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Continuing Education Course #247
Orifice and Venturi Pipe Flow Meters
For Liquid and Gas Flow

1. A differential pressure flow meter uses a constricted area of flow in the meter to decrease the velocity of the flowing fluid and increase its pressure.

- a. true
- b. false

2. In order to calculate the flow rate from the pressure reading across any of the differential pressure meters, the fluid density, cross-sectional area at the constriction, discharge coefficient, and ratio of constricted diameter to pipe diameter are all needed.

- a. true
- b. false

3. Friction losses and other non-ideal flow factors in differential flow meters are taken into account through the use of which of the following?

- a. a compressibility factor, Z
- b. a discharge coefficient, C
- c. an expansion factor, Y
- d. the reduced pressure, P_1/P_c

4. Calculation of a gas flow rate through a differential pressure flow meter requires input values for several additional parameters that are not needed to calculate liquid flow rate through such a meter.

- a. true
- b. false

5. The expansion factor, Y, is needed for gas flow through a differential pressure flow meter in order to account for the decrease in gas density due to decreased pressure in the constricted portion of the flow meter.

- a. true
- b. false

6. The expansion factor, Y, for gas flow through a flow nozzle meter is typically calculated with the same equation as that used to calculate Y for an orifice meter.

- a. true
- b. false

7. Calculate the density of air (in slugs/ft^3) at 15 psig and 80°F, using the Ideal Gas Law. Assume that atmospheric pressure is 14.7 psi.

- a. 0.00652
- b. 0.00288
- c. 0.00835
- d. 0.00462

8. Which of the following are the temperature and pressure conditions required in order to use the ideal gas law for accurately calculating the density of a gas?

- a. T << Tcritical and P << Pcritical
- b. T >> Tcritical and P >> Pcritical
- c. T >> Tcritical and P << Pcritical
- d. T << Tcritical and P >> Pcritical

9. Would it be acceptable to use the ideal gas law to calculate the density of methane gas at 10°C and 2 atm pressure?

- a. yes
- b. no

10. Calculate the expansion factor, Y, for flow of methane gas through an orifice meter with 6 inch pipe diameter, 2 inch orifice diameter, pressure drop of 2 psi and upstream pipe pressure of 40 psia. Use k = 1.3 for methane gas. The course spreadsheet may be used for this calculation.

- a. 0.986
- b. 0.978
- c. 0.970
- d. 0.965

11. Which of the following is the range for typical cone angle on the discharge side of a venturi meter?

- a. 2° to 4°
- b. 5° to 7°
- c. 10° to 15°
- d. 15° to 20°

12. The discharge coefficient for a venturi meter will typically be in which of the following ranges?

- a. 0.80 to 0.90
- b. 0.92 to 0.94
- c. 0.95 to 1.0
- d. 0.60 to 0.65

13. What is the flow rate of water at 50°F, through a venturi meter with 1" diameter throat in a 4" diameter pipe, when the pressure difference measured across the meter is 1.8 psig. The venturi coefficient for this meter is 0.97.

- a. 0.145 cfs
- b. 0.0867 cfs
- c. 0.0469 cfs
- d. 0.275 cfs

14. Which of the differential pressure flow meters causes the greatest frictional pressure loss for a given fluid, flow rate, pipe diameter and constricted diameter?

- a. venturi meter
- b. flow nozzle meter
- c. orifice meter
- d. They are all about the same.

15. Which of the ISO standard pressure tap configurations has the upstream and downstream taps placed at different distances from the orifice plate?

- a. none of them do
- b. flange taps
- c. corner taps
- d. D - D/2 taps

NOTE: The following question was revised on 22 June 2018

16. The ISO 5167 equation for the orifice coefficient can only be used to calculate C_o for an orifice meter with any of the three ISO standard pressure tap configurations (corner taps, flange taps, or D-D/2 taps).

- a. true
- b. false

17. The orifice coefficient for an orifice meter with ISO standard flange pressure taps can be calculated using the ISO 5167 equation if values for the pipe diameter, orifice diameter and pipe Reynolds number are known.

- a. true
- b. false

18. What is the value of M'_2 to be used in calculating the orifice coefficient, C_o, for flow through a 3 inch diameter orifice in an 8 inch diameter pipe if the orifice meter has flange taps?

- a. 0.41
- b. 0.40
- c. 0.39
- d. 0.38

19. The allowable range for Reynolds number in order to use the ISO 5167-2:2003 equation to calculate an orifice coefficient is the same for all three ISO standard types of pressure taps.

- a. true
- b. false

20. What is the Reynolds number for water at 40°F, flowing at 0.45 cfs through a 4 inch diameter pipe?

- a. 49,980
- b. 85,540
- c. 103,300
- d. 358,200

21. The iterative process described in this course for determining the orifice coefficient and flow rate through an orifice meter using the ISO 5167 equation for C_o, is started by assuming a value for which of the following parameters?

- a. volumetric flow rate through the meter
- b. average fluid velocity in the pipe
- c. average fluid velocity through the orifice
- d. Reynolds number in the pipe

22. The value of the orifice coefficient, C_o, for an orifice meter with β between 0.2 and 0.7 would typically be closest to which of the following values?

- a. 0.4
- b. 0.6
- c. 0.8
- d. 1.0

23. A flow nozzle meter is simpler and less expensive than a venturi meter, but not quite as simple as an orifice meter.

- a. true
- b. false

24. What is the flow rate of water at 50°F, through a flow nozzle meter with 2" nozzle diameter in a 6" diameter pipe, when the pressure difference measured across the meter is 2.2 psig. The nozzle coefficient for this meter is 0.96. You may use 1.94 slugs/ft^3 for the density of the water.

- a. 0.0393 cfs
- b. 0.393 cfs
- c. 0.0381 cfs
- d. 0.381 cfs

25. The frictional loss and discharge coefficients for flow nozzle meters are between typical values for venturi meters and orifice meters, but are closer to those for orifice meters.

- a. true
- b. false

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