TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B9

What happens to the pressure and velocity of water as it passes through a venturi?

A. Pressure remains constant, but the velocity increases as the diameter of the venturi decreases.

B. Pressure increases, but the velocity decreases as the diameter of the venturi decreases.

C. Pressure decreases, but the velocity remains constant as the diameter of the venturi increases.

D. Pressure increases, but the velocity decreases as the diameter of the venturi increases.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B159

A venturi flow device...

A. develops an output signal by measuring the differential pressure of the fluid as it passes through the device.

B. can measure the rate of flow of incompressible fluids, but not of compressible fluids.

C. develops an output signal by measuring the velocity of the fluid as it passes through the device.

D. has head loss greater than the head losses produced by an orifice.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B305 (P305)

A cooling water system is operating at steady-state conditions indicating 900 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1800 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 85 psid.

B. 120 psid.

C. 175 psid.

D. 240 psid.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B407 (P1606)

Refer to the drawing in which subcooled water is flowing through a convergent-divergent venturi (see figure below). The pipe diameters at P1 and P2 are equal.

Compared to the conditions at the inlet of the venturi (P1), the pressure at the outlet of the venturi (P2) has _____ and water velocity at the outlet of the venturi has _____. (Assume "real" conditions.)

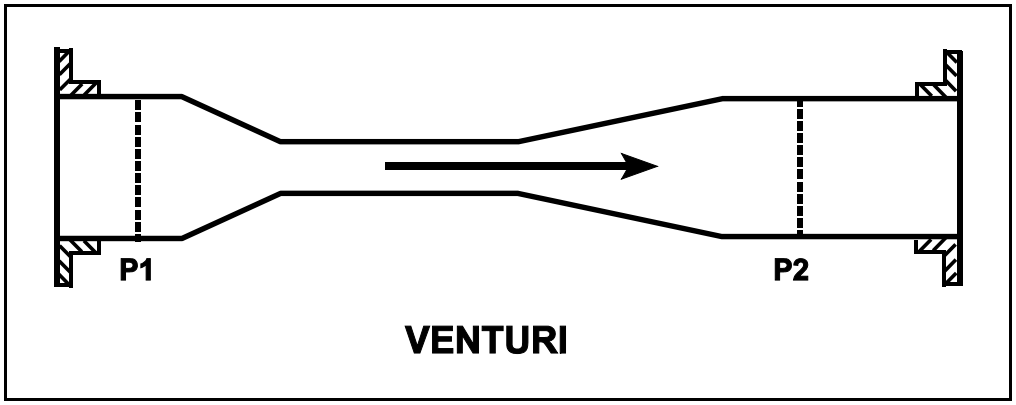
A. remained the same; remained the same

B. remained the same; decreased slightly

C. decreased slightly; remained the same

D. decreased slightly; decreased slightly

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B508

As water flows through a venturi flow element, the _____ pressure and the _____ velocity of the fluid occurs at the throat of the venturi.

A. highest; highest

B. lowest; lowest

C. lowest; highest

D. highest; lowest

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B706 (P707)

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be...

A. 85.7 psid.

B. 122.4 psid.

C. 171.4 psid.

D. 244.8 psid.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B807 (P807)

Refer to the drawing of a venturi flow element (see figure below) with direction of water flow indicated by the arrow.

Where should the high pressure tap of a differential pressure flow detector be connected?

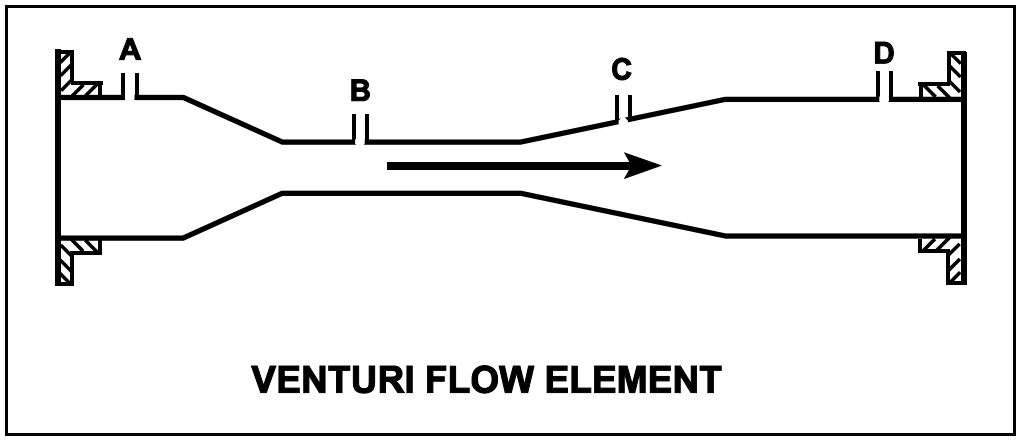
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B907 (P1308)

Refer to the drawing of a venturi flow element (see figure below) with direction of water flow indicated by the arrow.

A differential pressure detector measuring flow through the venturi will produce the highest flow indication if its high-pressure tap is connected at point _____ and its low-pressure tap is connected at point _____.

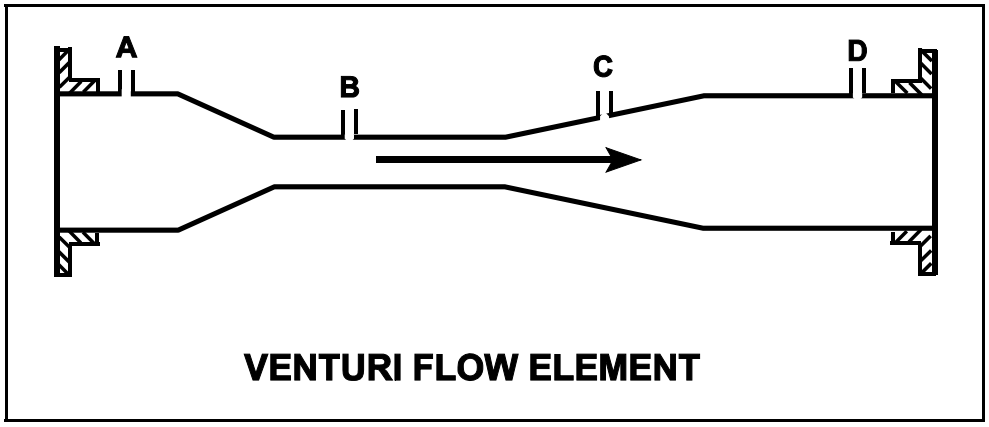
A. A; D

B. A; B

C. B; D

D. B; C

ANSWER: B.



VENTURI FLOW ELEMENT

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B2010 (P3306)

A cooling water system is operating at steady-state conditions. A calibrated system flow meter indicates 600 gpm with 50 psid across the flow transmitter venturi.

If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 63 psid.

B. 75 psid.

C. 97 psid.

D. 112 psid.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B2106 (P908)

Which one of the following flow measuring elements produces the largest unrecoverable head loss when used in an operating fluid system?

A. Venturi

B. Flow nozzle

C. Pipe elbow

D. Orifice

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B2206 (P2406)

A cooling water system is operating at a steady-state flow rate of 700 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 900 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 68 psid.

B. 77 psid.

C. 99 psid.

D. 127 psid.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B2306 (P2306)

A venturi is being used to measure flow rate in a cooling water system. As the water flows from the throat to the discharge of the venturi, water pressure will _____ and volumetric flow rate will _____. (Assume water is incompressible.)

A. increase; remain the same

B. increase; increase

C. decrease; remain the same

D. decrease; decrease

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B2606 (P2506)

A main steam flow rate measuring instrument uses a steam pressure input to produce main steam mass flow rate indication. Assuming volumetric steam flow rate does not change, a steam pressure decrease will cause indicated steam mass flow rate to...

A. decrease because the density of the steam has decreased.

B. increase because the specific volume of the steam has increased.

C. remain the same because steam pressure does not affect the mass flow rate of steam.

D. remain the same because the steam pressure input compensates for changes in steam pressure.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B2806 (P2808)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow detector was last calibrated, the following parameters were observed:

Upstream Pressure: 135 psig
Downstream Pressure: 120 psig

Actual Flow Rate: 100 gpm
Indicated Flow Rate: 100 gpm

Significant erosion of the orifice hole has occurred since the last calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 124 psig and 109 psig respectively.

What is the approximate currently indicated flow rate?

A. 44 gpm

B. 67 gpm

C. 100 gpm

D. 120 gpm

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B3206 (P3207)

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide cooling water flow rate indication. Water enters and leaves the venturi at 70°F, 120 psig and 20 ft/sec. Water velocity at the throat of the venturi is 45 ft/sec. Assume water is incompressible and the venturi experiences no unrecoverable head loss.

What is the approximate pressure of the water at the throat of the venturi?

A. 109 psig

B. 98 psig

C. 86 psig

D. 71 psig

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B3306 (P1106)

Refer to the drawing of a venturi flow element in an operating cooling water system (see figure below).

At what point does the lowest pressure exist?

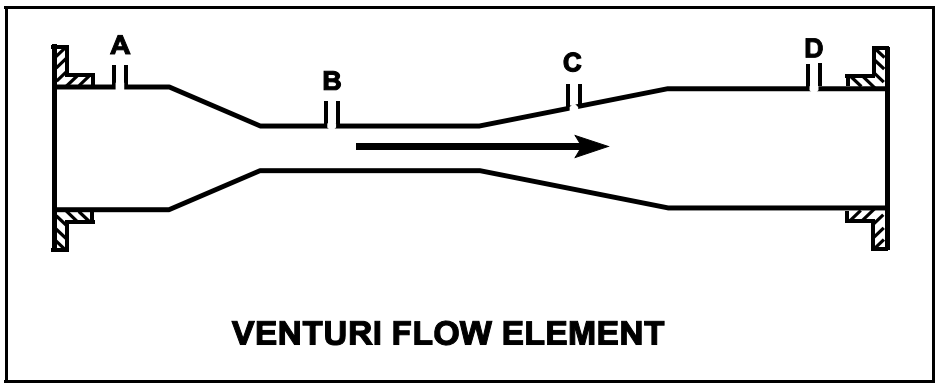
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B3706 (P3706)

The following is the current calibration data for an orifice plate that is being used for water flow rate measurement:

Upstream Pressure: 135 psig
Downstream Pressure: 120 psig
Flow Rate: 100 gpm

During a surveillance the following pressures are observed across the orifice plate:

Upstream Pressure: 124 psig
Downstream Pressure: 117 psig

What is the approximate water flow rate through the orifice plate?

A. 47 gpm

B. 57 gpm

C. 68 gpm

D. 78 gpm

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.01 [2.4/2.5]
QID: B4804 (P4804)

A cooling water system uses a horizontal venturi with a differential pressure flow detector to provide cooling water flow rate indication. Water enters and leaves the venturi at 70°F, 100 psig and 24 ft/sec. Water velocity at the throat of the venturi is 50 ft/sec. Assume water is incompressible and the venturi experiences no unrecoverable head loss.

What is the approximate pressure of the water at the throat of the venturi?

A. 98 psig

B. 94 psig

C. 87 psig

D. 74 psig

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B10

The change in pressure across a main steam line flow element is...

A. directly proportional to the volumetric flow rate.

B. inversely proportional to the volumetric flow rate.

C. directly proportional to the mass flow rate.

D. inversely proportional to the mass flow rate.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B906

If the density input to a density-compensated steam flow instrument rapidly fails high, the indicated flow will...

A. increase and stabilize at a new higher value.

B. increase temporarily, then return to its initial value.

C. decrease and stabilize at a new lower value.

D. decrease temporarily, then return to its initial value.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B1606 (P406)

The compensating input for a steam flow instrument is proportional to density. This compensating input converts volumetric flow rate to...

A. velocity flow rate.

B. specific work.

C. mass flow rate.

D. differential pressure.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B1806 (P6)

Density input is normally used in steam flow instruments to convert _____ into _____.

A. mass flow rate; volumetric flow rate

B. volumetric flow rate; mass flow rate

C. mass flow rate; differential pressure

D. differential pressure; volumetric flow rate

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B2506 (P2506)

A main steam flow rate measuring instrument uses a steam pressure input to produce main steam flow rate indication in lbm/hr. Assuming volumetric steam flow rate does not change, a steam pressure decrease will cause indicated steam flow rate to...

A. decrease because the density of the main steam has decreased.

B. increase because the specific volume of the main steam has increased.

C. remain the same because steam pressure does not affect the mass flow rate of main steam.

D. remain the same because the differential pressure across the flow rate measuring instrument has not changed.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.6]
QID: B2906 (P305)

If the steam pressure input to a density-compensated steam flow instrument fails high, the associated flow rate indication will...

A. decrease, because the density input has decreased.

B. increase, because the density input has decreased.

C. decrease, because the density input has increased.

D. increase, because the density input has increased.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B4604 (P4603)

A main steam flow rate differential pressure detector was properly calibrated to produce a main steam flow rate indication of 500,000 lbm/hr with the following initial input conditions:

Detector high pressure input: 1,000 psia
Detector low pressure input: 950 psia

The current detector input conditions are as follows:

Detector high pressure input: 985 psia
Detector low pressure input: 935 psia

Assume that the detector and associated circuitry do not have steam density compensation. Also assume that the main steam quality and volumetric flow rate do not change.

The current main steam flow rate indication is _____ 500,000 lbm/hr; and the current main steam flow rate is _____ 500,000 lbm/hr.

A. equal to; greater than

B. less than; greater than

C. equal to; less than

D. greater than; less than

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.02 [2.4/2.5]
QID: B4704 (P4703)

A nuclear power plant is initially operating with the following main steam parameter values:

Main steam pressure: 1,000 psia
Main steam flow rate: 500,000 lbm/hr

Main steam pressure decreases and stabilizes at 950 psia.

Assume 100% quality saturated steam and that main steam volumetric flow rate is the same before and after the pressure change.

Which one of the following is the approximate mass flow rate of main steam after the pressure change?

A. 528,000 lbm/hr

B. 500,000 lbm/hr

C. 472,000 lbm/hr

D. 444,000 lbm/hr

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B8

A leak develops in the high-pressure side of a flow detector. What effect does the leak have on the affected flow indication?

A. The measured ΔP will decrease, causing indicated flow to decrease.

B. The measured ΔP will decrease, causing indicated flow to increase.

C. The measured ΔP will increase, causing indicated flow to decrease.

D. The measured ΔP will increase, causing indicated flow to increase.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B211 (P207)

A differential pressure (D/P) cell is being used to measure flow rate in a cooling water system. Flow rate is indicating 75% of scale. If the D/P cell diaphragm ruptures, indicated flow rate will go to...

A. 0% because low D/P is sensed.

B. 0% because high D/P is sensed.

C. 100% (full-scale) because low D/P is sensed.

D. 100% (full-scale) because high D/P is sensed.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B307 (P307)

Which one of the following will cause indicated volumetric flow rate to be lower than actual volumetric flow rate using a differential pressure flow detector and a calibrated orifice?

A. System pressure decreases.

B. The orifice erodes over time.

C. Debris becomes lodged in the orifice.

D. A leak develops in the low pressure sensing line.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B707 (P706)

Flow rate is being measured using a differential pressure flow detector and a calibrated orifice. If actual flow rate remains constant, which one of the following will cause indicated flow rate to be higher than actual flow rate?

A. The flow detector equalizing valve is inadvertently opened.

B. A leak develops in the high pressure sensing line.

C. Debris becomes lodged in the orifice.

D. The orifice erodes over time.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B1006

Which one of the following will cause indicated liquid flow rate to be higher than actual flow rate when using a differential pressure (D/P) flow detector with a calibrated orifice?

A. System pressure decreases.

B. The detector diaphragm ruptures.

C. Debris becomes lodged in the orifice.

D. The pressure surrounding the D/P detector housing decreases.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B1506 (P1205)

If the orifice in a differential pressure (D/P) flow sensor erodes such that the orifice opening becomes larger, indicated flow rate will _____ due to a _____ D/P across the orifice. (Assume actual flow rate remains the same.)

A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B1607

A flow instrument for an operating cooling water system was calibrated with the differential pressure flow detector equalizing valve slightly open. If the valve is subsequently closed, flow indication will...

