NACD STAGE DIVER EXAM

1. **What is the primary purpose for stage diving?**

   To safely extend range by providing additional breathing gas in redundant cylinders.

2. **Describe two methods of stage diving.**

   Mounting a stage cylinder(s) at the surface and either carrying it throughout the dive or dropping it after a predetermined amount of gas has been used (no more than 1/3 of supply). If carried throughout the dive, penetration gas is used from the cylinder up to 1/3 of that cylinder's total supply with the remainder reserved for exit and emergencies.

   Executing a series of setup dives to preset stage cylinders at predetermined points along a planned route of travel.

3. **You are diving double LP104 back-mounted tanks with a single AL80 stage tank. Your 104's have 3500 psig and your AL80 has 3200 psig. Answer each of the following questions:**

   a. **Total volume of gas**

      104's- 273 cf/AL 80's- 83 cf

   b. **Total volume of usable gas for penetration**

      104's- 86 cf/AL80's 26 cf

   c. **Proper gas management of all cylinders.**

      The Rule of Thirds should be strictly followed at all times.

4. **Name an appropriate drop point for a stage tank in a system with which you are familiar. Why is that area a good one for leaving your tank?**

   Each student will answer and explain his answer.

5. Name an inappropriate drop point for a stage tank in a system with which you are familiar. Why is that area inappropriate for leaving your tank?

Each student will answer and explain his answer.

6. You have decided to execute a swim dive in a high flow system to a point 3,300' from the entrance. The average depth for the dive is 80 fsw. Due to flow within the system and the length of dive, your average SAC rate is .6 cf/minute, penetration rate is 40 ft/minute and exit rate is 60 ft/minute. Describe, in detail, the volume of gas required for this dive, EANx % used (if used), deco gases used (if used), gas management for each tank/set of tanks (AL80s filled to 3300 psi will be used for stages and LP104s filled to 3600 psi for back gas), penetration and exit times, deco times, stage drop points and any other consideration necessary to safely execute this dive.

TIME

3300 ÷ 40 = 83 minutes of penetration time **Total dive time = 138 minutes**
3300 ÷ 60 = 55 minutes of exit time

VOLUME

80 ft. ÷ 34 + 1 = 3.35 ATA

ATA X SAC X TIME = Required Volume

3.35 X .6 X 83 = 167 cf of gas required for penetration
3.35 X .6 X 55 = 111 cf of gas required for exit

7.8 (baseline of 104s) X 12 (representing usable gas in 104s) = 93cf (1/3rds in 104s)
2.6 (baseline for 80s) X 11 (representing usable gas in 80s) = 28cf (1/3rds in 80s)

This dive will require 1/3 of back gas and three stage AL80 cylinders

CYLINDER PLACEMENT

Penetration distance for AL80s:

3.35 ATA X .6 SAC = 2.01 cf of gas breathed per minute at depth
28 cf (usable gas in each AL80) ÷ 2.01 cf = 13.93 minutes per AL80 (rounded to 13)
13 X 40 = 520 feet of penetration for each AL80

Since line markers are set at 100 foot intervals and extra gas is available, I would suggest to the student that dive planning becomes simpler if the AL80's are place at 500 foot intervals- 500' and 1000'.

Penetration distance for 104s:

93 cf (usable gas in 104s) ÷ 2.01 = 46 minutes of penetration time for 104s
46 X 40 = 1840 feet of penetration for 104s

With this plan, the diver has sufficient gas to reach a point 3340' in the cave. I would suggest to the student that he carry the initial stage tank with him and switch at each drop point for a fresh cylinder, leaving the third cylinder at the 1500' line marker. On exit, the diver may pick up all stage cylinders or may leave one or more for a subsequent cleanup dive.

DECOMPRESSIOM CONSIDERATIONS

Using the "T-formula" the best gas for an 80' dive is EAN41. Due to the length of the dive and exertion involved in the dive, I would recommend reducing that to EAN36.

Based on information contained in the NOAA Nitrox II table, a dive to 80' for 140 minutes will require decompression of 39 minutes @ 10'. This time may be substantially reduced with the use of EAN80- 100% oxygen and a multi-gas dive computer or decompression program (Pro Planner, Deco Planner, etc.).

