Unit 1
Medical Gas Storage

GOAL

On completion of this unit, the student should have an understanding of gas storage methods, their usage, safety systems and handling techniques.

COMPETENCIES

1. Identify medical gas cylinders by size, color and USP labeling.
2. Inspect medical gas cylinders and note the meaning of all markings.
3. Locate and/or describe the safety systems on available cylinders.
4. Demonstrate proper transport techniques for available cylinders.
5. Calculate cylinder contents in liters and L/psig.
6. Calculate how long a cylinder will last given a specific cylinder size, pressure, gas and flow.
7. Identify components of a bulk liquid oxygen (LOX) system.
8. Describe the operating principle of an LOX system.

EQUIPMENT

1. various medical gas cylinders
2. cylinder hand trucks for E and K cylinders

EXERCISE A – CYLINDER MARKINGS

1. Label the following cylinder markings on Fig. 1.
   a. approved specifications
   b. service pressure
   c. serial number
   d. owner's stamp
   e. manufacturer's stamp
   f. first hydrostatic test date
   g. subsequent hydrostatic test dates
   h. last hydrostatic test date
   i. inspector's stamp

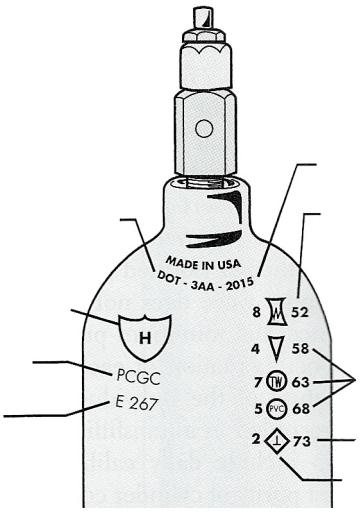


Fig. 1

EXERCISE B – CYLINDER EXAMINATION/DESCRIPTION

1. Complete the following table.

Gas	Cylinder Size	Serial Number	Color	Service Pressure	Filling Pressure	Last Hydrostatic Test Date	Volume (ft^3 & liters)

EXERCISE C – CYLINDER SAFETY SYSTEMS

1. Complete the following table.

Gas	Cylinder Size	Pin Index Hole Positions	Left or Right Hand Threads	F/F Disc (Yes/No)

EXERCISE D – TRANSPORTING CYLINDERS

1. Transport a K cylinder without a hand truck according to instructions given in class.
2. Transport a K cylinder with a hand truck according to instructions given in class.
3. Transport an E cylinder with a hand truck according to instructions given in class.

EXERCISE E – CALCULATING CYLINDER CONTENTS AND DURATION

Note: While all cylinders containing oxygen are filled to 2200 psig, a full H cylinder contains 244 ft^3 of oxygen and a full E cylinder contains 22 ft^3 of oxygen. The conversion of ft^3 to liters is ft^3 x 28.3. (Information provided in this unit applies only to cylinders that are completely filled with gas. Some cylinders, such as those containing pure carbon dioxide, contain a mixture of gas and liquid.)

1. Determine the factor (L/psig) for an **E cylinder** of oxygen.

$$\text{factor} = \frac{ft^3 \text{ in full cylinder x } L/ft^3}{\text{psig in cylinder}}$$

a. $\text{factor} = \dfrac{\_\_\_\_\ ft^3 \text{ x } \_\_\_\_\ L/ft^3}{\_\_\_\_\ \text{psig}}$

b. $\text{factor} = \dfrac{\_\_\_\_\ L}{\_\_\_\_\ \text{psig}}$

c. factor = _____ L/psig

2. Determine the factor (L/psig) for an **H cylinder** of oxygen.

$$\text{factor} = \frac{ft^3 \text{ in full cylinder x } L/ft^3}{\text{psig in cylinder}}$$

a. $\text{factor} = \dfrac{\_\_\_\_\ ft^3 \text{ x } \_\_\_\_\ L/ft^3}{\_\_\_\_\ \text{psig}}$

b. $\text{factor} = \dfrac{\_\_\_\_\ L}{\_\_\_\_\ \text{psig}}$

c. factor = _____ L/psig

3. Determine how long a full **E cylinder** of oxygen running at 3 L/min. will be safe to use.
   Note: Since cylinders containing less than 500 psig should not be used, subtract 500 psig from the manometer reading.

$$\text{minutes of use} = \frac{(\text{psig} - 500) \text{ x factor}}{\text{flow in L/min}}$$

a. $\text{minutes of use} = \dfrac{(\_\_\_\_\ \text{psig} - 500) \text{ x } \_\_\_\_\ L/\text{psig}}{L/\text{min}}$

b. minutes of use = $\frac{\text{\_\_\_\_ psig x \_\_\_\_ L/psig}}{\text{L/min}}$

c. minutes of use = $\frac{\text{\_\_\_\_ L}}{\text{\_\_\_\_ L/min}}$

d. minutes of use =

4. Determine how long a full **H cylinder** of oxygen running at 14 L/min. will be safe to use.
   Note: Since cylinders containing less than 500 psig should not be used, subtract 500 psig from the manometer reading.

