



MEDICAL GASES

Manufacture, Storage, Transport & Delivery

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DEPT OF PHARMACEUTICAL CHEMISTRY

Composition of the Air

- We breathe earth's atmosphere composed of:
 - Nitrogen (78%)
 - Oxygen (21%)
 - Carbon Dioxide (0.03%)
 - Argon and trace gases (0.93%)
 - Neon, Xenon, Krypton and Deon

How Oxygen is produced

Fractional Distillation

Physical Separation

Nitrogen Molecular sieve

Semi-Permeable membrane

Fractional Distillation

Large Manufacturing Facility

Fractional Distillation

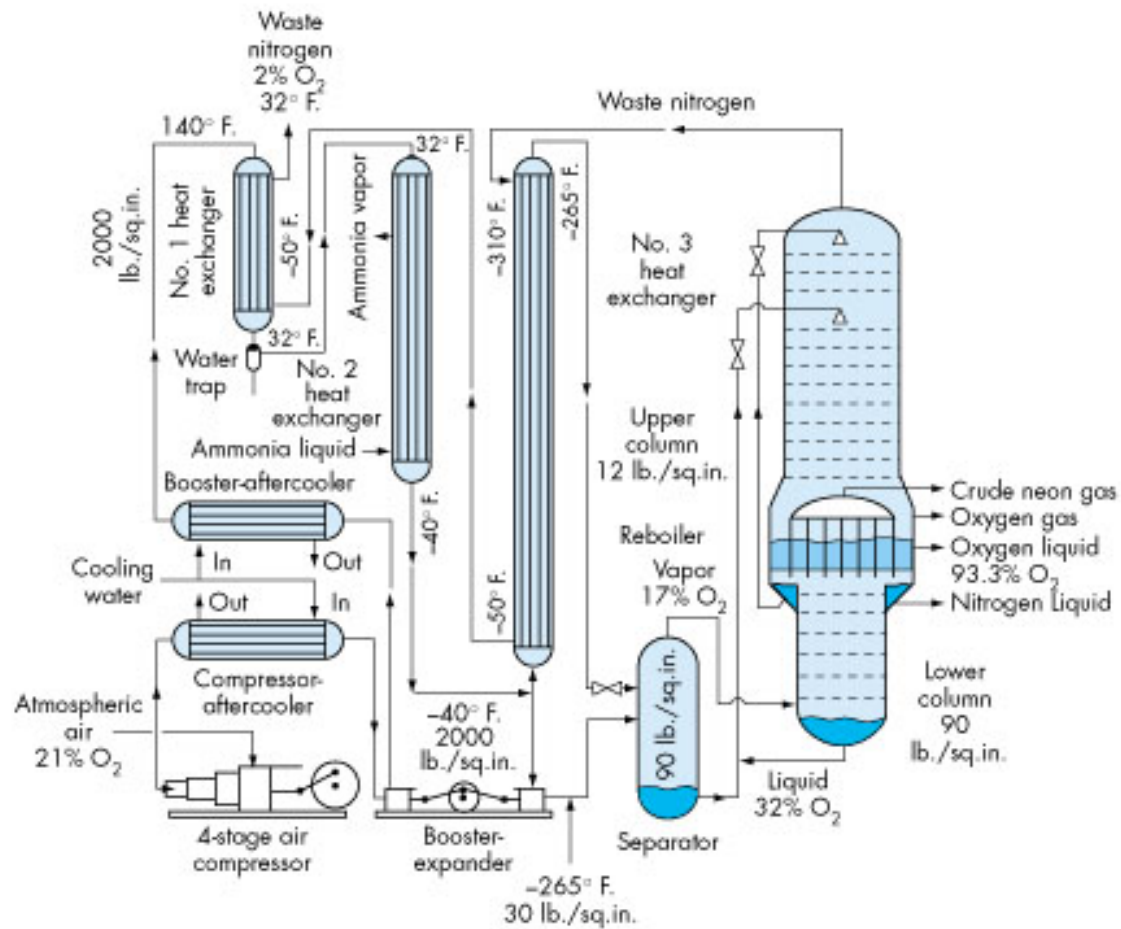


Figure 2-1 Fractional distillation apparatus for producing liquid oxygen. (Courtesy Nellcor Puritan Bennett, Pleasanton, Calif.)
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Fractional Distillation