A. decrease and stabilize above 0 gpm.

B. decrease and stabilize at 0 gpm.

C. increase and stabilize at the actual flow rate.

D. increase and stabilize above the actual flow rate.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.04 [2.9/3.1]
QID: B2310 (P2305)

An orifice is being used in an operating cooling water system to measure flow rate. Which one of the following will cause the differential pressure sensed across the orifice to decrease?

A. System pressure decreases.

B. System flow rate decreases.

C. Debris becomes lodged in the orifice.

D. A leak develops in the low pressure sensing line.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B607 (P8)

How will flow rate indication be affected if the equalizing valve for the associated differential pressure detector is fully opened?

A. Increase temporarily, then return to initial value

B. Decrease temporarily, then return to initial value

C. Increase to the maximum value

D. Decrease to the minimum value

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B608 (P607)

The flow rate of a fluid passing through a venturi can be determined by measuring the:

A. differential pressure of the fluid as it passes through the venturi.

B. linear displacement of a metering plug installed in the throat of the venturi.

C. change in the velocity of the fluid as it passes through the venturi.

D. rotation of a paddle wheel type device installed in the throat of the venturi.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B708 (P705)

A steam flow measuring instrument uses density compensation and square root compensation to convert the differential pressure across the flow element to flow rate in lbm/hr.

The purpose of square root compensation in this flow measuring instrument is to convert _____ to _____.

A. volumetric flow rate; mass flow rate

B. volumetric flow rate; differential pressure

C. differential pressure; mass flow rate

D. differential pressure; volumetric flow rate

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B908

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following locations is the lowest pressure sensed? (Assume a constant pipe diameter and zero head loss in this section of pipe.)

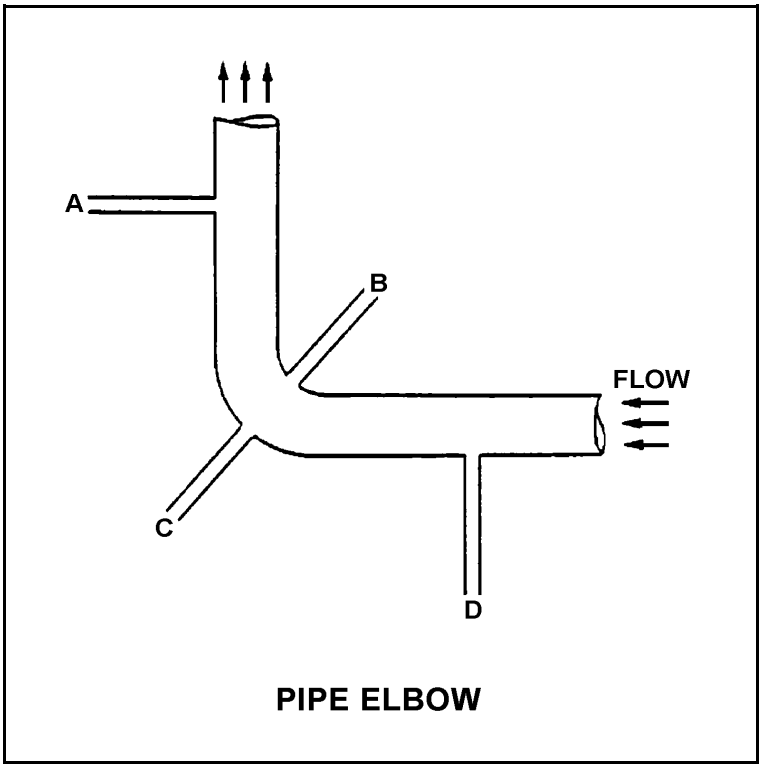
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1007 (P2807)

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following locations is the highest pressure sensed? (Assume a constant pipe diameter and zero head loss in this section of pipe.)

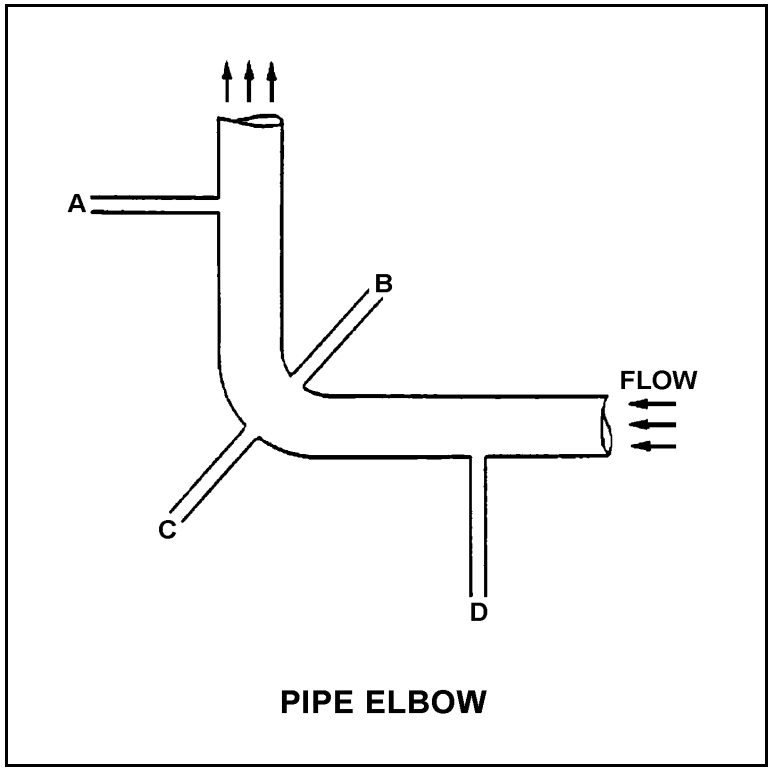
A. Point A

B. Point B

C. Point C

D. Point D

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1108

If the flow rate through a differential pressure (D/P) detector flow nozzle doubles, by what factor would the D/P increase?

A. $\sqrt{2}$

B. 2

C. 4

D. 8

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1307

Flow rate in a cooling water system, measured using a differential pressure (D/P) detector, indicates 100 gpm at a D/P of 30 psid. If indicated flow rate increases to 150 gpm, what D/P is being sensed by the detector?

A. 36.7 psid

B. 37.5 psid

C. 66.7 psid

D. 67.5 psid

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1408 (P1906)

Refer to the drawing of a pipe elbow used for flow measurement (see figure below).

At which one of the following pairs of connection points will the greatest differential pressure be sensed?

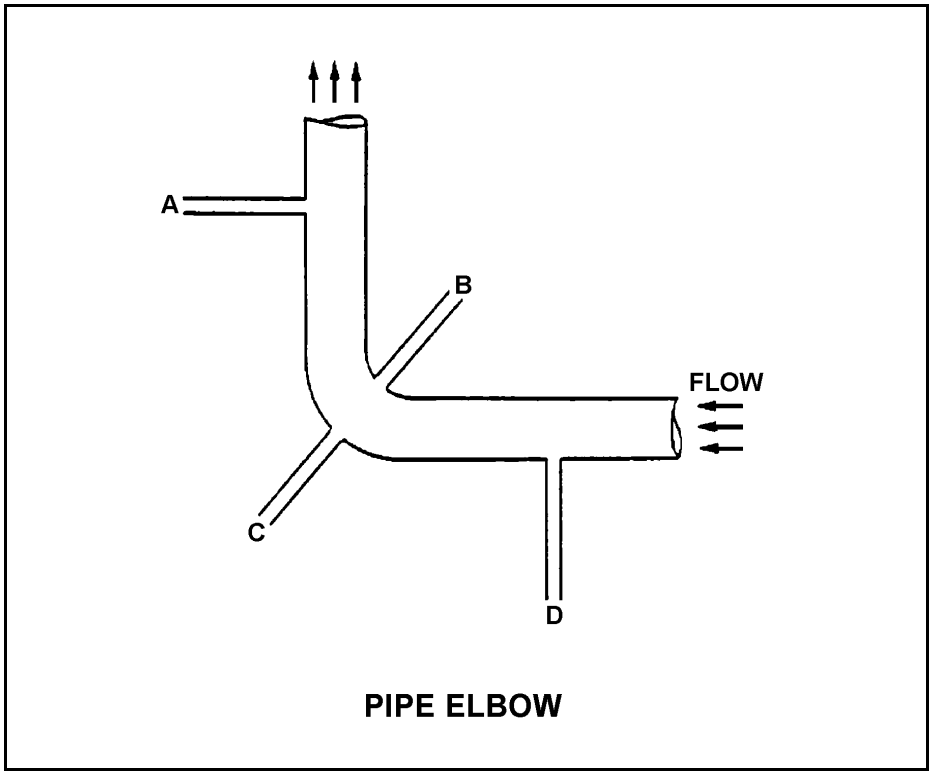
A. Points A and B

B. Points B and C

C. Points C and D

D. Points D and A

ANSWER: B.



PIPE ELBOW

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1608 (P1608)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows differential pressure flow detectors are connected to taps A, B, C, and D as follows:

DETECTOR	TAPS
X	A and D
Y	B and D
Z	C and D

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap D ruptures?

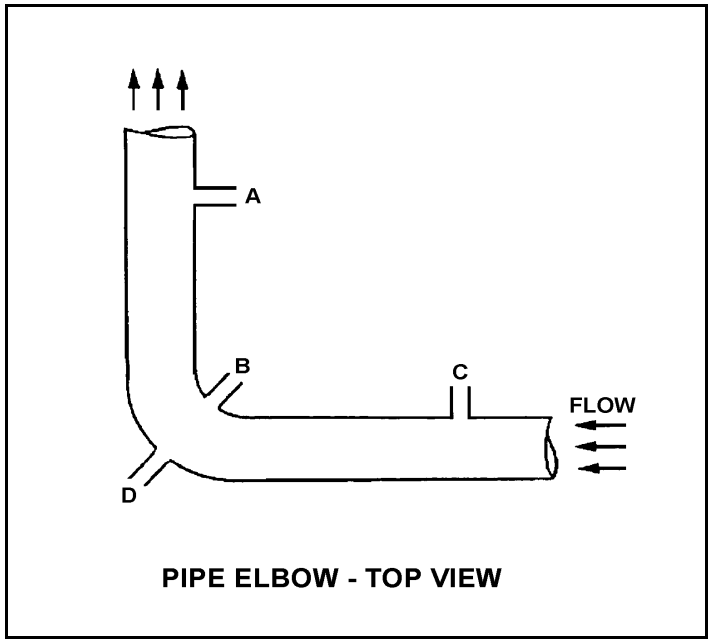
A. All detectors will fail low.

B. All detectors will fail high.

C. Two detectors will fail low and one will fail high.

D. Two detectors will fail high and one will fail low.

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1773 (P1873)

Subcooled water is flowing through each of the following devices. Which one of the devices will produce an outlet pressure that is greater than the inlet pressure?

A. Convergent nozzle

B. Divergent nozzle

C. Orifice

D. Flow restrictor

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1905 (P907)

A differential (D/P) detector is being used to measure main steam flow rate. At a steam flow rate of 5×10^6 lbm/hr measured D/P is 40 psid.

If steam flow changes such that current D/P is 30 psid, what is the current steam flow rate?

A. 2.11×10^6 lbm/hr

B. 3.54×10^6 lbm/hr

C. 3.75×10^6 lbm/hr

D. 4.33×10^6 lbm/hr

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B1907 (P1007)

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line A develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

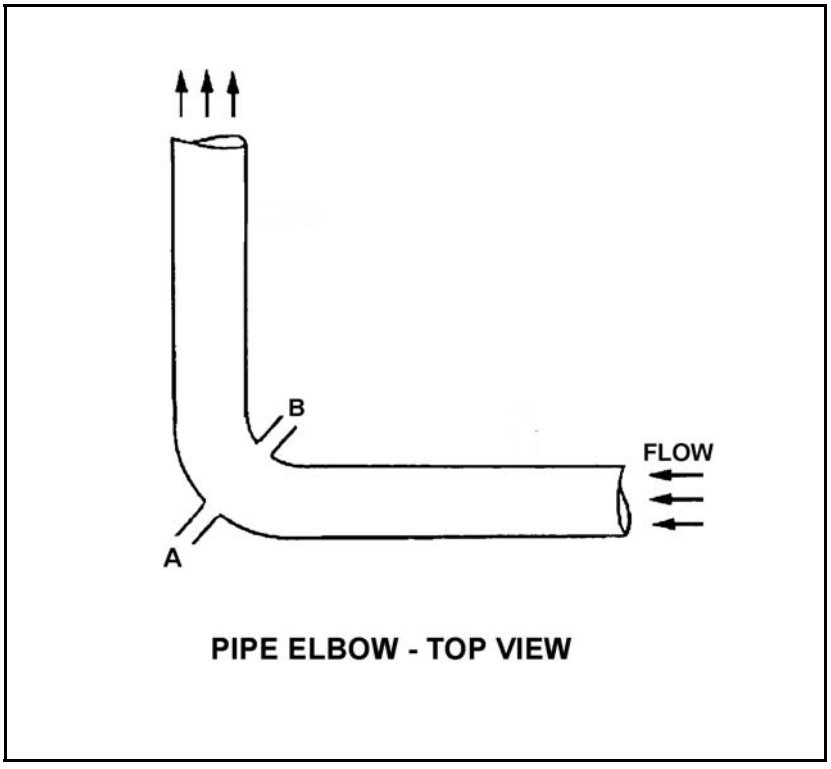
A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B2112

A cooling water system is operating at a steady-state flow rate of 500 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 1000 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 85 psid.

B. 120 psid.

C. 240 psid.

D. 480 psid.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B2209 (P2107)

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below).

A differential pressure (D/P) flow detector is connected to instrument lines A and B.

If instrument line B develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

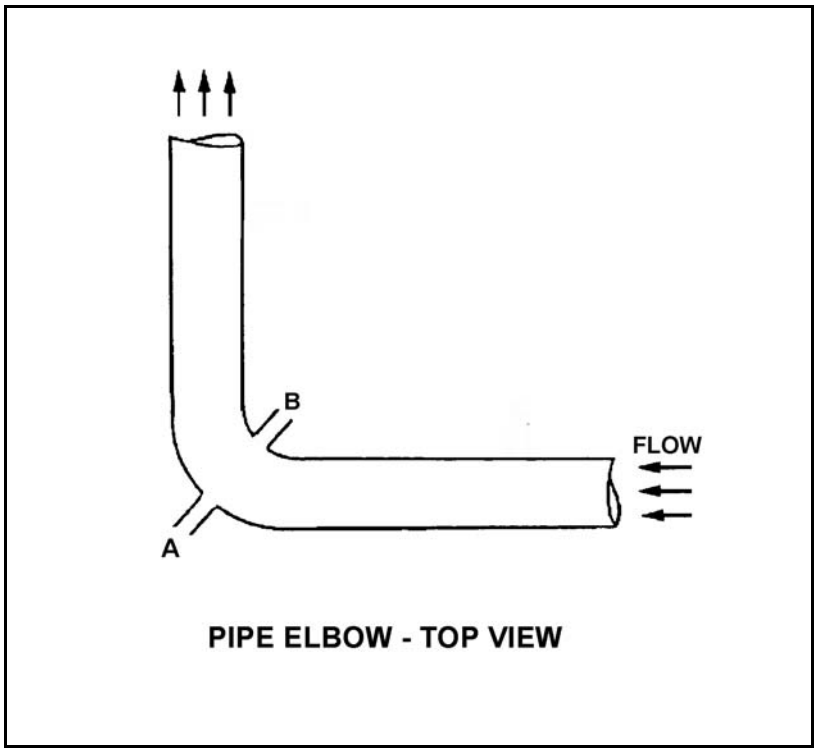
A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B2307 (P2307)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below). Three separate bellows differential pressure flow detectors are connected to taps A, B, C, and D as follows:

DETECTOR	TAPS
X	A and D
Y	B and D
Z	C and D

Assume that water is incompressible and there is no head loss in this section of pipe. How will the detectors be affected if system flow rate remains the same while system pressure increases from 1000 psig to 1200 psig?