   minutes of use = $\frac{\text{(psig - 500) x factor}}{\text{flow in L/min}}$

   a. minutes of use = $\frac{\text{(\_\_\_\_ psig - 500) x \_\_\_\_\_ L/psig}}{\text{L/min}}$

   b. minutes of use = $\frac{\text{(\_\_\_\_ psig - 500) x \_\_\_\_\_ L/psig}}{\text{L/min}}$

   c. minutes of use = $\frac{\text{\_\_\_\_ L}}{\text{\_\_\_\_ L/min}}$

   d. minutes of use =

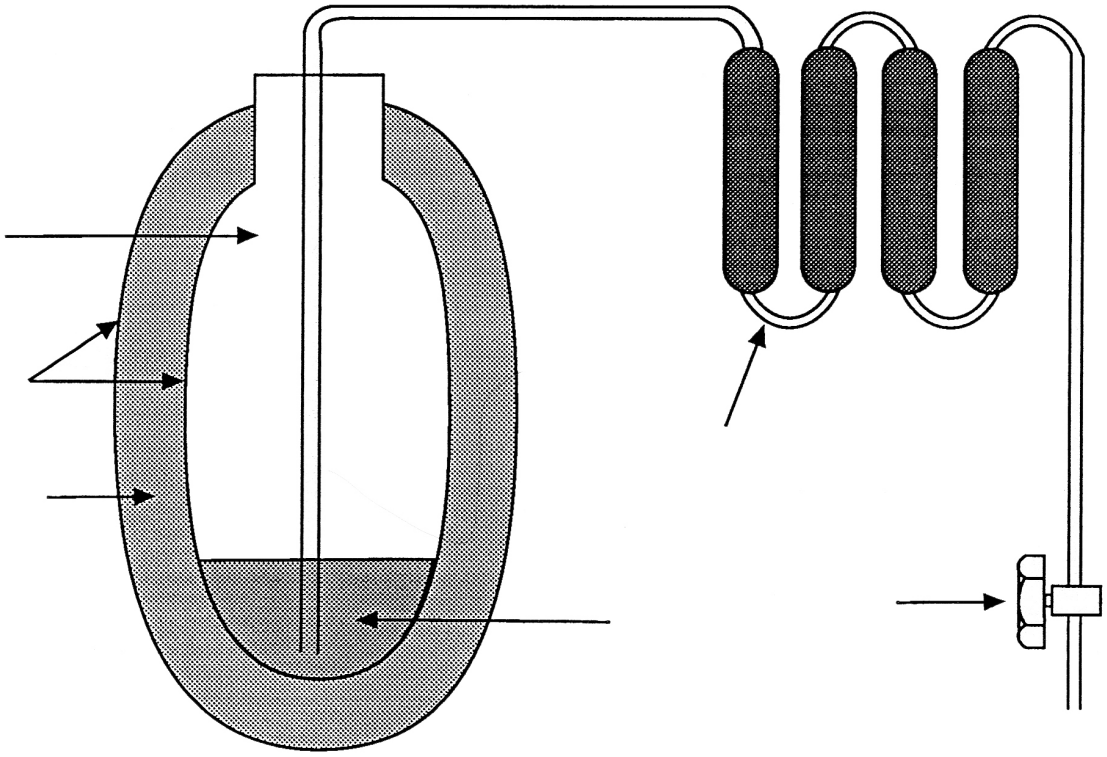
5. Determine how long the following oxygen cylinders will be safe to use.

Gas	Cylinder Size	Cylinder Pressure	Flow (L/min)	Minutes of Use
O_2	E	2200	3	
O_2	E	1000	4	
O_2	H	1900	12	
O_2	H	850	10	

EXERCISE F – LIQUID OXYGEN SYSTEMS

1. Label the following LOX system components on Fig. 2.
   a. liquid oxygen
   b. gaseous oxygen
   c. near vacuum
   d. insulation
   e. vaporizers
   f. reducing valve

Fig. 2



WORKSHEET

1. Complete the following table.

Gas	Cylinder Size	Color	Filling Pressure (psig)	Volume (ft^3)
O_2	E			
O_2	H			
CO_2	H			
CO_2/O_2	E			
CO_2/O_2	H			
He	E			
He/O_2	E			
He/O_2	H			
N_2O	E			
N_2O	H			

2. List and briefly describe four cylinder safety systems.

3. Describe the proper procedure in transporting gas cylinders by hand truck.

4. An E cylinder of oxygen containing 1950 psig is connected to a flowmeter running at 5 L/min. How long will this cylinder be safe to use?

5. An H cylinder of oxygen containing 1400 psig is connected to a flowmeter running at 8 L/min. How long will this cylinder be safe to use?

6. Describe the operating principle of an LOX system.