- Atmospheric air is filtered of pollutants, carbon dioxide and water
- Air is compressed and cooled to a liquid
- Then it is slowly heated and the nitrogen boils off.
- Liquid oxygen remains

Physical Separation

Molecular Sieve

Semi-Permeable Plastic Membrane
(in the home)

Molecular Sieve

- Composed of inorganic sodium aluminum silicate pellets
- These pellets absorb the nitrogen and water vapor from the air
- Produces up to 90% mixture

Oxygen Concentrator

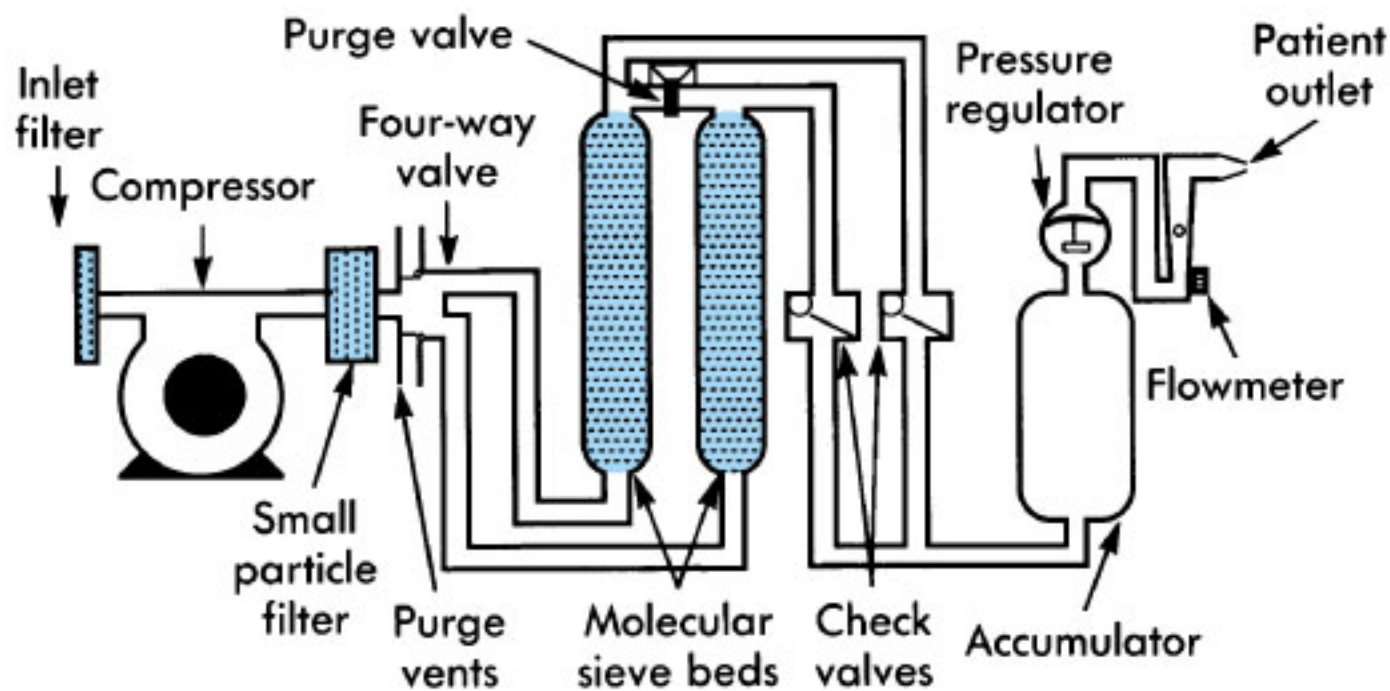


Figure 2-26 Oxygen concentrator that relies on a molecular sieve.
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Semipermeable Membrane

- Pulls air through membrane
- Oxygen passes through faster than nitrogen
- Can produce 40% mixture
- Good for long-term low flow oxygen