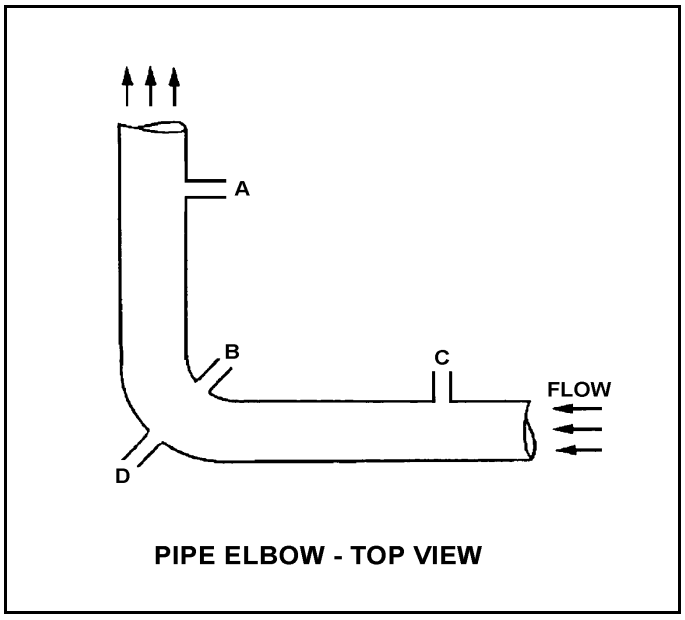
A. All detectors will indicate higher flow.

B. Only two detectors will indicate higher flow.

C. Only one detector will indicate higher flow.

D. Detector indication will not change.

ANSWER: D.



PIPE ELBOW - TOP VIEW

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B2508 (P2507)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow detector was last calibrated, the following parameters were observed:

Upstream Pressure:	125 psig	Actual Flow Rate:	100 gpm
Downstream Pressure:	116 psig	Indicated Flow Rate:	100 gpm

Significant erosion of the orifice has occurred since the calibration such that actual flow rate through the orifice has increased to 120 gpm while the upstream and downstream pressures have changed to 110 psig and 106 psig respectively.

What is the approximate flow rate that is currently indicated?

A. 44 gpm

B. 67 gpm

C. 81 gpm

D. 120 gpm

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B2607

A cooling water system is operating at a steady-state flow rate of 400 gpm with 60 psid across the flow transmitter venturi. If cooling water flow rate is increased to 600 gpm, differential pressure across the flow transmitter venturi will be approximately...

A. 73 psid.

B. 90 psid.

C. 114 psid.

D. 135 psid.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B2807

Refer to the drawing of a pipe elbow used for flow measurement in a cooling water system (see figure below). A differential pressure (D/P) flow detector is properly connected to instrument lines A and C. Connections B and D are capped.

If instrument line A develops a leak, indicated flow rate will _____ due to a _____ measured D/P.

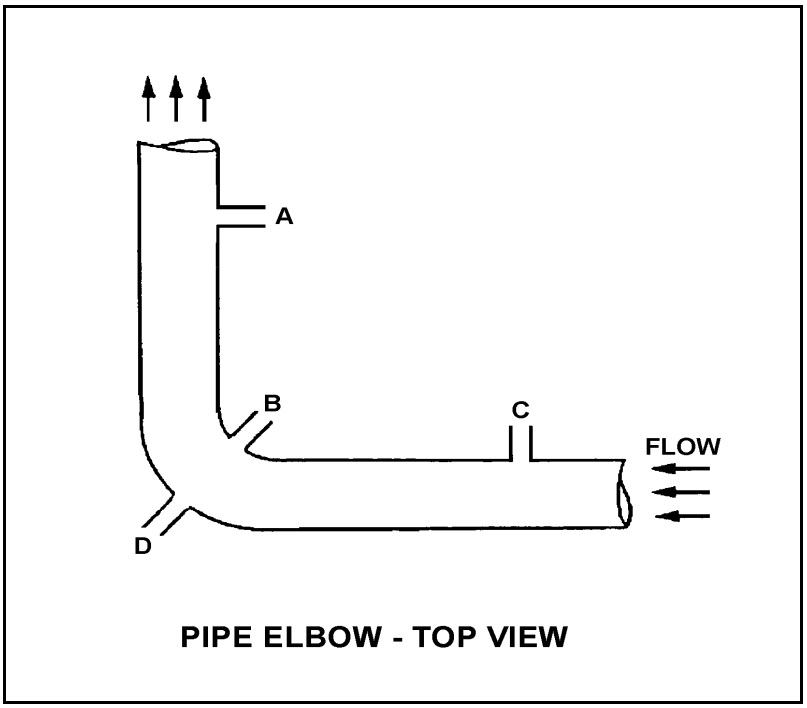
A. increase; larger

B. increase; smaller

C. decrease; larger

D. decrease; smaller

ANSWER: A.



PIPE ELBOW - TOP VIEW

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B3108 (P2905)

Refer to the drawing of a horizontal pipe elbow (top view) in an operating water system (see figure below).

Three separate bellows-type differential pressure flow detectors are connected to taps A, B, C, and D as follows:

DETECTOR	TAPS
X	A and D
Y	B and D
Z	C and D

Assuming zero head loss in this section of pipe, how will the detectors be affected if tap B experiences a significant leak? (Assume water system pressure does not change.)

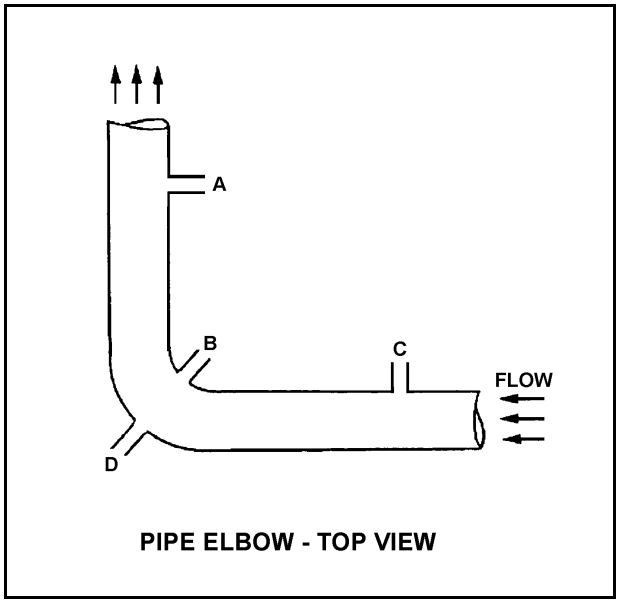
A. All detectors will fail low.

B. All detectors will fail high.

C. Only one detector will fail, and it will fail low.

D. Only one detector will fail, and it will fail high.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B3608 (P3605)

A steam flow measuring instrument uses density compensation and square root extraction to convert the differential pressure across the flow element to flow rate in lbm/hr.

The purpose of density compensation in this flow measuring instrument is to convert _____ to _____.

A. volumetric flow rate; mass flow rate

B. volumetric flow rate; differential pressure

C. differential pressure; mass flow rate

D. differential pressure; volumetric flow rate

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B3807 (P3807)

Refer to the drawing of a differential pressure manometer (see figure below).

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow. The manometer is currently indicating a water level difference of 16 inches at an air flow rate of 300 ft^3/min.

Which one of the following will be the approximate rate of air flow when the manometer indicates a water level difference of 4 inches?

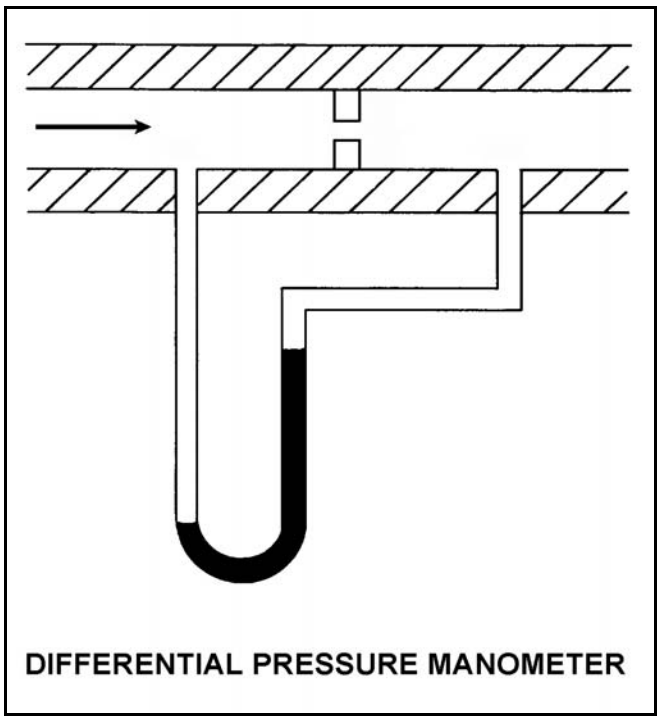
A. 75 ft^3/min.

B. 125 ft^3/min.

C. 150 ft^3/min.

D. 175 ft^3/min.

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B4005 (P4003)

A differential pressure detector is being used with an orifice plate to measure water flow rate through a pipe. When the flow instrument was last calibrated, the following parameters were observed:

Upstream Pressure:	125 psig	Actual Flow Rate:	100 gpm
Downstream Pressure:	116 psig	Indicated Flow Rate:	100 gpm

Since the calibration, debris has collected in the orifice such that the actual flow rate through the orifice has decreased to 80 gpm while the upstream and downstream pressures have changed to 135 psig and 110 psig, respectively.

What is the approximate flow rate that is currently indicated by the flow instrument?

A. 125 gpm

B. 133 gpm

C. 156 gpm

D. 167 gpm

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.05 [3.1/3.1]
QID: B4605 (P4604)

Refer to the drawing of a differential pressure manometer (see figure below).

The manometer is filled with water and installed across an orifice in a ventilation duct to determine the rate of air flow. The manometer is currently indicating a water level difference of 8 inches at an air flow rate of 300 cubic feet per minute (ft^3/min).

Which one of the following will be the approximate air flow rate when the manometer indicates a water level difference of 4 inches?

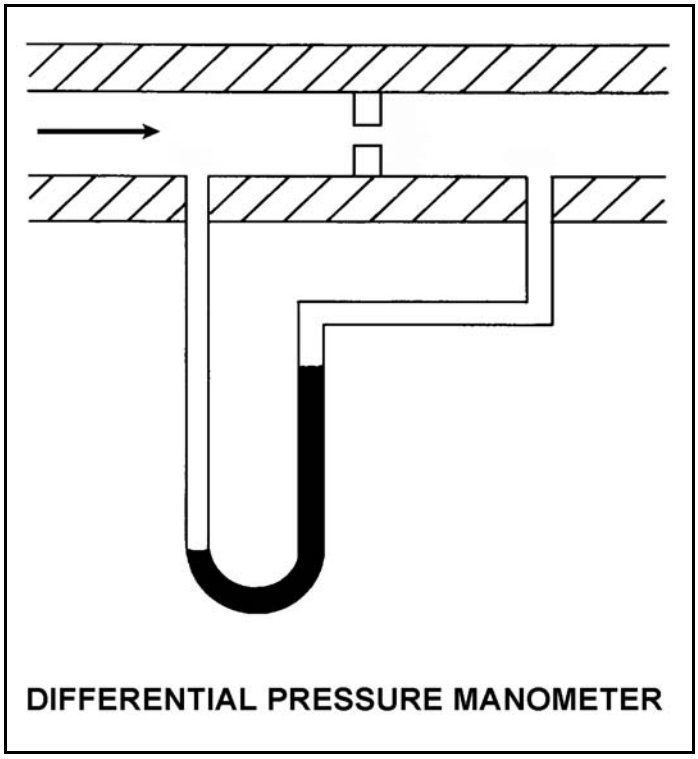
A. 75 ft^3/min

B. 150 ft^3/min

C. 188 ft^3/min

D. 212 ft^3/min

ANSWER: D.



DIFFERENTIAL PRESSURE MANOMETER

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B11

Refer to the drawing of a reactor vessel (RV) differential pressure (D/P) level detection system (see figure below).

What is the reason for the reference leg being connected to the RV instead of being connected to a water source independent of the RV?

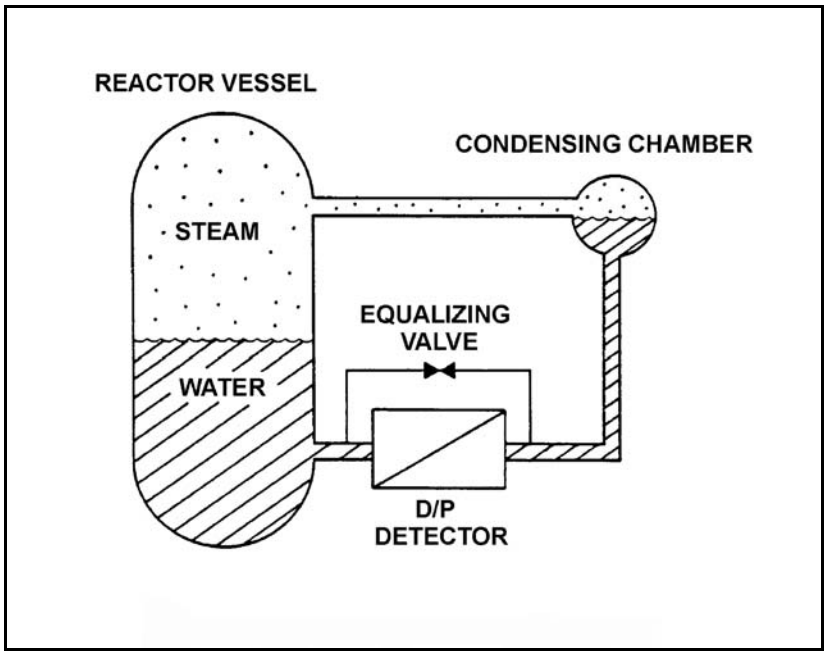
A. To provide a vent path to prevent collapse of the reference leg during a rapid RV depressurization

B. To remove the need for density compensation of the level signal by keeping the reference leg at the same temperature as the variable leg

C. To make the indicated level proportional to the square root of the D/P pressure between the reference and variable legs for all reactor pressures

D. To provide compensation for the RV pressure exerted on the variable leg

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B209

Refer to the drawing of a tank differential pressure level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 80% at the current tank temperature of 100°F. If tank temperature gradually decreases and stabilizes at 70°F, actual tank level will...

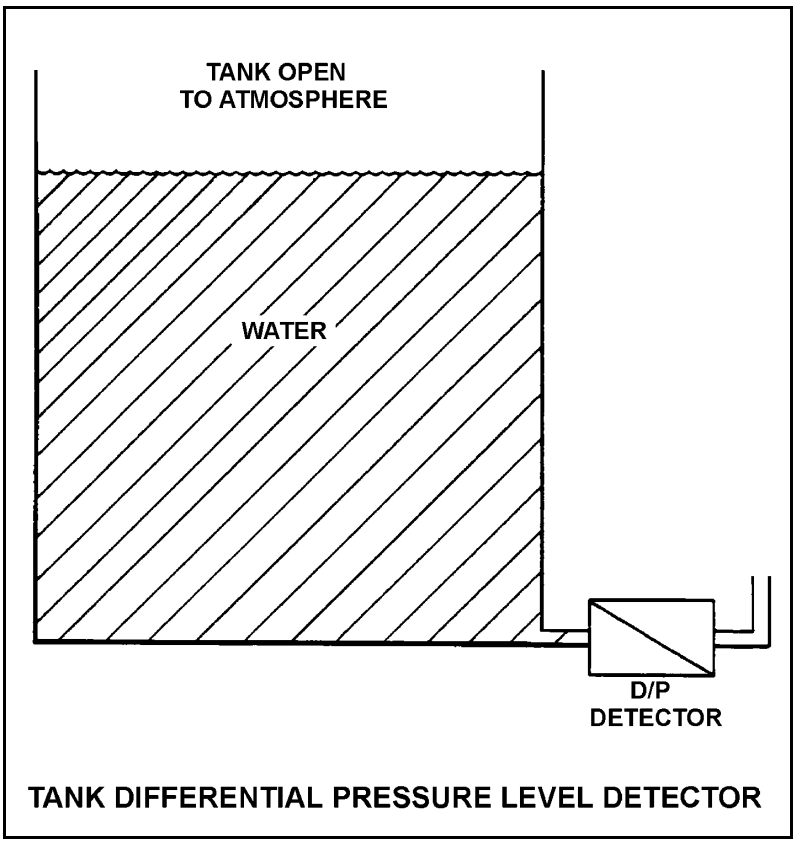
A. remain at 80%.

