Pressure Regulators

- devices that reduce high-pressure gases from cylinders or bulk storage units to lower working pressures, usually ______ psi
- classified as single-stage or ______________
- within those classifications are preset and adjustable

Typical Pressure Regulator
Flowmeters

- devices that ___________ and indicate the ___________ delivered to patients
- three types
  - Thorpe tube flowmeters
  - Bourdon flowmeters
  - flow restrictors

Thorpe tube flowmeters

- Thorpe tubes are the most common flowmeters used.
- consist of a tapered flow tube with a scale marked in liters per minute (Lpm, L/min), a float and a needle valve
- delivered flow is read at the center of the float against the scale

Thorpe flow tube

- gas flowing through the tube pushes the float higher, allowing more gas to flow around it
- the height of the float depends on the force of gravity pulling down on it and the force of the flow pushing it up
- the float becomes stationary when the pressures above and below it are equal
Thorpe tube flowmeters

- classified as pressure-compensated and non-pressure-compensated
- in pressure-compensated flowmeters the needle valve is located distal to the flow tube allowing the pressure in the flow tube to be maintained at 50 psi
- in non-pressure-compensated flowmeters the needle valve is located proximal to the flow tube allowing the pressure in the flow tube to be equal to ambient pressure

The term distal means remote; farther from any point of reference.

In this usage, it means the needle valve is located after or downstream of the flow tube, therefore, back pressure has no effect on float position.
The term proximal means nearest to a point of reference, as to a center or median line or to the point of attachment or origin.

In this usage, it means the needle valve is located before or upstream of the flow tube, therefore, back pressure will effect float position.

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**Thorpe tube flowmeters**

<table>
<thead>
<tr>
<th>back pressure uncompensated</th>
<th>back pressure compensated</th>
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<tr>
<td><img src="image1" alt="Thorpe tube uncompensated" /></td>
<td><img src="image2" alt="Thorpe tube compensated" /></td>
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**Bourdon flowmeters**

- a Bourdon flowmeter is actually a __________ that controls the pressure gradient across an outlet with a fixed orifice
- as such, it does not directly measure flow - it measures pressure and indicates flow
- **HUH??**
Bourdon flowmeters

• remember back to our discussion on adjustable regulators...flow is determined by adjusting the pressure against a fixed orifice...

• if the size of the orifice is known, the amount of pressure needed to produce a specific flow can be calculated.

Bourdon flowmeters

• if that pressure can be calculated, then the gauge can be calibrated to indicate the flow being delivered.

• therefore, the device is measuring pressure, but indicating flow.

Bourdon flowmeters

• these flowmeters are accurate as long as the orifice remains clearly...

• if a restricting device is placed on the flowmeter, flows may read falsely because the device is calibrated for the orifice size and pressure without any resistance.
Bourdon flowmeters

- Bourdon flowmeters are used on cylinders and are a part of the regulator assembly
- these devices are particularly useful in situations when the cylinder may not remain in an __________________ position

Flow restrictors

- operate on a principle similar to that of the Bourdon flowmeters – the higher the driving pressure, the higher the resulting flow
- have the same problem with inaccuracy as Bourdon flowmeters when a restriction is place downstream to the orifice
- there are 2 types of restrictors
  - fixed orifice
  - adjustable, multiple-orifice