Oxygen concentrator – Semi-permeable membrane

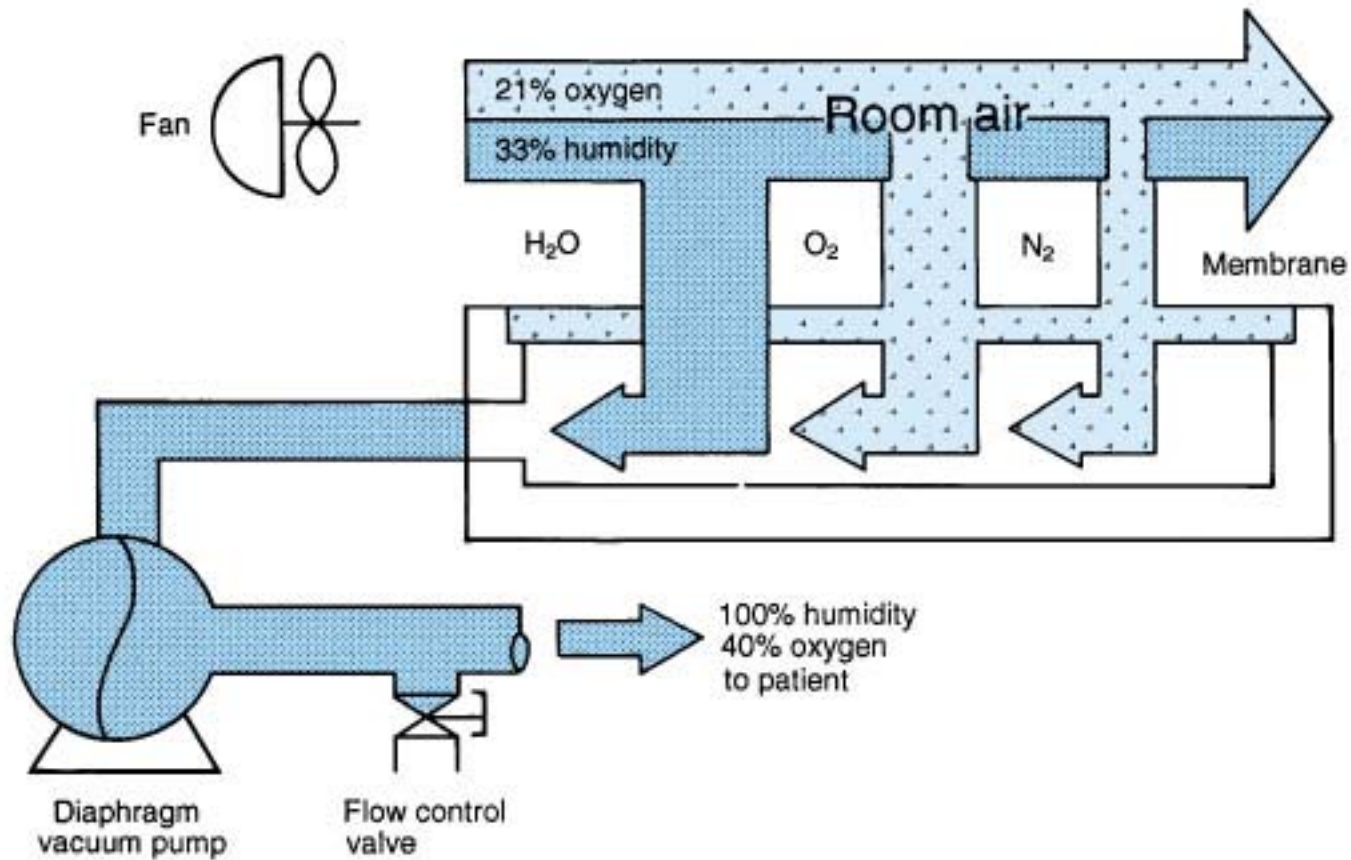


Figure 2-25 Oxygen concentrator that uses semipermeable membrane. (Courtesy Oxygen

Physical Separators

- Will produce concentrations for nasal cannula but only at low flows
- Used in oxygen concentrators IN THE HOME

Medical Gases

Oxygen, Carbon Dioxide, Helium,
Nitrous Oxide, Nitric Oxide, Nitrogen,
Carbon Monoxide

Properties of Common Gases

- Chemical symbol
- Molecular weight
- Color, odor, taste
- Physical state
 - Critical temperature, boiling point
- Combustion characteristics

Oxygen

- O_2
- Molecular Weight 32
- Colorless, odorless, tasteless
- Slightly heavier than air
 - Density of 1.29 g/L
- Nonflammable but supports combustion

Compressed Air

- Is the same mixture of nitrogen, oxygen, carbon dioxide and argon.
- Is piped in to all modern hospitals
- Used to power pneumatically powered equipment
- Some situations (patients are CO₂ retainers) when oxygen is contraindicated

Carbon Dioxide

- CO_2
- Colorless and Odorless
- Does not support combustion
 - Used in fire extinguishers
- More soluble in liquids than oxygen
 - Easier transporting in blood than oxygen
- Used to treat hiccups (singulation)

