Q2 sol

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Quiz 2, W10 Solutions

Describe in a couple of sentences why air can be a preferable fluid over oil for fluid power applications.
- safe
- clean
- available
- can vent to atmosphere

Describe in a couple of sentences a drawback of using air as the fluid in a fluid power application.
- low force
- compressible → low precision

A pressure gauge on a receiver tank reads 125.5 psi at sea level. If this tank were brought to Huancayo Peru at an altitude of 10,013 ft with an air pressure of 10.2 psi, what would the tank pressure read? [130]

$P_{abs} = P_g + P_{atm}$
$= 125\,psi + 14.7\,psi$
$P_{abs} = 140.2\,psi$

$P_{abs} = P_g + P_{atm}$
$140.2\,psi = P_g + 10.2\,psi$
$P_g = 130\,psi$

Standard air is defined as air at what temperature? [68]

A gas has an initial temperature of 25 degrees Celsius. It is cooled until its temperature reduces by 10%. What is it new temperature in degrees Celsius? [-4.8]

$T_{abs} = 25°C + 273$
$= 298\,K$
take 90% of $298\,K = 268\,K$

$T_c = T_K - 273$
$= 268\,K - 273$
$T_c = -4.8°C$

Gas at 70 bars gage pressure and 37.8°C is contained in a 12,900-cm³ cylinder. A piston compresses the volume to 9680 cm³ while the gas is heated to 93.3°C. What is the final pressure in the cylinder in bars? [110]

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{70\,bars \times 12900\,cm^3}{(37.8°C + 273)} = \frac{P_2 \times 9680\,cm^3}{(93.3°C + 273)}$$

$P_2 = 110\,bars$

Two cylinders act right after one another. Each cylinder is metered, and some actions are slow, and there is a dwell between some actions. What is the minimum flow rate required (CFM) to operate this cylinders? [0.35]

Sequence of operations:
- Cyl. A extends with metering (takes 1.5 second)
- Dwell time for 2 seconds for part machining
- Cyl. B extend and retracts without metering (2 second)
- Dwell time for 10 seconds while an electric mixer is operated
- Cyl. A retracts quicky with no metering (0.5 seconds)
- Dwell time for 5 seconds while a part is placed before next cycle

Assuming the displacements of the cylinders are:
- Cyl. A $D_E = 65\,in^3$
- Cyl. A $D_R = 62\,in^3$
- Cyl. B $D_E = 44\,in^3$
- Cyl. B $D_R = 41\,in^3$

$T_{total} = (1.5 + 2 + 2 + 10 + 0.5 + 5)\,s$
$= 21\,sec$

$Q = D_T \times \frac{n}{t_{min}} \div 1728\,\frac{in^3}{ft^3}$

$D_{total} = (65 + 62 + 44 + 41)\ in^3$

$= 212\ in^3$

$Q = 0.35\ CFM$

A gas has an initial Temperature of 16 ºC and a pressure of 14.7 psia. If the temperature increases to 45 ºC what is the new pressure? [16.2]

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \qquad \frac{14.7\ psi}{16°C + 273} = \frac{P_2}{45°C + 273} \qquad P_2 = 16.2\ psi$$

$V_1 = V_2$

The compressor is to a pneumatic system what a [pump] is to a hydraulic system.

- ✓ Pump
- Cylinder
- Prime mover
- fluid

For low volume high pressure applications, the [displacement] compressor is the preferred class of compressor.

- ✓ Displacement
- Dynamic

A piston reciprocating compressor works by moving a piston up and down. With each stroke, the volume of the intake air is reduced in the piston chamber thus raising it's pressure before expelling the compressed air to the pneumatic system. [true]

A pneumatic system operating at 85 psi comprises a series of pneumatic actuators which consume 2.4 CFM when operating. What is the minimum required CFM from a compressor which produces 120 psi? [1.8]

$$Q_1 P_1 = Q_2 P_2$$

$$Q_1 (120\ psi + 14.7) = 2.4\ CFM\ (85\ psi + 14.7)$$

$$Q_1 = 1.8\ CFM$$

A pneumatic motor for a torque gun requires 8 CFM at 110 psi to operate. What minimum SCFM flow rate is required into the compressor to run this tool? [67.9]

$$Q_1 P_1 = Q_2 P_2$$

$$Q_1 (14.7\ psi) = 8\ CFM\ (110\ psi + 14.7)$$

$$Q = 67.9\ CFM$$

What size of receiver tank (gal) for a compressor is required if the pneumatic system is used to drive 5 linear cylinders which collectively consume 12 SCFM for 5 minutes? The compressor pressure switch operates between 90 and 110 psi. [330]

$$V = \frac{14.7\ t\ (Q_f - Q_c)}{P_{max} - P_{min}} = \frac{14.7 \times 5\ min\ (12\ SCFM - 0)}{110\ psi - 90\ psi}$$

$$V = 44\ ft^3 = 330\ gal$$

Matching

Device	Description
Breather	Filters ambient air before entering the compressor.
Strainer	Removes contaminants from the pressurized air.
Regulator	Sets the operating pressure of the pneumatic system.
Moisture Separator	Removes moisture from the compressed air. Works in conjunction with the strainer.
Aftercooler	A cold-water heat exchanger used to condense moisture from the air.
Air Heater	Used to prevent freezing of exhaust ports in cold environments
Silencer	Sintered brass usually placed on exhaust ports.
Shut off/on valve	Provides manual control of air flow.
PRV	Expels air when excess pressure is sensed.
Accumulator	Used to reduce pulsations and also can be used as an emergency backup supply.