructor Signature _____ Completion Date _____

Practical Application 2

I verify that this student has satisfactorily completed the Practical Application Session as outlined in the PADI Enriched Air Diver Specialty Course Instructor Guide including:

- Demonstrate the procedures for obtaining an enriched air fill and/or renting an enriched air cylinder from an enriched air fill station

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name _____ PADI # _____

Instructor Signature _____ Completion Date _____

Open Water Dives or Predive Simulation Exercise

Dive 1 or Predive Simulation Exercise 1

I verify that this student has satisfactorily completed Dive 1 as outlined in the PADI Enriched Air Diver Specialty Course Instructor Guide including:

- Execute a dive within the no stop limits, maximum depth and oxygen exposure limits established by the instructor during predive planning

OR this student has satisfactorily completed Predive Simulation Exercise 1.

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name _____ PADI # _____

Instructor Signature _____ Completion Date _____

Dive 2 or Predive Simulation Exercise 2

I verify that this student has satisfactorily completed Dive 2 as outlined in the PADI Enriched Air Diver Specialty Course Instructor Guide including:

- With little or no assistance, plan an enriched air dive within the no stop limits, maximum depth and oxygen limits established by the instructor.
- Execute the planned dive within the limits determined during the dive plan

OR this student has satisfactorily completed Predive Simulation Exercise 2.

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name _____ PADI # _____

Instructor Signature _____ Completion Date _____

I verify that I have completed all performance requirements for this PADI Enriched Air Diver specialty course. I am adequately prepared to dive in areas and under conditions similar to those in which I was trained. I agree to abide by PADI Standard Safe Diving Practices.

Student Name _____

Student Signature _____ Completion Date _____

PADI Adventure Dive Training Record

Adventure Dive: Enriched Air

Skills Overview

- Knowledge Review
- Practical Application – analyze enriched air cylinder
- Complete contents sticker/tag and fill log
- Dive Planning – calculate maximum depth and time, and set dive computer
- Briefing
- Gearing Up
- Predive Safety Check (BWRAF)
- Entry
- Descent
- Dive within planned depth/time limits
- Ascent – Safety Stop
- Debrief
- Log Dive – Complete Training Record

Instructor Statement

I verify that this student has satisfactorily completed the Knowledge Review and Performance Requirements (as described in PADI's Advanced Open Water Diver Instructor Guide) for this PADI Adventure Dive. I am a renewed, Teaching status PADI Instructor for the current year.

Instructor Name _____ PADI # _____

Instructor Signature _____ Completion Date _____

Instructor Contact Information (Please Print)

Instructor Mailing Address _____

City _____ State/Province _____

Country _____ Zip/Postal Code _____

Phone _____ Email _____

Student Diver Statement

I verify that I have completed all of the Performance Requirements for this Adventure Dive. I realize that there is more to learn about enriched air diving and that completion of a PADI Enriched Air Diver course is highly recommended. I also agree to abide by PADI Standard Safe Diving Practices.

Student Name _____

Student Signature _____ Completion Date _____

Enriched Air Fill Log

I understand that the cylinder _____ (tank serial number), obtained on _____ (date diver receives fill)

from _____ (dive operation) contains enriched air with _____ (oxygen analysis) percent oxygen

as determined by _____ (blender) and my personal analysis, which may be used to

a maximum depth of _____ (maximum depth @ 1.4 ata PO_2). The cylinder pressure is _____ (pressure in bar/mpa/psi).

_____ (diver's name, enriched air certification & number) _____ (diver's signature)

I understand that the cylinder _____ (tank serial number), obtained on _____ (date diver receives fill)

from contains enriched air with _____ (dive operation) (oxygen analysis) percent oxygen

as determined by _____ (blender) and my personal analysis, which may be used to

a maximum depth of _____ (maximum depth @ 1.4 ata PO_2). The cylinder pressure is _____ (pressure in bar/mpa/psi).

_____ (diver's name, enriched air certification & number) _____ (diver's signature)

I understand that the cylinder _____ (tank serial number), obtained on _____ (date diver receives fill)

from _____ (dive operation) contains enriched air with _____ (oxygen analysis) percent oxygen

as determined by _____ (blender) and my personal analysis, which may be used to

a maximum depth of _____ (maximum depth @ 1.4 ata PO_2). The cylinder pressure is _____ (pressure in bar/mpa/psi).

_____ (diver's name, enriched air certification & number) _____ (diver's signature)