Helium

- He
- Odorless, tasteless, non-flammable
- Second lightest of gases
- Combined with oxygen (heliox) to reduce work of breathing with swollen upper airways

Nitrous Oxide

- N_2O
- Nonflammable but supports combustion
- Used as an anesthesia in OR (laughing gas)
- Always mixed with oxygen (Entonox) and other anesthesia agents

Nitric Oxide

- NO
- Is nonflammable but supports combustion
- Used experimentally in low concentrations (ppm) for pulmonary vasodilation
- Recently has had excellent results with premature babies

Nitrogen

- N_2
- Used as lab gas (liquid) for freezing tissue

Carbon Monoxide

- CO
- Used in Pulmonary Function Lab
- Very diffusible – used to test how easily gas will pass through the lung membranes

Cyclopropane

- Strictly an anesthesia gas

Ethylene Oxide

- Used to gas sterilize medical equipment
- Useful for equipment that can't handle high temperatures or immersion in water

Oxygen Storage

Tanks – Liquid

Tanks - Gas

Tank Sizes and Capacities

Large Cylinders

Small Cylinders

Oxygen Tank Sizes

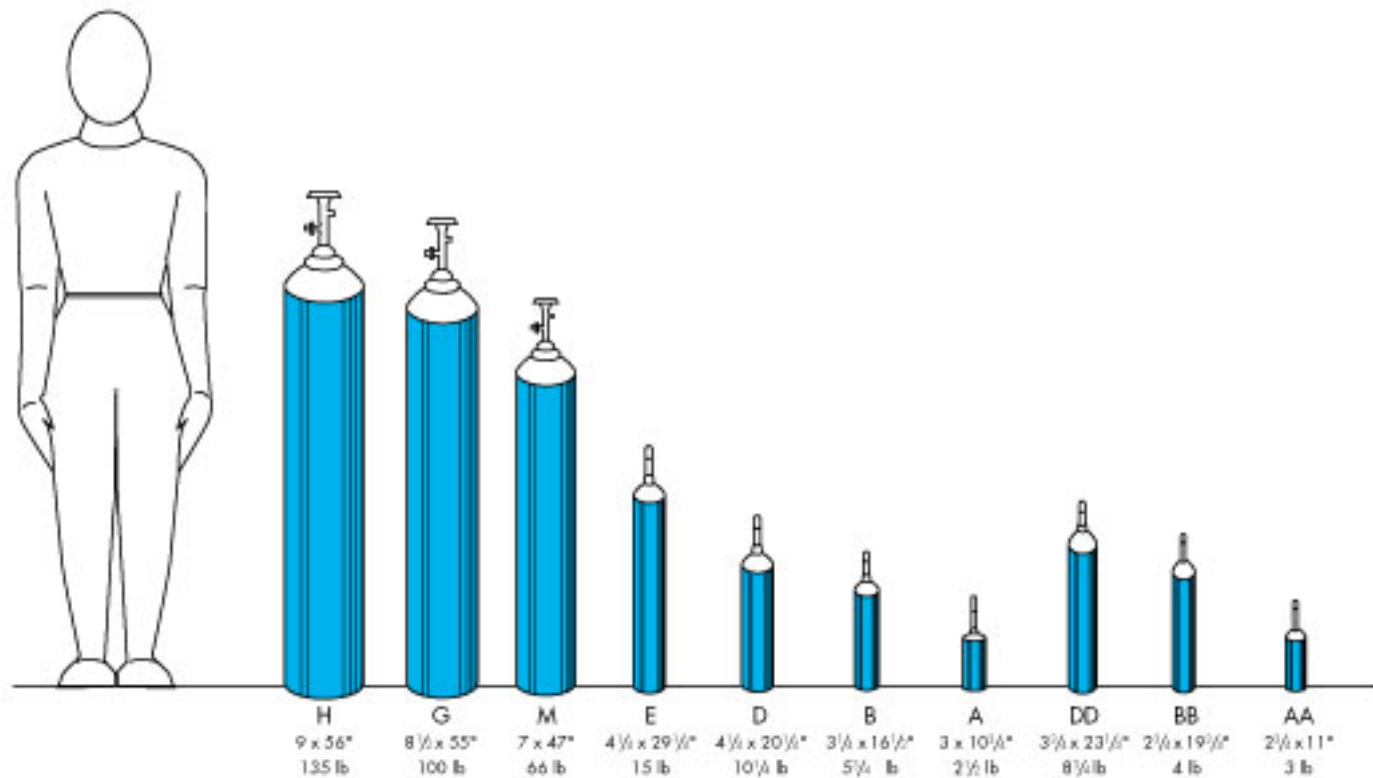


Figure 2-2 Various types of high-pressure cylinders used in medical gas therapy. (Modified from Barnes TA: Core textbook of respiratory care practice, ed 2, St Louis, 1994, Mosby.)
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H Cylinders