Example: Pro Planner will require a 28 minute stop at 20' on EAN80 and Deco Plan will require a 1 minute stop at 30' on EAN36 and an 18 minute stop at 20'.

(Take this opportunity to emphasize to the student the need for some advanced gas training when planning and diving at this level.)

7. Describe all action you would take to set up the dive in Question 6.

A series of setup dives should be executed by the diver to verify and confirm the "paper dive"- no extended range dive should be performed blind. During the setup dives, the diver would verify SAC rate, penetration and exit travel rates and volume of gas expended from the stage cylinders between drop points and rate of gas. These setup dives also allow the diver to increase their awareness of the system for the portions of the cave dived.

Once information is verified, the diver will require at least one dive to drop stage cylinders along the pre-designated points. This will allow for a final verification of the information necessary to safely complete the dive.

8. What markings are appropriate for a stage tank?

VIP sticker, oxygen clean inspection sticker if used for nitrox, MOD markings and percentage of EANx contained in the cylinder.

9. Explain the difference between a "buddy bottle" and a stage tank.

A "buddy bottle" is carried by the diver throughout the dive with no gas being used from that cylinder and is intended to provide gas for emergency use only.

A stage tank may either be carried by the diver during the dive or dropped at a point in the cave along the intended route of exit with gas being used from the cylinder to extend the diver's range.

10. In what position should the tank valve knob be left when a stage tank is dropped? Why?

In the "off" position so that gas will not escape from the cylinder.

11. Describe the proper procedure for dropping a stage tank within a cave system.

Prior to the drop point, the diver should have the regulator stowed and the valve knob in the "off" position. As the drop point is approached, the bottom clip should be loosened and the top clip readily available to unclip. When the diver reaches the drop point he should, as quickly as safely possible, remove the stage cylinder and double wrap it to the permanent line. Once completed, the diver should move away from the drop point and hold his position while other team members drop their cylinders.

12. What methods should be used for distinguishing a stage tank from a deco cylinder:

a. In good visibility

The deco cylinder may be of a smaller size (AL40/LP72) with appropriate oxygen content labels or MOD 20 labels, painted green with a green knob and the regulator may have a green LP hose with the second stage having a green mouthpiece.

b. In zero or substantially reduced visibility?

The deco cylinder may be of smaller size (AL40/LP72), employ the use of a yoke system on the first stage and have a second stage mouthpiece "guard" in place.

13. At the maximum point of penetration of a dive, your backup regulator DIN to valve o-ring fails. You have an AL80 with 2200 psig as a stage tank (you used 1000 psig of gas from that tank on penetration). Describe your tank and gas management after you have successfully closed the appropriate valve.

Exhaust the gas from the stage cylinder, clip the cylinder to a permanent line to decrease drag if distance from the exit requires it and exit the system. As with any other gas failure, the affected diver should take the lead position with other team members maintaining a heightened level of awareness to effectively respond to any other emergencies which may arise.

14. What particular problems will arise as a result of the circumstance described in Question 13?

If configured in the "standard" manner, the SPG will be nonfunctioning.

Have each student detail other nonfunctioning system components based upon their equipment configuration.

15. Describe your configuration for diving two stage tanks, back-mounted doubles and a decompression cylinder. Explain the reasons for your configuration.

Each student should discuss this configuration with their instructor.

16. Is a stage tank an appropriate place for storage of necessary backup equipment- i.e.- mask, light, tables, etc.? Explain your answer.

No. The diver will not have access to that equipment if the stage cylinder is dropped either as part of the planned dive or in the event of an emergency.

17. List four hazards of stage diving.

Improper gas management
Increased exertion due to increased drag
Increased silting potential
Increased entanglement potential
Increased likelihood of cave damage
Increased task loading

18. What additional environmental factors should be considered prior to executing a stage dive?

Passage configuration and size
Guideline configuration
Silting potential
Fragility of system

19. State your motivations for stage diving.

Each student should state appropriate reasons for staging.

20. Do you believe that you are adequately trained to safely undertake this level of cave diving without further assistance or supervision from your diving instructor?

Yes or No

I have reviewed this exam with my instructor and have a thorough understanding of all questions.

Student's Signature _____ Date _____