B. increase and stabilize above 80%.

C. oscillate around 80%.

D. decrease and stabilize below 80%.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B510 (P14)

Refer to the drawing of a water storage tank with two differential pressure level indicators (see figure below).

Indicator 1 was calibrated at 200°F and indicator 2 was calibrated at 100°F. If tank water temperature is 150°F, then...

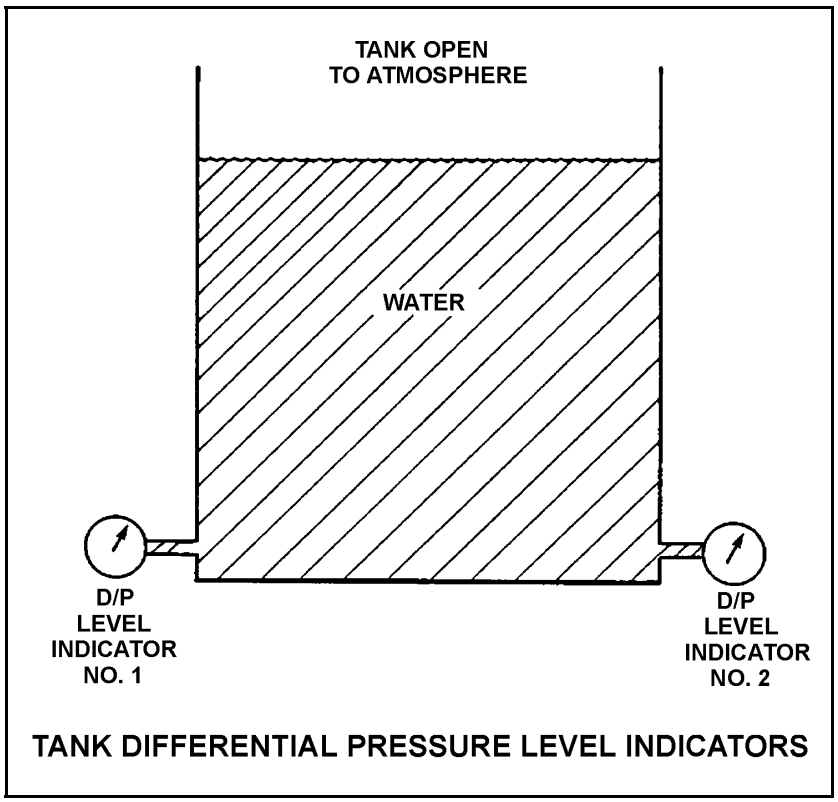
A. indicator 1 will read greater than indicator 2.

B. indicator 2 will read greater than indicator 1.

C. indicators 1 and 2 will read the same.

D. both indicators will be inaccurate, but it is impossible to predict which indicator will read greater.

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B709

Refer to the drawing of a water storage tank with two differential pressure level indicators (see figure below).

Indicator 1 was calibrated at 120°F and indicator 2 was calibrated at 180°F. If tank water temperature is 150°F, then indicator...

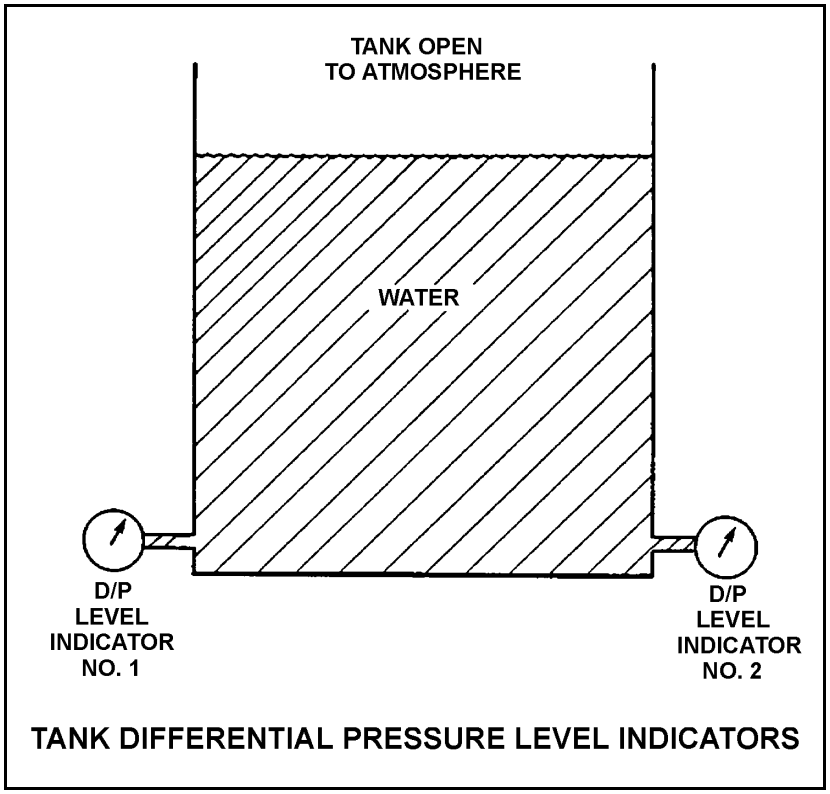
A. 1 will read greater than indicator 2.

B. 2 will read greater than indicator 1.

C. 1 and 2 readings will increase by the same amount.

D. 1 and 2 readings will decrease by the same amount.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B809 (P808)

Refer to the drawing of a tank differential pressure level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 80% at the current tank temperature of 100°F. If tank temperature gradually increases and stabilizes at 150°F, actual tank level will...

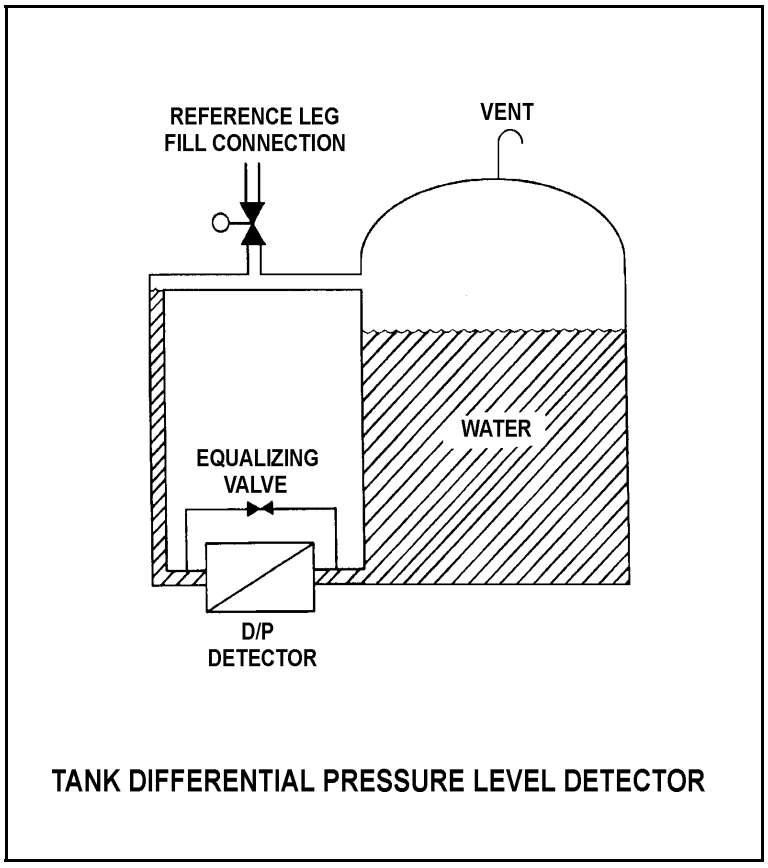
A. remain stable at 80%.

B. increase and stabilize above 80%.

C. oscillate and then stabilize at 80%.

D. decrease and stabilize below 80%.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B909 (P208)

Refer to the drawing of a tank differential pressure level detector (see figure below).

The associated level instrument was calibrated with the water storage tank at 100°F. If mass in the tank remains constant and the water temperature increases to 120°F, the indicated level will...

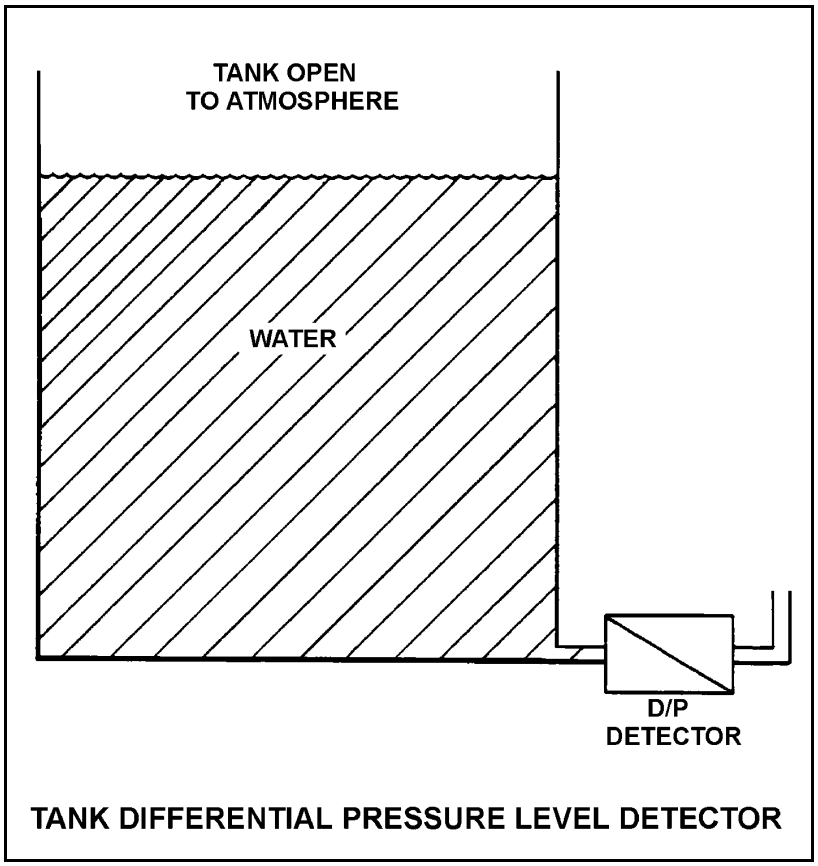
A. remain the same although actual level increases.

B. increase but remain less than actual level.

C. decrease in direct proportion to the temperature rise.

D. increase in direct proportion to the temperature rise.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B1209

Two differential pressure level transmitters are installed on a large water storage tank. Transmitter I is calibrated at 100°F and transmitter II is calibrated at 200°F water temperature.

Which transmitter will indicate a higher level?

A. Transmitter I below 150°F, transmitter II above 150°F

B. Transmitter II below 150°F, transmitter I above 150°F

C. Transmitter I at all water temperatures

D. Transmitter II at all water temperatures

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B1409 (P1607)

Refer to the drawing of a tank differential pressure level detector (see figure below).

The associated level instrument was calibrated with the water storage tank at 120°F. If mass in the tank remains constant and the water temperature decreases to 100°F, the indicated level will...

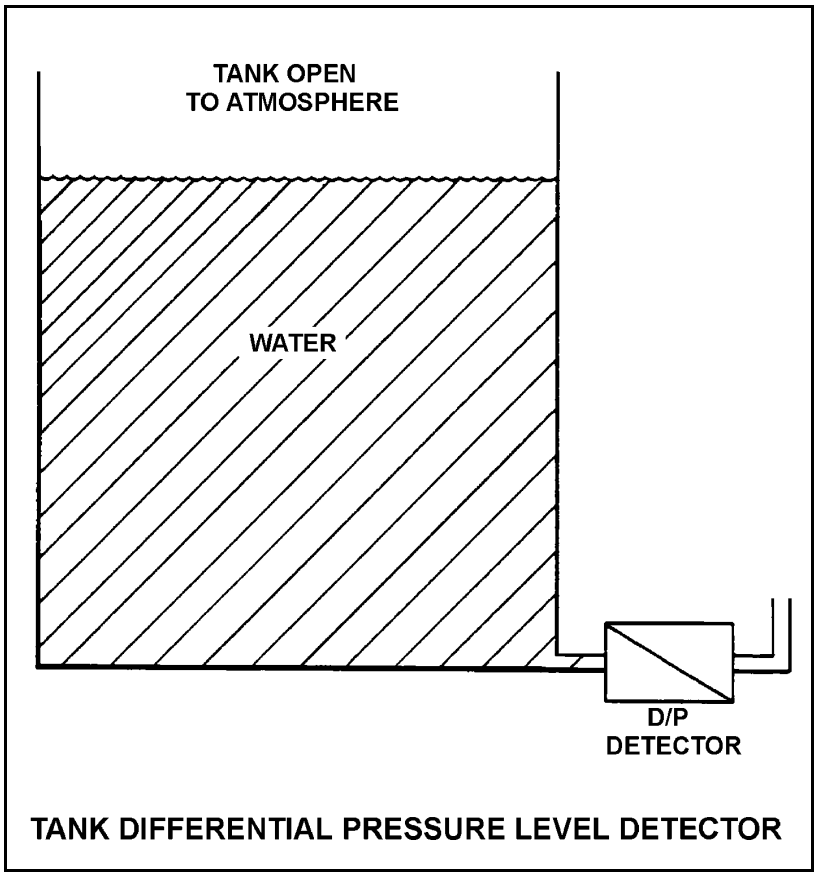
A. remain the same although actual level decreases.

B. remain the same although actual level increases.

C. increase in direct proportion to the temperature decrease.

D. decrease in direct proportion to the temperature decrease.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B1706 (P1706)

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator No. 1 was calibrated at 200°F water temperature and indicator No. 2 was calibrated at 100°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

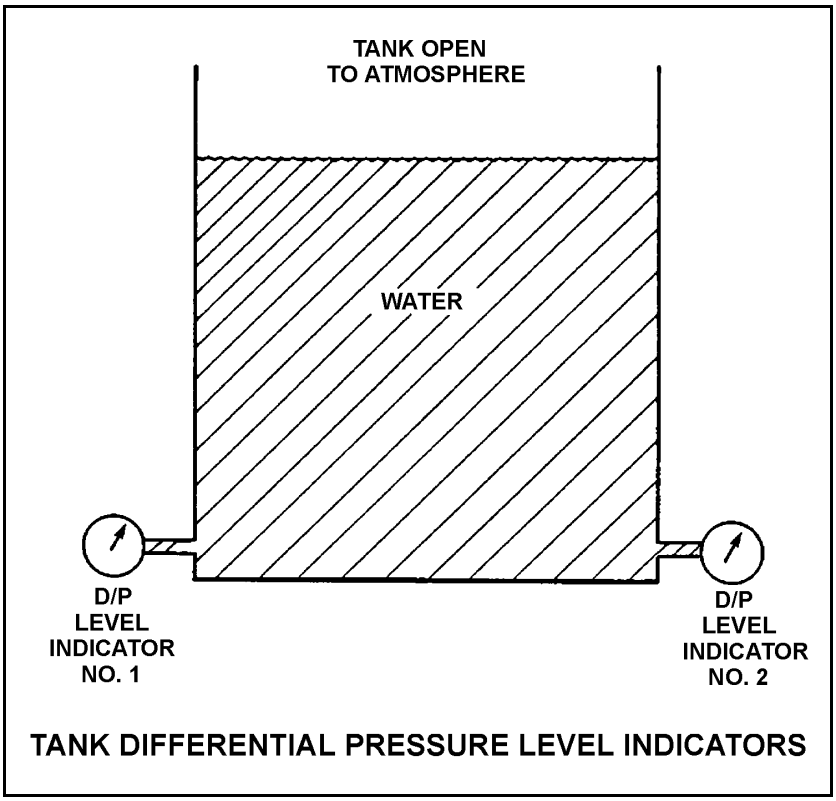
A. Indicator 1 at all water temperatures

B. Indicator 2 at all water temperatures

C. Indicator 1 below 150°F, indicator 2 above 150°F

D. Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B1809

Refer to the drawing of a tank differential pressure level detector that was recently calibrated at a tank water temperature of 80°F (see figure below).