- 2200 psi
- A.S.S.S safety system
- Threaded connection
- Need to be safety chained and in a secured dolly for moving

E Cylinders

- Small and lightweight (15 pounds)
- PISS – Pin Index
- Yoke connection

Types and colors of cylinders

- Air - Yellow
- Oxygen - Green – Int'l (White)
- Helium - Brown
- CO₂ - Grey
- Nitrogen - Black
- Nitrous Oxide - Blue

Do NOT trust the color of the tank as sole indicator of it's contents

Labels – The only sure way

O₂
LIQUID OXYGEN

WARNING!

Accelerates combustion
Keep oil and grease away
Extremely cold liquid
May cause burns

Avoid contact with skin, eyes, and clothing
Avoid spills

H₂
HYDROGEN

FLAMMABLE

Keep away from heat,
flame, and sparks

O₂
OXYGEN

WARNING!

Accelerates combustion
Keep oil and grease away

Figure 2-5 Example of gas labels. (Modified from McPhearson S: Respiratory care equipment, ed 5. St Louis, 1995. Mosby.)

Other Oxygen Tank Markings

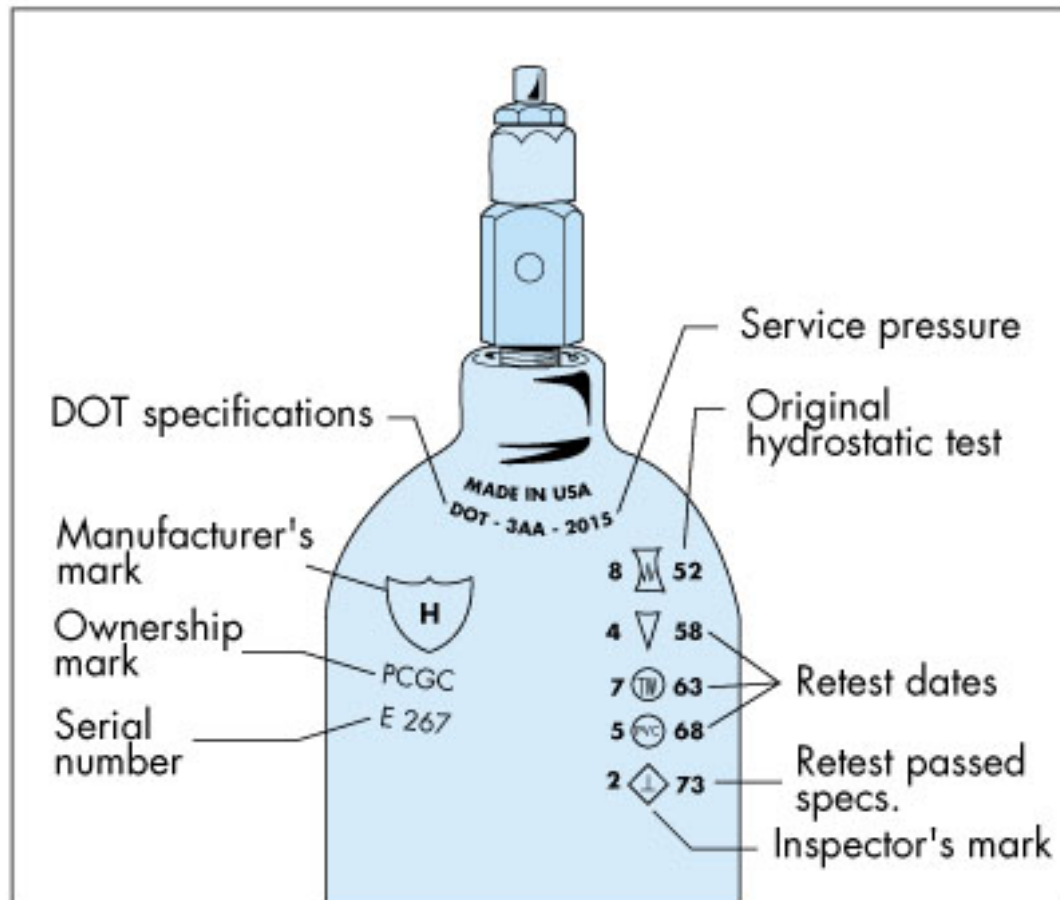


Figure 2-4 Standard markings for compressed gas cylinders. (Modified from Nellcor Puritan Bennett, Pleasanton, Calif.)
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Liquid vs Gas

