

## **2.2.13 Gas Blender**

### **2.2.13.1 Course Outcomes**

GUE's Gas Blender course is designed to introduce students to the essential skills required for blending diving gases (nitrox and helium-based breathing gases). Training includes the theory of gas blending as well as practical skills required for blending breathing gas mixtures.

### **2.2.13.2 Prerequisites**

Applicants for a Gas Blender course must:

- a. Submit a completed Course Registration form, Medical History Form, and Liability Release Form to GUE HQ.
- b. Be physically and mentally fit.
- c. Be a nonsmoker.
- d. Be a minimum of 18 years of age. Documented parental or legal guardian consent must be submitted to GUE HQ when the participant is a minor.

### **2.2.13.3 Course Content**

The Gas Blender course is normally conducted over one day. It requires at least eight hours of academics and practical skills application.

### **2.2.13.4 Gas Blender Specific Training Standards**

- a. Student-to-instructor ratio is not to exceed 6:1
- b. Can be run with one trainee

### **2.2.13.5 Required Training Materials**

GUE training materials and recommended reading as determined by the course study packet received via online download after GUE course registration.

### **2.2.13.6 Academic Topics**

- a. Introduction: GUE organization and course overview (objectives, limits, expectations)
- b. Gas properties
- c. Gas physics
- d. GUE Standard Gases
- e. Pressure hazards
- f. Oxygen hazards and oxygen service
- g. Blending systems
- h. Practical blending
- i. Blending formulas and software
- j. Cascading
- k. Gas boosters
- l. Gas analysis and record keeping

### **2.2.13.7 Practical Skills Topics**

- a. Analyzing
- b. Field calculations
- c. Partial pressure nitrox and trimix blending

- d. Continuous flow/membrane blending (when available)
- e. Remixing
- f. Use of gas booster (when available)

#### 2.2.13.8 Required Skills and Drills

- a. Demonstrate proficiency with gas blending calculations, including remixes.
- b. Demonstrate safe and accurate gas blending practices (within +/- 1% O<sub>2</sub>, +/- 3% He).
- c. Demonstrate a safe and responsible demeanor throughout all training.
- d. Demonstrate accurate gas analysis, marking, and logging.

#### 2.2.13.9 Equipment Requirements

- a. Appropriate cylinders to blend gases into
- b. Partial pressure filling equipment for both oxygen and helium
- c. Compressor or banked HP air
- d. Continuous flow or membrane nitrox system (optional)
- e. Gas booster (optional)
- f. Nitrox and trimix analyzer
- g. GUE gas analysis tape
- h. Computer with GUE Gas Management Program software

Prior to the commencement of the class, students should consult with a GUE representative to verify equipment requirements and appropriateness of any selected equipment.

## Appendix A - GUE Base Equipment Configuration

The GUE base equipment configuration is comprised of:

- a. Tanks/cylinders: Students may use a single tank/cylinder with a single- or dual-outlet valve. Students may also use dual tanks/cylinders connected with a dual-outlet isolator manifold, which allows for the use of two first stages. Dual tanks/cylinders connected with a dual-outlet, non-isolator manifold can be used, but only in recreational (no decompression) diving, and are considered an alternative for a single tank/cylinder. Consult course-specific standards and your instructor to verify size requirements.
- b. Regulators:
  - i. Single tank: The first stage must supply a primary second stage via a 5 to 7 ft/1.5 to 2 m hose. A backup second stage must be necklaced and supplied via a short hose. The first stage must also supply an analog pressure gauge, inflation for the buoyancy compensator (BC), and (when applicable) inflation for a drysuit.
  - ii. Double tank: One first stage must supply a primary second stage via a 5 to 7 ft/1.5 to 2 m hose (7 ft/2 m hose is required for all cave classes), and inflation for the buoyancy compensator (BC). The other first stage must supply a necklaced backup second stage via a short hose, an analog pressure gauge, and (when applicable) inflation for a drysuit.
- c. Backplate system:

- i. Is held to the diver by one continuous piece of webbing. This webbing is adjustable and uses a buckle to secure the system at the waist.
- ii. A crotch strap is attached and looped through the waistband to prevent the system from riding up a diver's back.
- iii. The continuous webbing must support five D-rings;
  - 1. The first placed at the left hip
  - 2. The second placed in line with a diver's right collarbone
  - 3. The third placed in line with the diver's left collarbone
  - 4. The fourth and fifth are placed on the front and back of the crotch strap when divers plan to use advanced equipment such as DPVs.
- iv. The harness below the diver's arms has small restrictive bands to allow for the placement of backup lights. The webbing and system retains a minimalist approach.
- d. Buoyancy compensation device (BC):
  - i. A diver's BC is back-mounted and minimalist in nature.
  - ii. It is free of extraneous strings, tabs, or other material.
  - iii. There are no restrictive bands or restrictive elastic affixed to the buoyancy cell.
  - iv. Wing size and shape is appropriate to the cylinder size(s) employed for training.
- e. At least one time/depth measuring device
- f. Wrist-mounted compass
- g. Mask and fins: Mask is low-volume; fins are rigid, non-split.
- h. Backup mask
- i. At least one cutting device
- j. Wetnotes with pencils
- k. Surface marker buoy (SMB) with spool: when required, the SMB should be appropriate for environmental conditions and deployed using a spool with at least 100 ft/30 m of line.
- l. Exposure suit appropriate for the duration of exposure

### Additional Course-Specific Equipment

- a. Where required, back gas and stage cylinders are marked in accordance with the GUE General Training Standards, Policies, and Procedures document and configured in line with GUE protocols.
- b. When drysuit inflation systems are applicable, they should be sized appropriately for the environment; small tanks are placed on the backplate with larger supplies affixed to the diver's left back gas tank.
- c. Underwater lights:
  - i. When required, backup lights should be powered by alkaline batteries (not rechargeable) and stowed on the D-rings at a diver's chest.
  - ii. Backup lights should have a minimal amount of protrusions and a single attachment at the rear.
  - iii. The primary light should consist of a rechargeable battery pack and be fitted with a Goodman-style light handle.
  - iv. When burn time requirements create the need for an external battery pack, it should reside in a canister mounted on the diver's right hip.

- d. Guideline devices, as required during cave diving activities:
  - i. A primary reel is required for all cave diving and provides a minimalist form factor with a handle designed to support a Goodman or “hands free” handle operation. The primary reel must contain at least 150 ft/45 m of line.
  - ii. A safety spool is required for each diver while cave diving and must contain at least 150 ft/45 m of line.
  - iii. A jump or gap spool is required during Cave 2 diving and must contain at least 75 ft/23 m of line.