If the mass of the water in the tank remains the same while the tank water temperature is raised from 80°F to 150°F, the indicated level will...

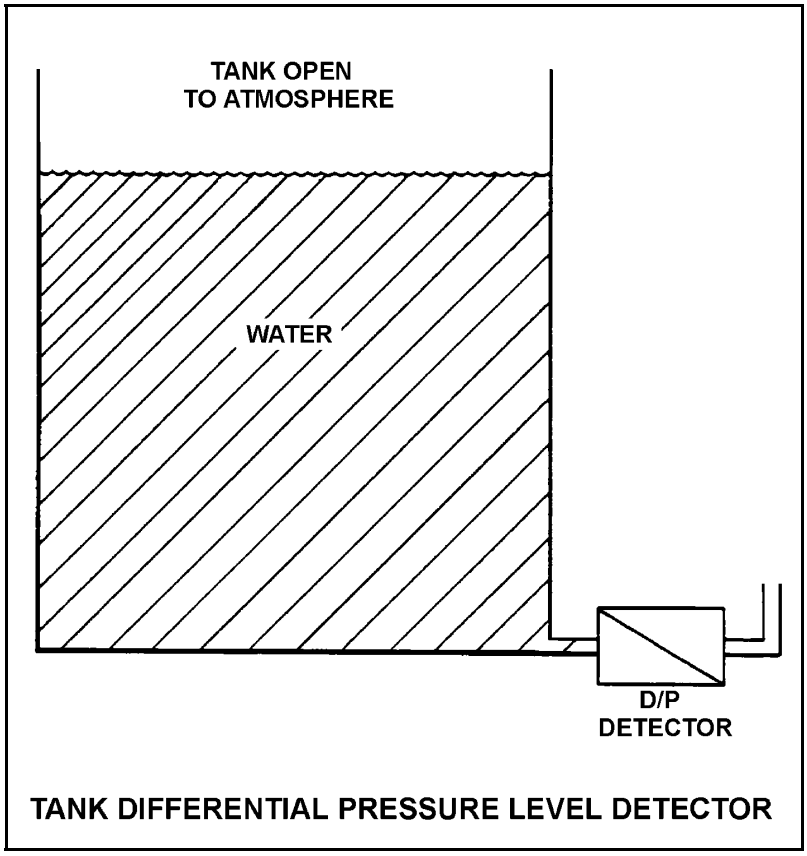
A. remain equal to actual level.

B. increase due to the expansion of the water.

C. remain the same.

D. decrease due to the expansion of the water.

ANSWER: C.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B2408 (P2108)

Refer to the drawing of a water storage tank with two differential pressure (D/P) level indicators (see figure below).

Indicator 1 was calibrated at 180°F and indicator 2 was calibrated at 120°F. If tank water temperature is 150°F, then indicator...

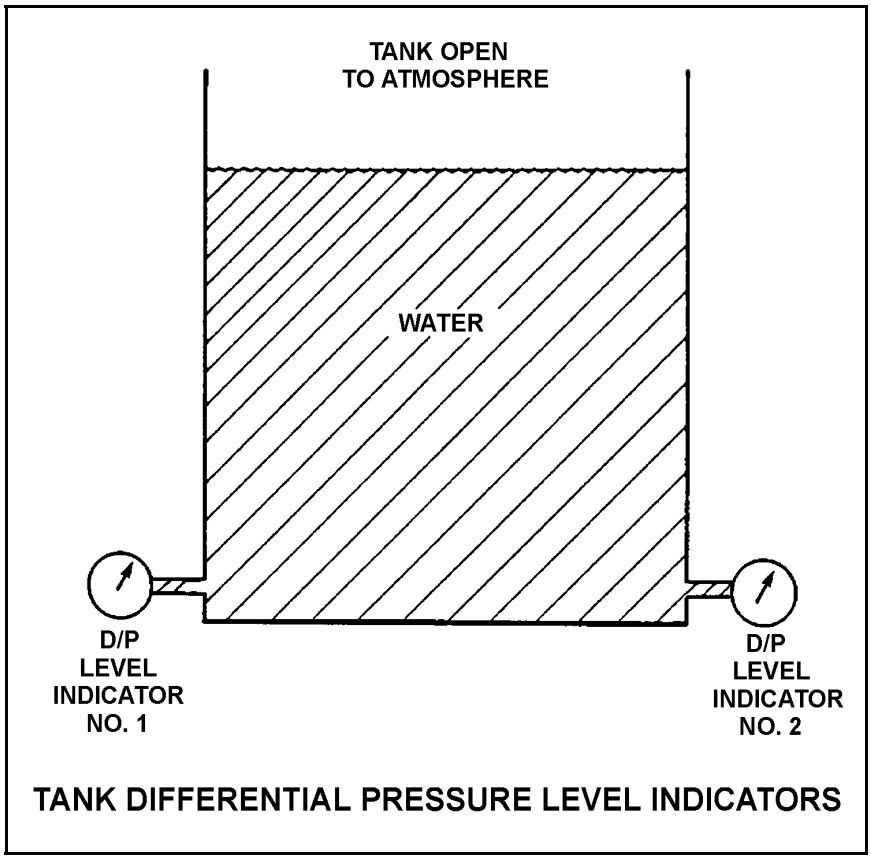
A. 1 will read greater than indicator 2, and greater than actual water level.

B. 1 will read greater than indicator 2, and less than actual water level.

C. 2 will read greater than indicator 1, and greater than actual water level.

D. 2 will read greater than indicator 1, and less than actual water level.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B2409

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system that was calibrated at 1,000 psia (see figure below).

A reactor vessel cooldown has resulted in a decrease in reactor vessel pressure from 1,000 psia to 500 psia over several hours. Without density compensation of the level instrumentation, at the end of the cooldown, reactor vessel level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly. (Assume the reference leg does not flash to steam.)

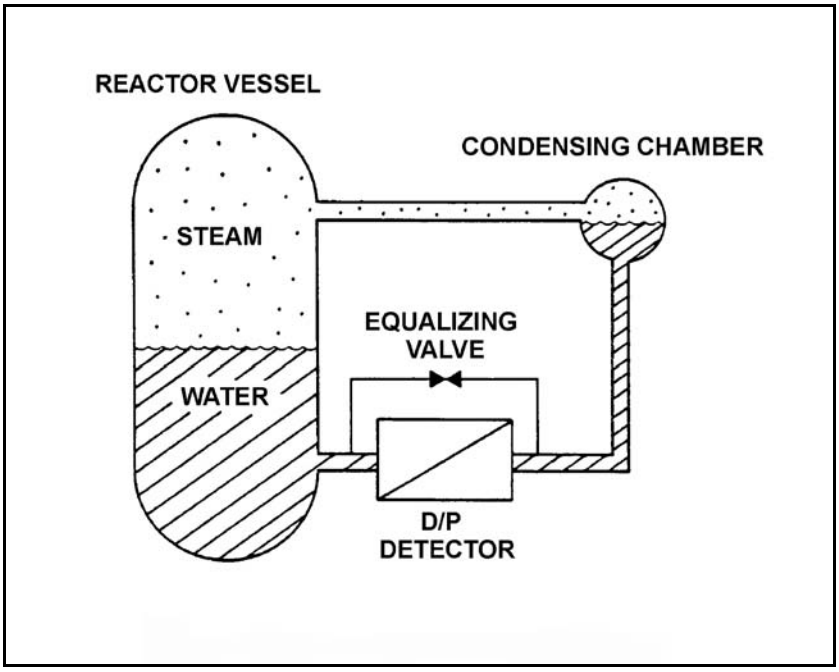
A. higher; reactor vessel

B. higher; reference leg

C. lower; reactor vessel

D. lower; reference leg

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B2509

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system that was calibrated at 500 psia (see figure below).

A reactor vessel heatup has resulted in an increase in reactor vessel pressure from 500 psia to 1,000 psia over several hours. Without density compensation of the level instrumentation, at the end of the heatup, reactor vessel level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly.

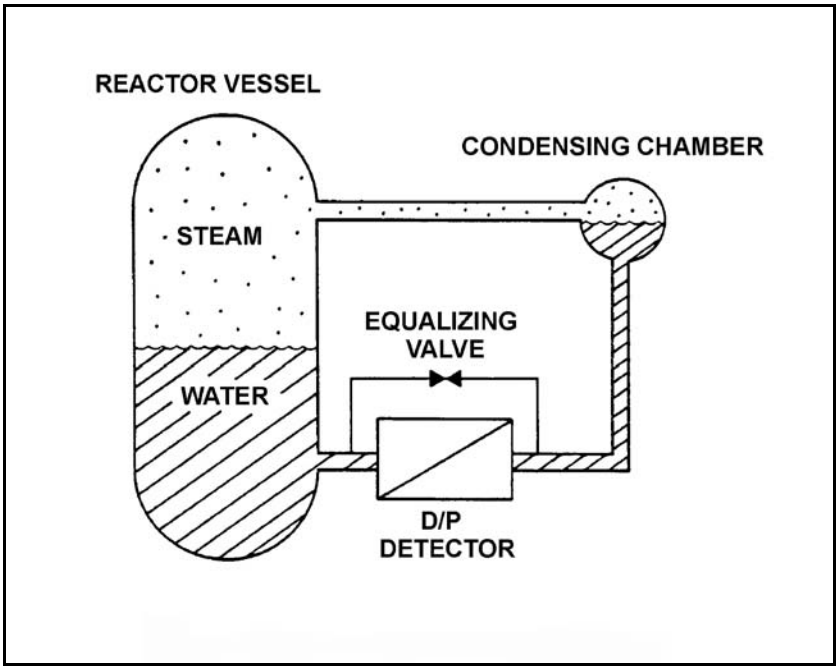
A. higher; reactor vessel

B. higher; reference leg

C. lower; reactor vessel

D. lower; reference leg

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B3210

A nuclear reactor is currently shut down at 180°F. Reactor vessel (RV) level is being monitored using a normal at-power RV level instrument that was calibrated at normal plant operating conditions.

The RV level instrument indicates _____ than actual RV level because, compared to the calibration conditions, there has been a significant change in the density of the fluid in the _____.

A. less; reference leg

B. less; reactor vessel

C. greater; reference leg

D. greater; reactor vessel

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B3508 (P911)

Refer to the drawing of a reactor vessel (RV) differential pressure level detection system (see figure below) that was recently calibrated at normal operating conditions.

With the reactor shut down, RV pressure was inadvertently decreased from 1,000 psig to 500 psig in 5 minutes due to operator error. RV pressure was stabilized at 500 psig, but during the pressure decrease a small amount of water in the condensing chamber flashed to steam. Assume the reference leg water remains subcooled, except for the small amount of water that flashes to steam in the condensing chamber.

As a result of the small loss of condensing chamber water, RV level will indicate _____ than actual level; and as the condensing chamber refills, indicated level will _____.

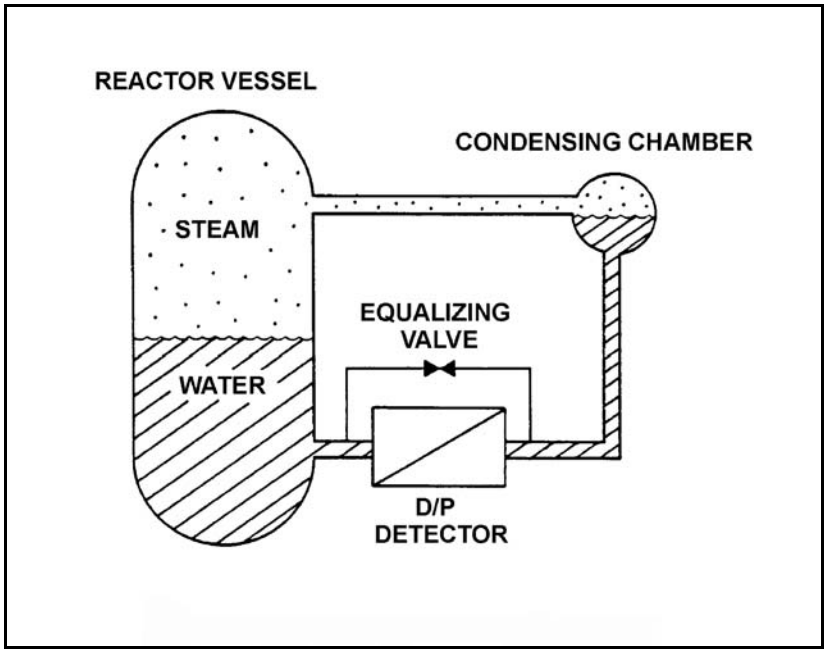
A. higher; decrease and stabilize above the actual level

B. higher; decrease and stabilize below the actual level

C. lower; increase and stabilize above the actual level

D. lower; increase and stabilize below the actual level

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B4104

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system that was recently calibrated at normal operating conditions (see figure below). Assume that the associated reactor vessel level instrument does not use density compensation.

With the nuclear power plant shut down at reduced reactor vessel temperature and pressure, the reactor vessel level instrument will indicate _____ than actual water level; the D/P currently sensed by the D/P detector is_____ than the D/P for the same reactor vessel water level at normal operating conditions.

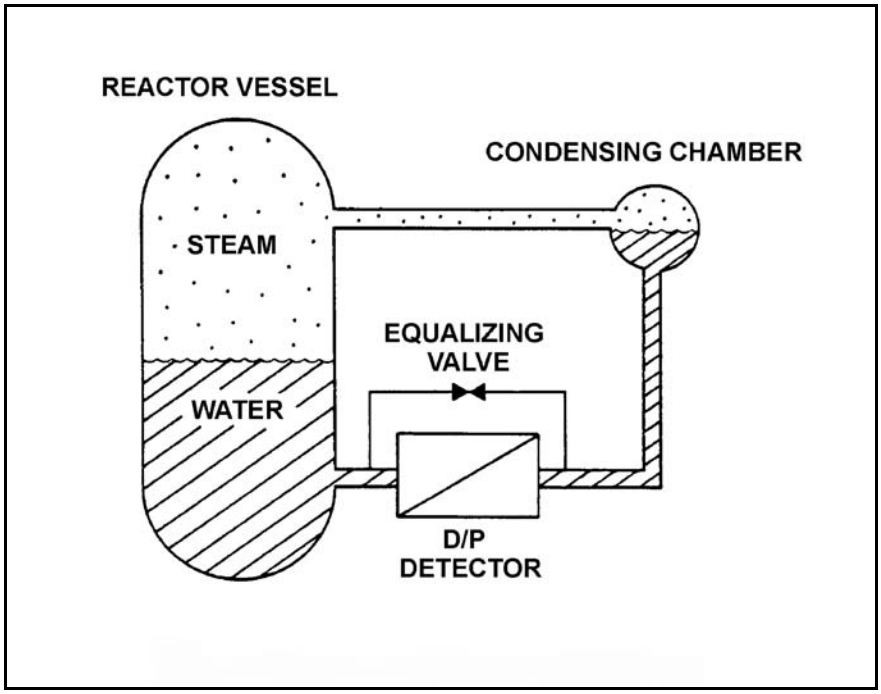
A. higher; smaller

B. higher; larger

C. lower; smaller

D. lower; larger

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B4205 (P4204)

Refer to the drawing of a water storage tank with two differential pressure (D/P) level indicators (see figure below).

Indicator 1 was calibrated at a tank water temperature of 120°F and indicator 2 was calibrated at 180°F. If tank water temperature is currently 150°F, then indicator...