- Insulated – Liquid
- Solid metal - Gas
- Large continuous demand – Liquid
- Small portable – Liquid or tank

- Tanks act differently if they contain gas or liquid
 - No accurate gauge on liquid tank content

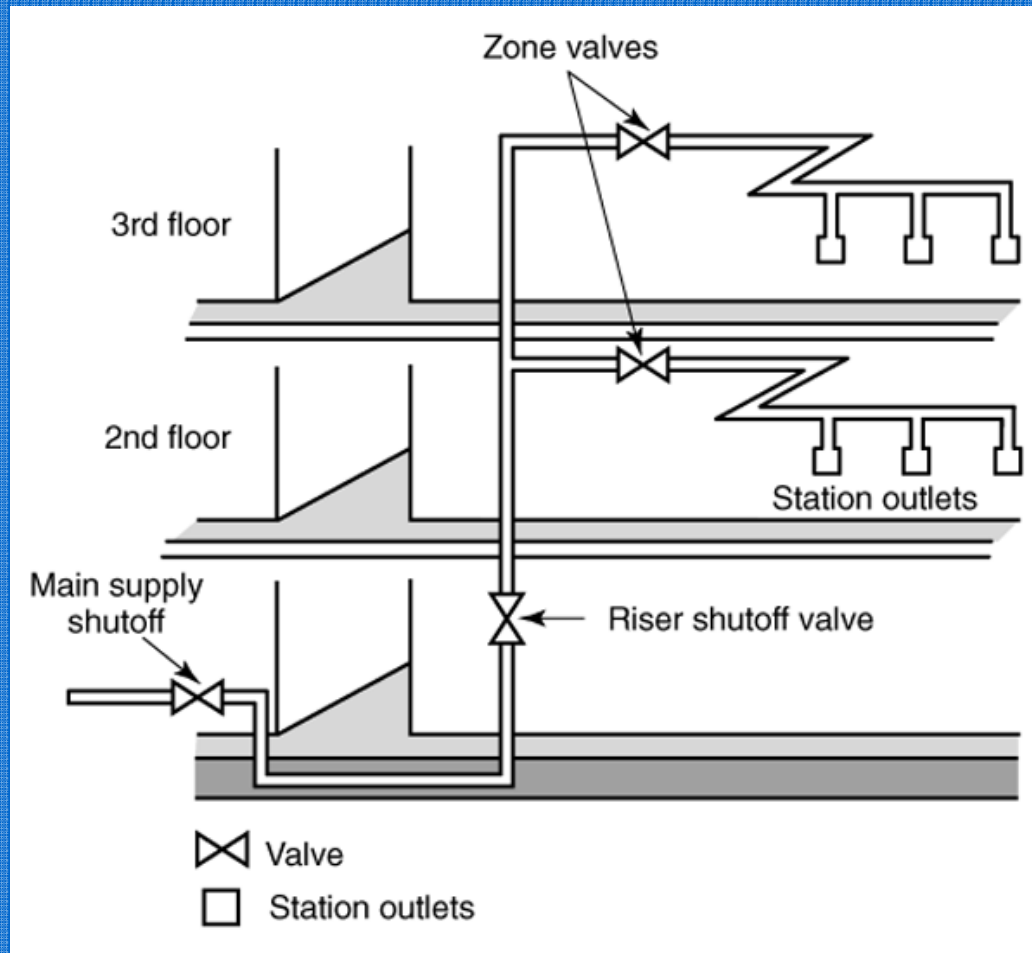
Flowmeters

- Thorpe Tube is most common
- Can use Bourdon Gauge

Other Safety Features

Zone Valves

Zone Valve System



Regulators

- They decrease internal tank pressure down to a working pressure (50psi)
- They read and display the internal tank pressure
- They meter out the precise flow for patient use.

THANK YOU