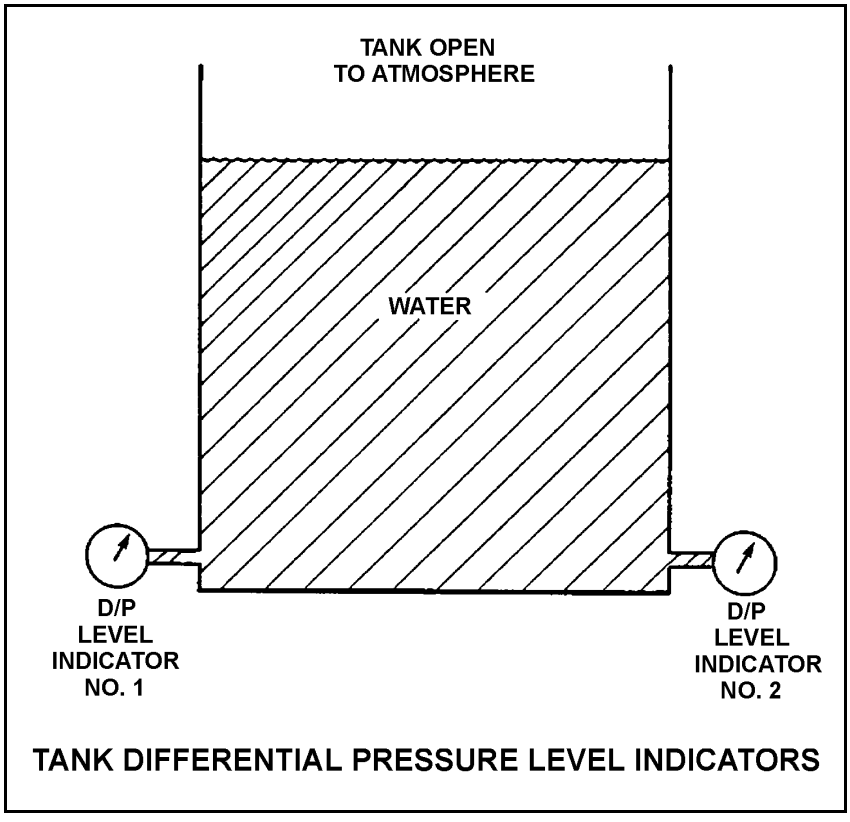
A. 1 will read greater than indicator 2, and indicator 1 will read greater than actual water level.

B. 1 will read greater than indicator 2, and indicator 1 will read less than actual water level.

C. 2 will read greater than indicator 1, and indicator 2 will read greater than actual water level.

D. 2 will read greater than indicator 1, and indicator 2 will read less than actual water level.

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B4504

Refer to the drawing of a differential pressure (D/P) level detection system for a reactor vessel at normal operating temperature and pressure (see figure below).

A nuclear power plant uses several differential pressure detectors like the one below to provide multiple channels of reactor vessel water level indication. A hot channel was calibrated when the reactor vessel was at normal operating temperature. A cold channel was calibrated when the reactor vessel was at 160°F.

How will the level indications on the two channels compare when the reactor vessel is at normal operating temperature?

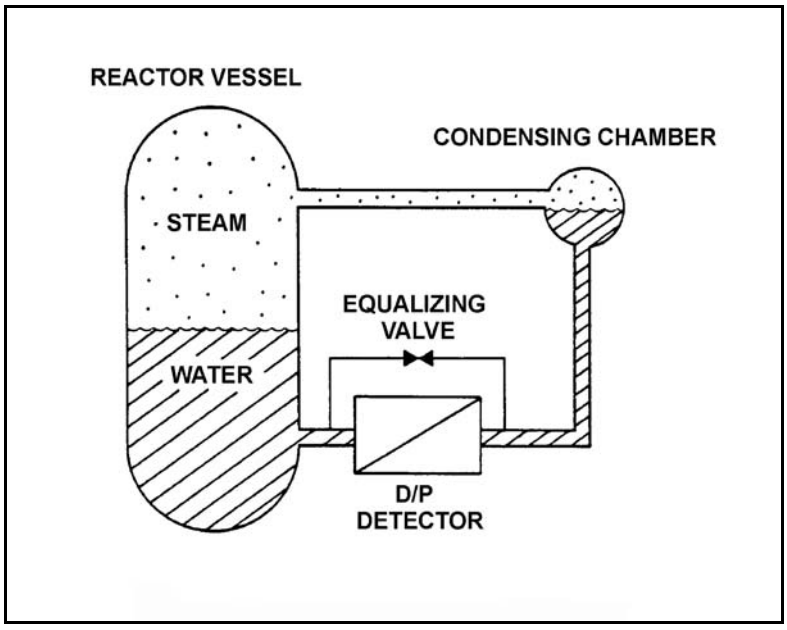
A. The cold channel will indicate higher than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

B. The cold channel will indicate lower than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

C. The cold channel will indicate higher than the hot channel due to the difference in reactor vessel water density at the two calibration temperatures.

D. The cold channel will indicate lower than the hot channel due to the difference in reactor vessel water density at the two calibration temperatures.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.06 [2.8/2.9]
QID: B5105

Refer to the drawing of a differential pressure (D/P) level detection system for a reactor vessel at normal operating temperature and pressure (see figure below).

A nuclear power plant uses several differential pressure detectors like the one below to provide multiple channels of reactor vessel water level indication. A hot channel was calibrated when the reactor vessel was at normal operating temperature. A cold channel was calibrated when the reactor vessel was at 160°F.

How will the level indications on the two channels compare when the reactor vessel is at 160°F?

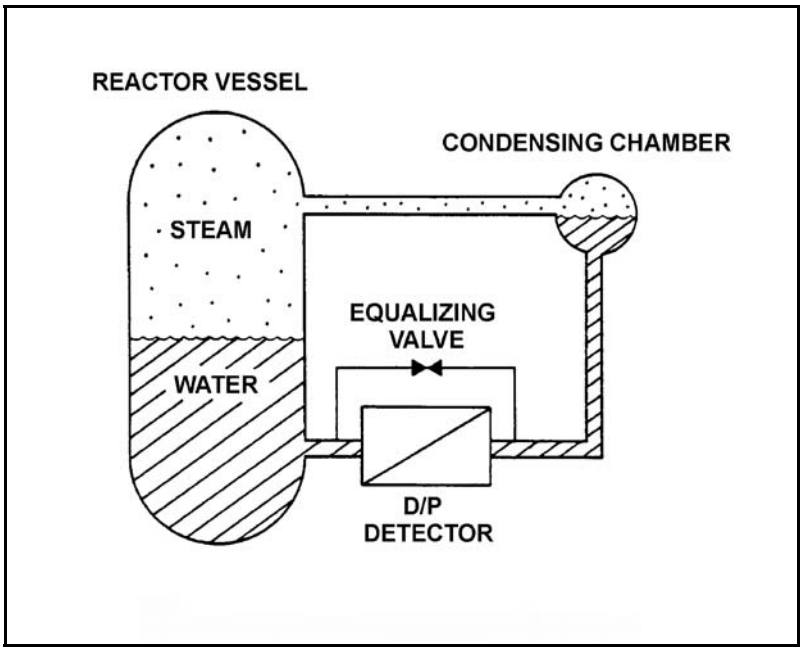
A. The cold channel will indicate higher than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

B. The cold channel will indicate lower than the hot channel due to the difference in reference leg water density at the two calibration temperatures.

C. The cold channel will indicate higher than the hot channel due to the difference in reactor vessel water density at the two calibration temperatures.

D. The cold channel will indicate lower than the hot channel due to the difference in reactor vessel water density at the two calibration temperatures.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B155

Many reactor vessel water level instruments are designed with a condensing chamber in the reference leg. The purpose of the condensing chamber is to...

A. provide a steady source of makeup water to the reference leg during normal operations.

B. provide reference leg compensation for the reactor pressure exerted on the variable leg.

C. prevent reference leg flashing during a rapid depressurization of the reactor vessel.

D. ensure the reference leg temperature remains near the temperature of the water in the reactor vessel.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B910 (P910)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The D/P sensed by the detector varies in the _____ direction as the temperature of the water in the tank if the _____ of the tank water is constant. (Assume reference leg and tank water temperatures are initially the same.)

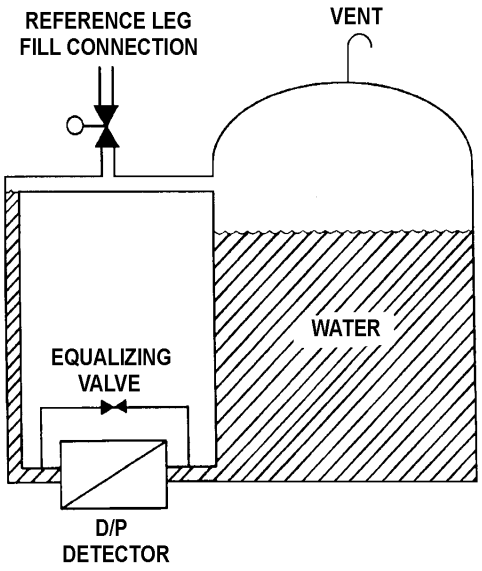
A. same; level

B. inverse; level

C. same; mass

D. inverse; mass

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B1211 (P1807)

A cooling water system is cooling a lube oil heat exchanger. Cooling water system surge tank level is being measured using a differential pressure level detector that has been calibrated at the current water temperature in the tank. A leak in the heat exchanger results in lube oil collecting in the surge tank.

Assuming that the temperature of the contents in the surge tank does not change, indicated tank level will be _____ than actual tank level because lube oil is _____ than water.

A. higher; more dense

B. higher; less dense

C. lower; more dense

D. lower; less dense

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B1507 (P1107)

Refer to the drawing of two tank differential pressure (D/P) level indicators (see figure below).

Two D/P level indicators are installed on a large water storage tank. Indicator 1 was calibrated at 100°F water temperature and indicator 2 was calibrated at 200°F water temperature.

Assuming both indicators are on scale, which indicator will indicate the lower level?

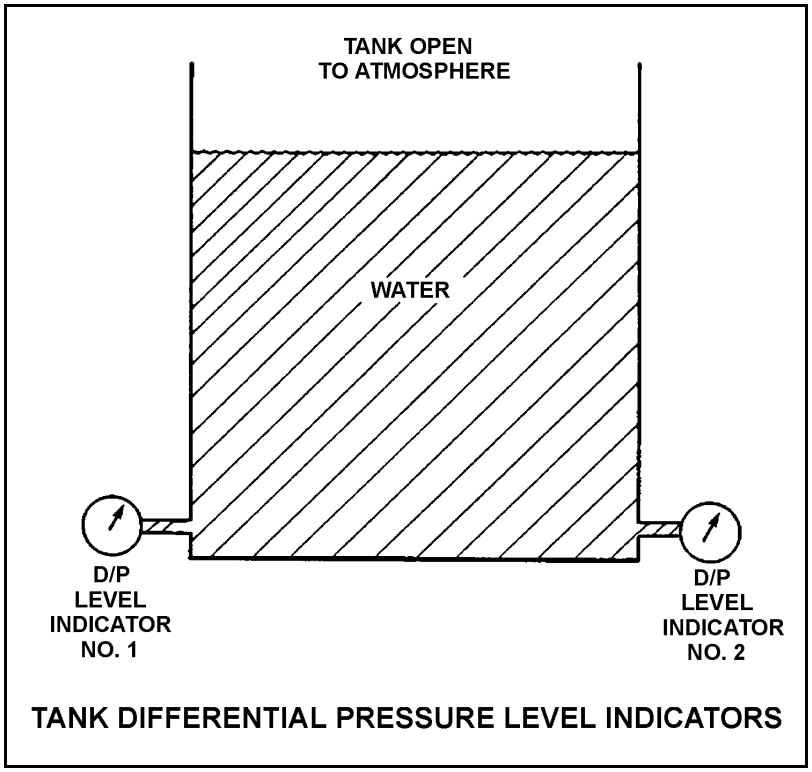
A. Indicator 1 at all water temperatures

B. Indicator 2 at all water temperatures

C. Indicator 1 below 150°F, indicator 2 above 150°F

D. Indicator 2 below 150°F, indicator 1 above 150°F

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL INDICATORS

TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B3010 (P3008)

Refer to the drawing of a tank with a differential pressure (D/P) level detection system (see figure below).

Assume the initial temperature of the reference leg and the water in the tank is 100°F, and that reference leg temperature does not change.

If the temperature of the water in the tank increases by 20°F, the D/P sensed by the detector will _____ as long as the water _____ is maintained constant.

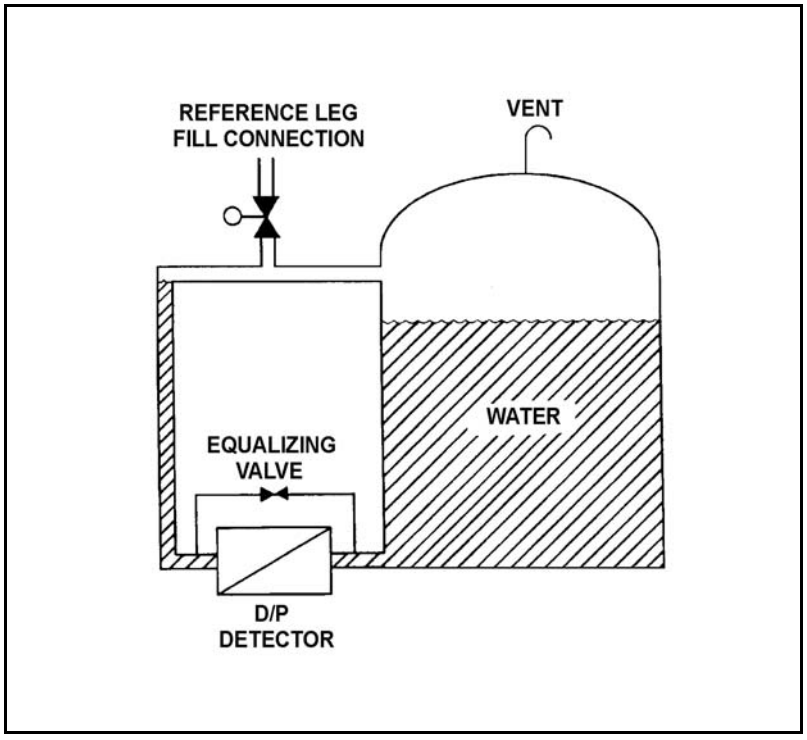
A. increase; level

B. decrease; level

C. increase; mass

D. decrease; mass

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B5004

The downcomer region of a reactor vessel contains 40 feet of saturated water at 536°F. A reactor vessel water level detector has a pressure tap located at the bottom of the downcomer region. Approximately how much of the total pressure at the pressure tap is caused by the downcomer water?

A. 0.6 psi

B. 13.0 psi

C. 27.7 psi

D. 156.0 psi

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.07 [3.2/3.2]
QID: B5204

Refer to the drawing of a differential pressure (D/P) level detection system (see figure below) for a reactor vessel at normal operating temperature and pressure. The level detector has just been calibrated.

The high pressure side of the detector is connected to the _____; and if the equalizing valve is opened the indicated reactor vessel level will be _____ than the actual level.

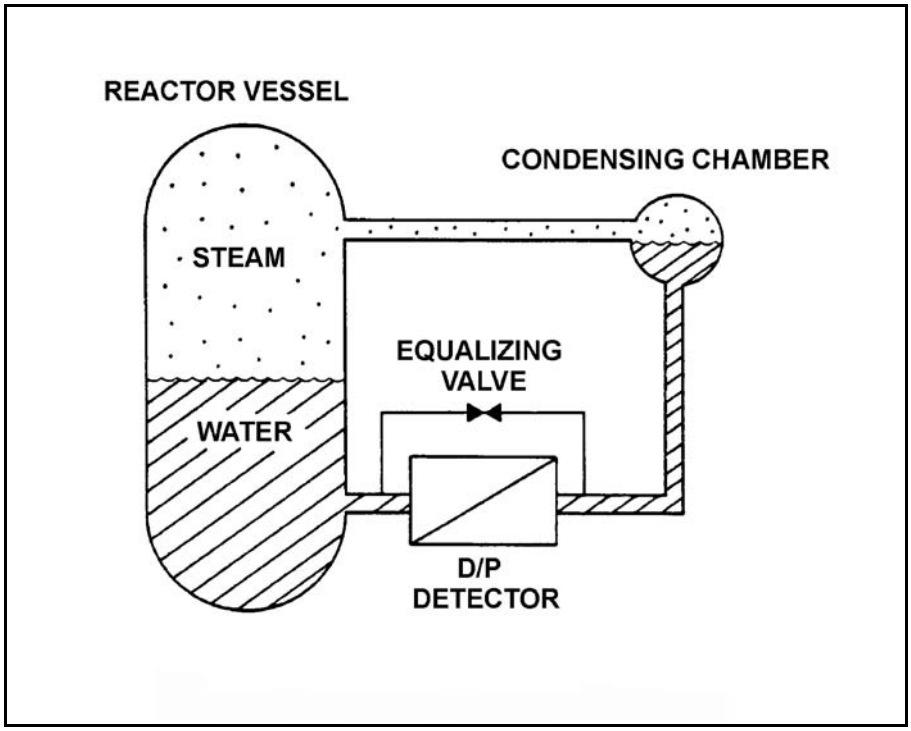
A. condensing chamber; lower

B. condensing chamber; higher

C. reactor vessel; lower

D. reactor vessel; higher

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B12 (P609)

Refer to the drawing of four tank differential pressure level detectors (see figure below).

The tanks are identical with equal water levels and both are pressurized to 20 psig. All detectors were calibrated at the current water temperature and 70°F external (ambient) temperature.

Which detectors will provide the most accurate level indication following an increase in external (ambient) temperature from 70°F to 100°F? (Assume tank contents temperatures and external pressure do not change.)

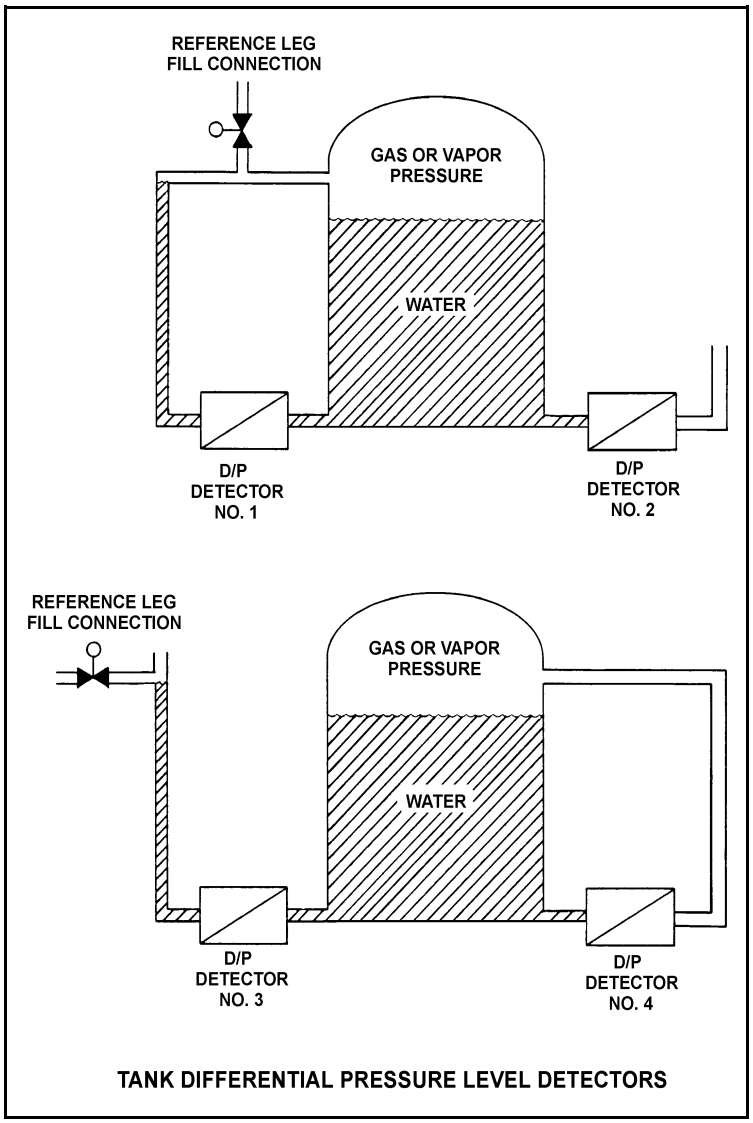
A. 1 and 3

B. 2 and 4

C. 1 and 4

D. 2 and 3

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTORS

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B308 (P309)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

Tank water level indication will be lower than actual level when reference leg temperature is _____ than calibration conditions or when there is a break in the _____ leg of the D/P detector.

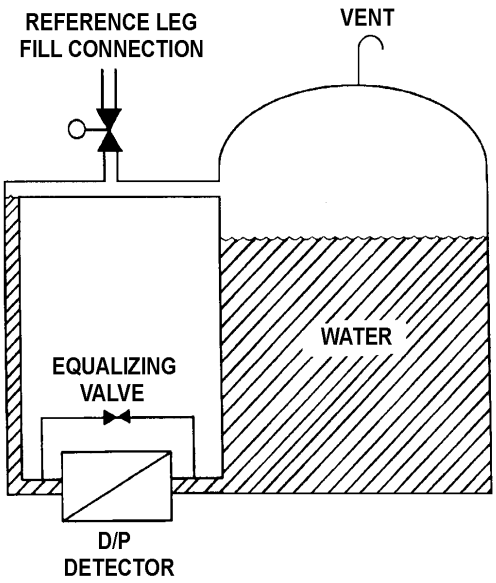
A. less; reference

B. less; variable

C. greater; reference

D. greater; variable

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B710 (P709)

Refer to the drawing of four differential pressure (D/P) level detectors (see figure below).

The tanks are identical and are being maintained at 17 psia and 70% water level (calibration conditions). They are located in a building that is currently at atmospheric pressure.

If the building ventilation system creates a vacuum in the building, which level detectors will provide the lowest level indications?

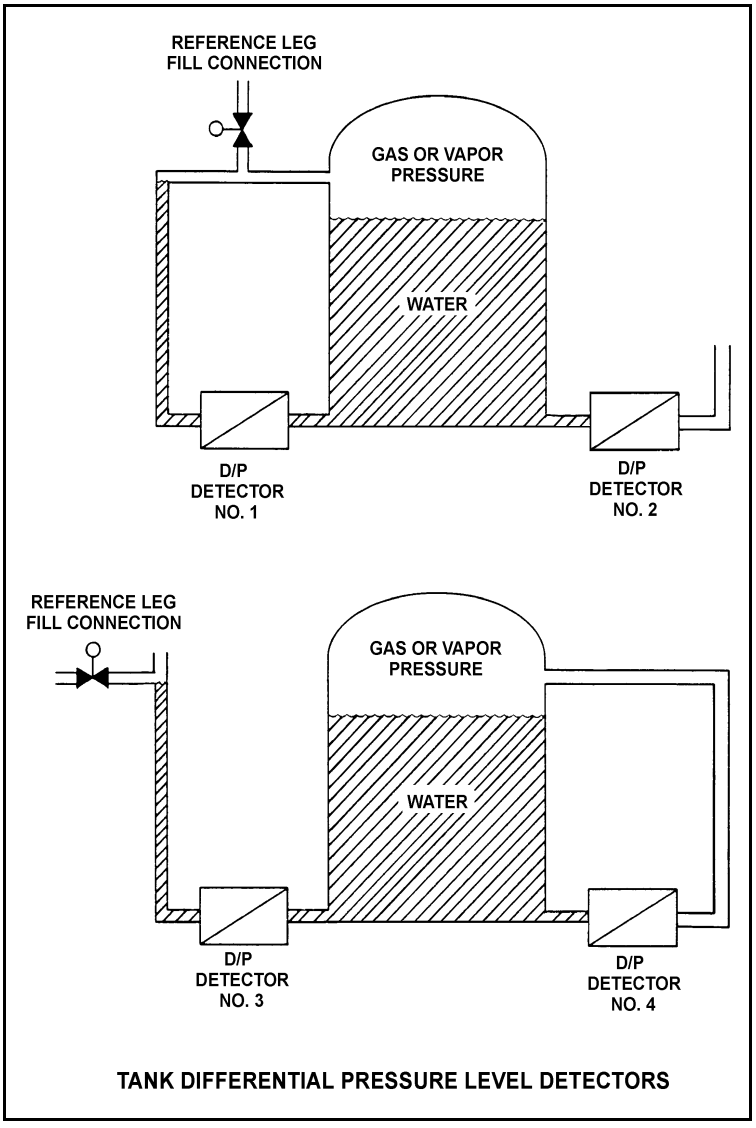
A. 1 and 3

B. 1 and 4

C. 2 and 3

D. 2 and 4

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B1609 (P1108)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The D/P level detector is being used to measure level in a vented tank inside the containment building. If building pressure decreases with no change in temperature, the associated level indication will...

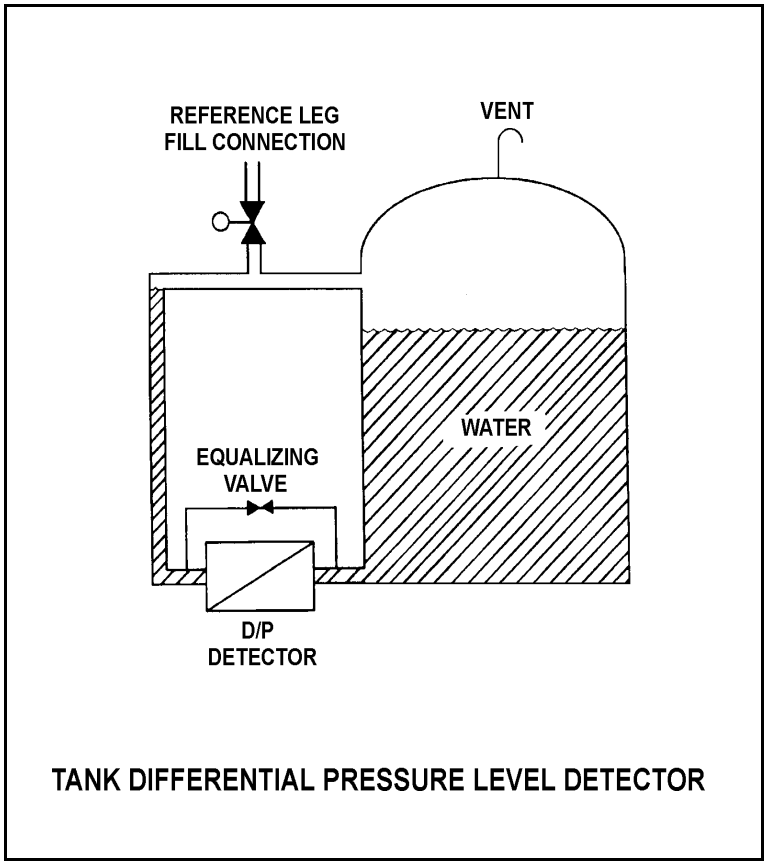
A. decrease, then increase and stabilize at the actual level.

B. decrease and stabilize below the actual level.

C. increase and stabilize above the actual level.

D. remain at the actual level.

ANSWER: D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B1909 (P1008)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 75% at the current water temperature of 120°F. If water temperature gradually decreases and stabilizes at 90°F, actual tank level will...

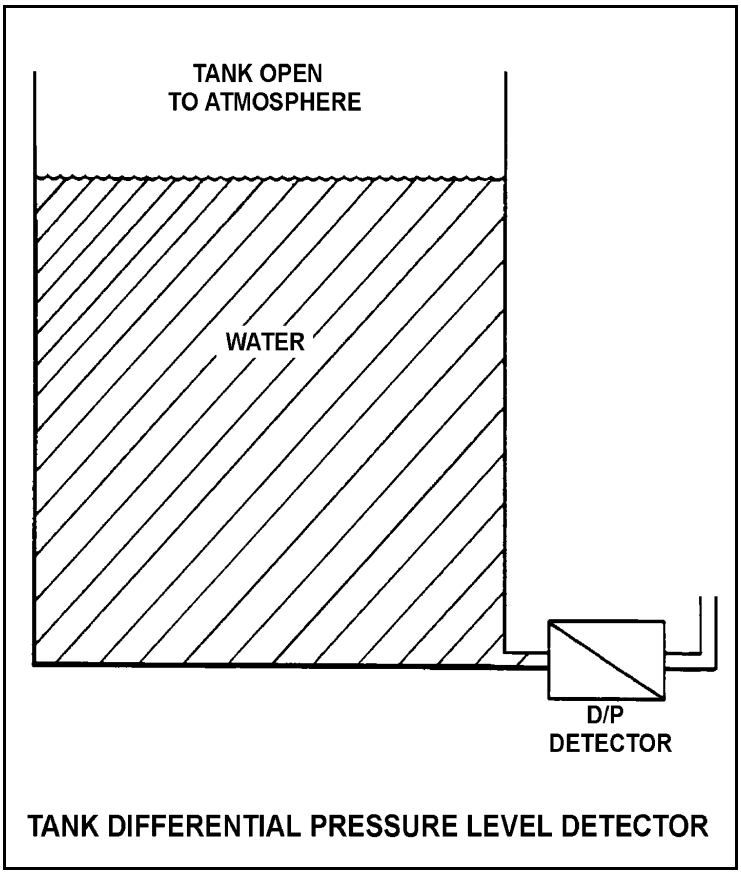
A. remain at 75%.

B. increase and stabilize above 75%.

C. oscillate around 75%.

D. decrease and stabilize below 75%.

ANSWER: D.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B2210

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 80% at the current water temperature of 70°F. If water temperature gradually increases and stabilizes at 90°F, the level control system will cause actual tank level to...

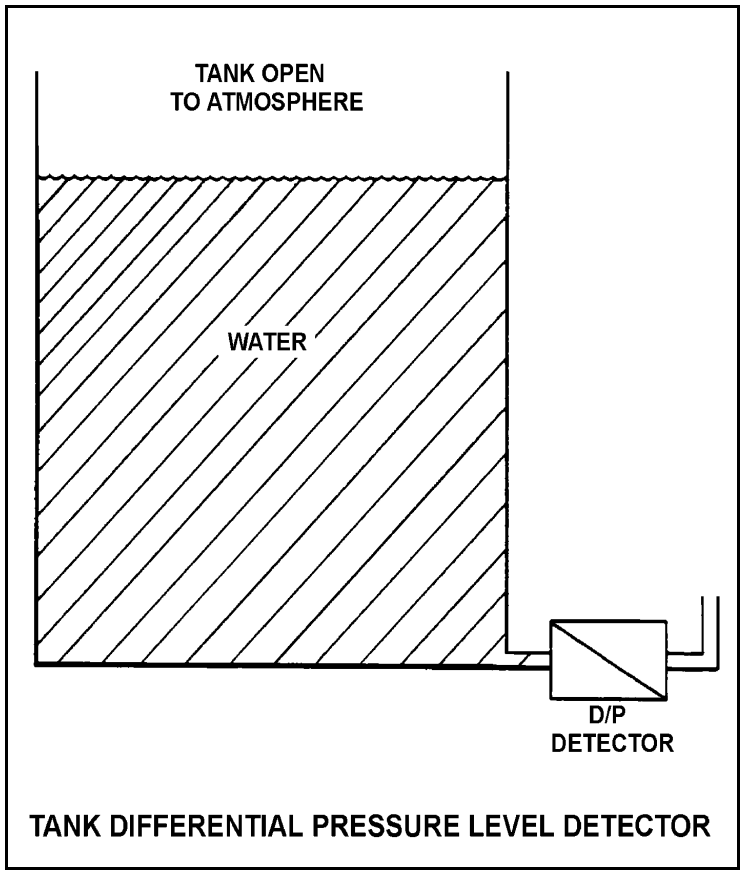
A. remain at 80%.

B. increase and stabilize above 80%.

C. oscillate around 80%.

D. decrease and stabilize below 80%.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B2609 (P708)

Refer to the drawing of a tank differential pressure (D/P) level detector (see figure below).

The level detector is being used in a level control system that is calibrated to maintain tank level at 75% at the current water temperature of 90°F. If water temperature gradually increases and stabilizes at 120°F, the level control system will cause actual tank level to...

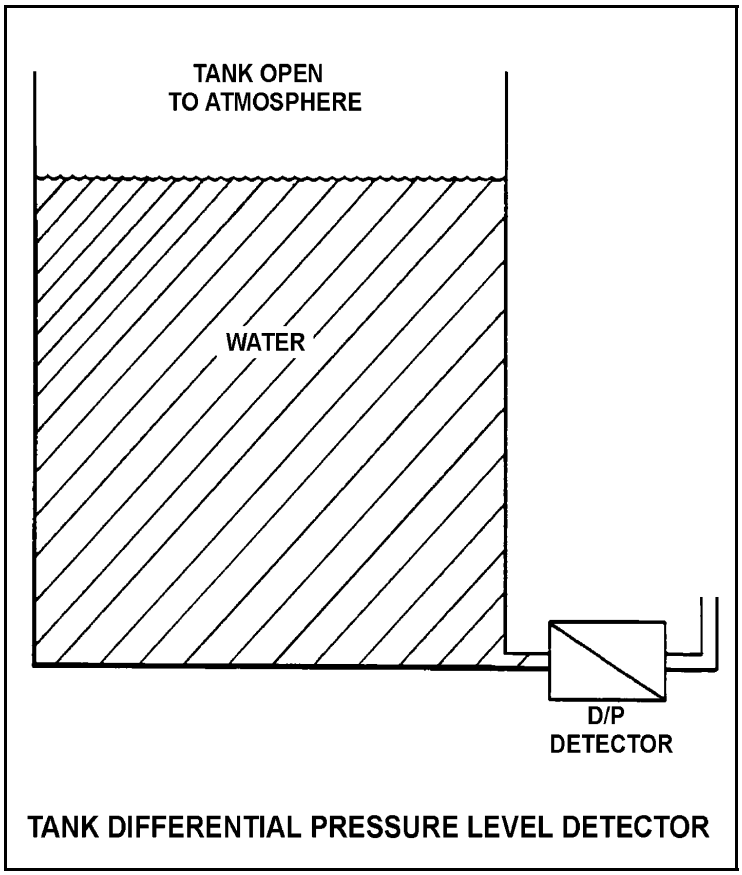
A. remain at 75%.

B. increase and stabilize above 75%.

C. oscillate around 75%.

D. decrease and stabilize below 75%.

ANSWER: B.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B2808 (P2810)

Refer to the drawing of a reactor vessel level detection system (see figure below). The differential pressure (D/P) detector was calibrated while the plant was at normal operating conditions.

With the plant initially at normal operating conditions, a reactor vessel head leak occurred. Reactor vessel pressure decreased by 300 psia, and the ambient air temperature surrounding the reference leg increased by 80°F, where these parameters stabilized.

If the actual reactor vessel water level is 6 feet above the fuel, the reduced reactor vessel pressure will tend to make the indicated reactor vessel level read _____ than actual; and the increased reference leg temperature will tend to make the indicated reactor vessel level read _____ than actual.

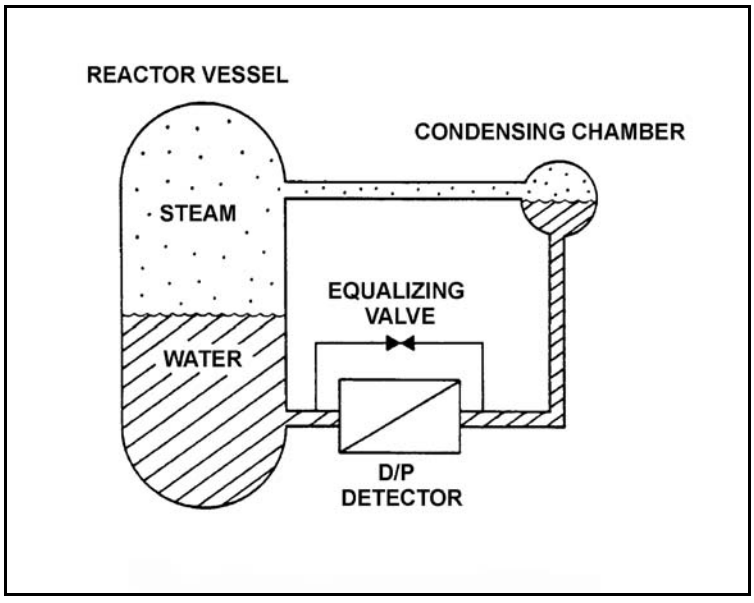
A. higher; higher

B. higher; lower

C. lower; higher

D. lower; lower

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B3408 (P3407)

Refer to the drawing of a tank with a differential pressure (D/P) level detector (see figure below). Assume that the initial temperature of the reference leg and the water in the tank are the same, and that reference leg temperature and level do not change.

The level detector is being used in a level control system (not shown) that is calibrated to maintain tank level at 75% at the current tank water temperature (70°F) and pressure (5 psig).

If the tank water temperature remains constant, but the tank pressure is increased by 10 psig, the level control system will cause actual tank level to...

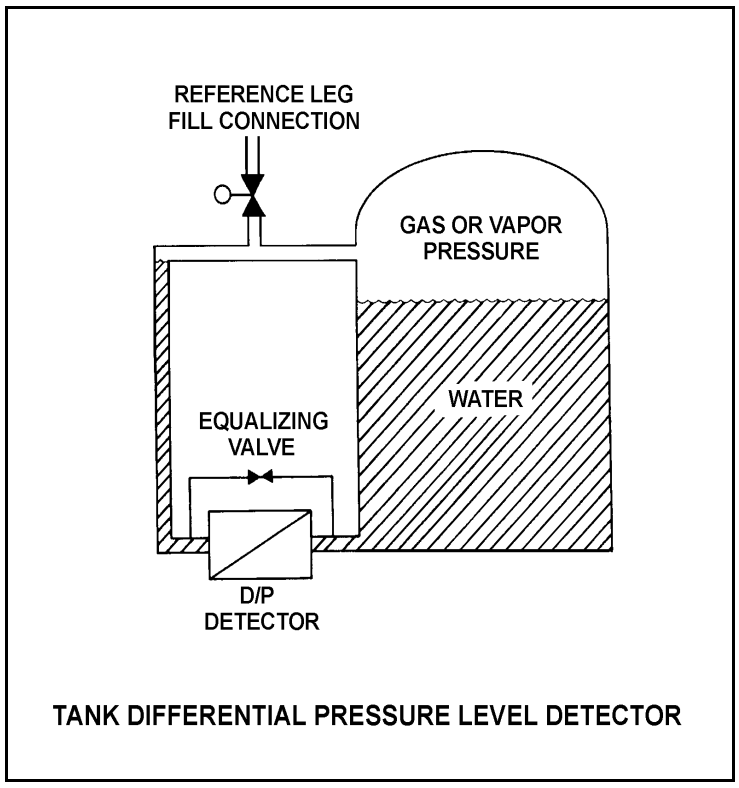
A. remain at 75%.

B. increase and stabilize above 75%.

C. oscillate around 75%.

D. decrease and stabilize below 75%.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.08 [2.8/2.9]
QID: B4006 (P4004)

Refer to the drawing of an open water storage tank with a differential pressure (D/P) level detector (see figure below).

The level instrument has just been calibrated to indicate actual tank water level. Assume that tank water temperature and level remain constant. If the reference leg temperature increases by 20°F, indicated tank water level will...

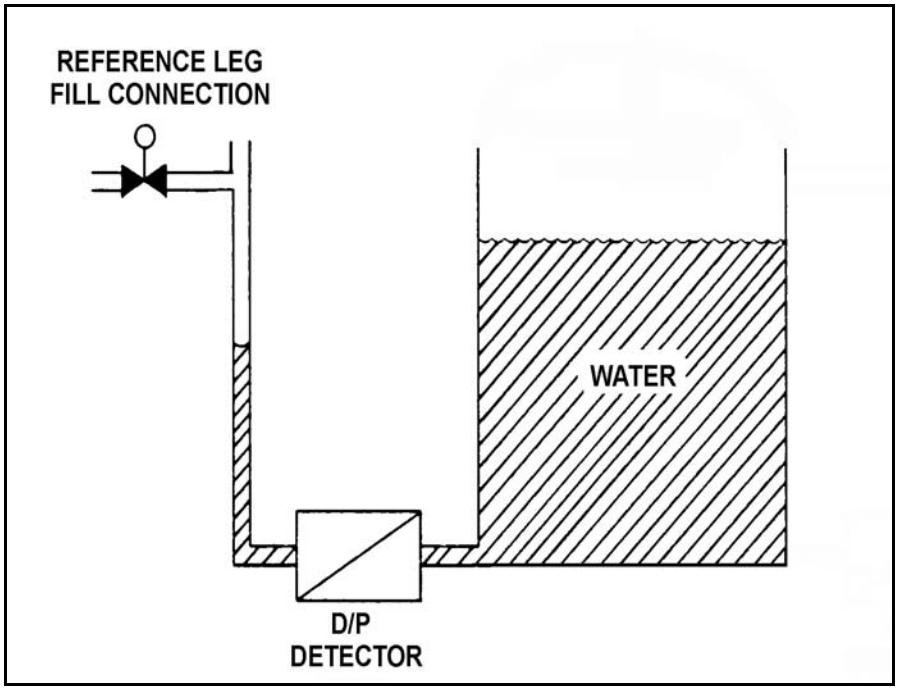
A. be unpredictable.

B. equal the actual level.

C. read less than the actual level.

D. read greater than the actual level.

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B165

Reactor feedwater flow and vessel level detectors use differential pressure (D/P) cells to measure flow and level. If a level D/P cell diaphragm fails, the level indication...

A. will go to 0.

B. will slowly move to 50% (midrange).

C. will indicate 100% (full range).

D. remains the same.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B207

Refer to the drawing of a tank differential pressure (D/P) level detector connected to a pressurized tank (see figure below).

Which one of the following failures of a wet reference leg D/P level detector will cause its level indicator to indicate the lowest stable water level? (Assume no operator action and no tank makeup.)

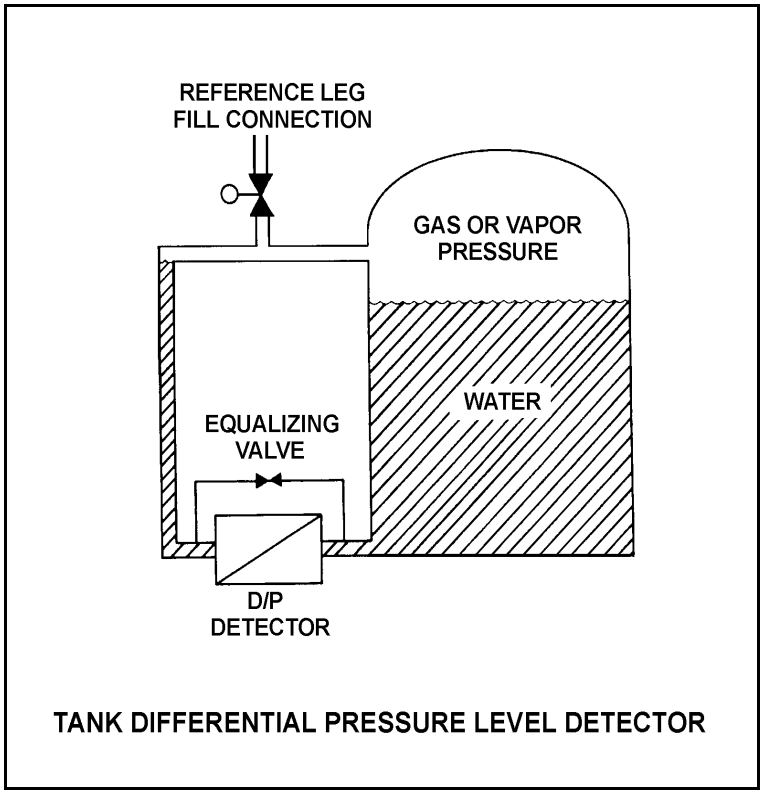
A. The tank level sensing line ruptures at the detector.

B. The reference leg ruptures at the detector.

C. The gas or vapor space ruptures.

D. The D/P cell diaphragm ruptures.

ANSWER: A.



TANK DIFFERENTIAL PRESSURE LEVEL DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B1010 (P209)

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system (see figure below).

The D/P detector was calibrated at the current conditions. Which one of the following will cause the level instrument to indicate lower than actual level? (Assume actual level remains the same.)

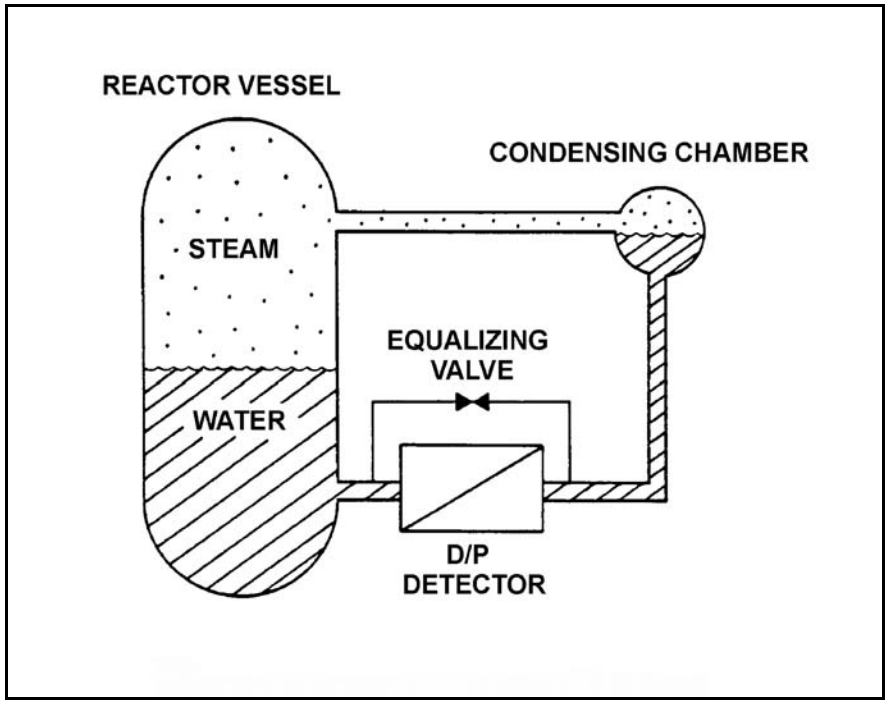
A. The variable leg ruptures.

B. The equalizing valve is opened.

C. The reference leg temperature increases.

D. The D/P cell diaphragm ruptures.

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B1212 (P2408)

Refer to the drawing of a reactor vessel (RV) differential pressure (D/P) level detection system (see figure below).

Which one of the following events will result in a reactor vessel level indication that is greater than actual level?

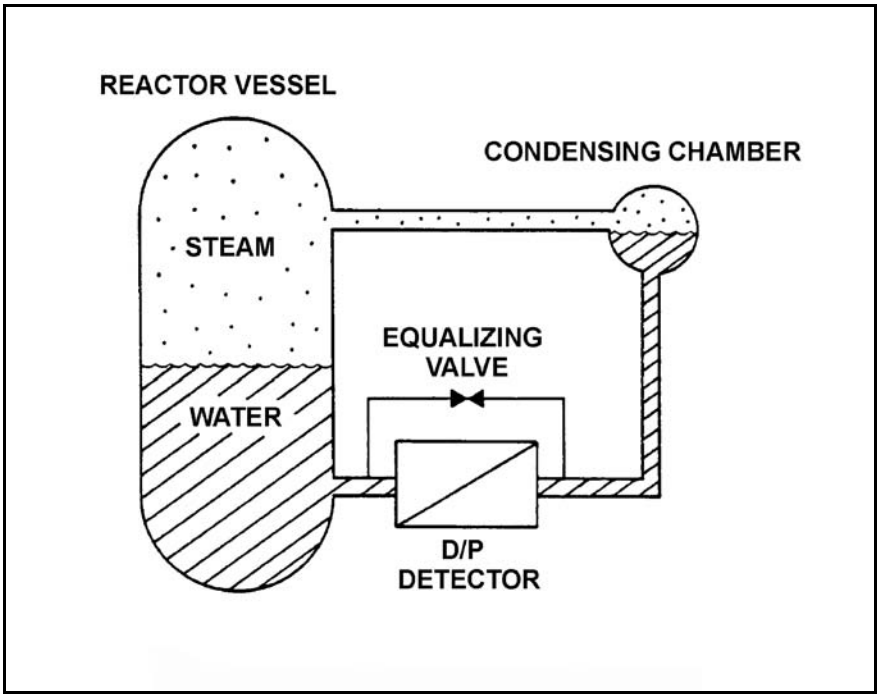
A. The RV pressure increases by 50 psia.

B. The variable leg breaks and completely drains.

C. A portion of the reference leg water flashes to steam.

D. The temperature surrounding the RV and reference leg decreases by 30°F.

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B1308

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system (see figure below).

Which one of the following will result in the lowest reactor vessel level indication?

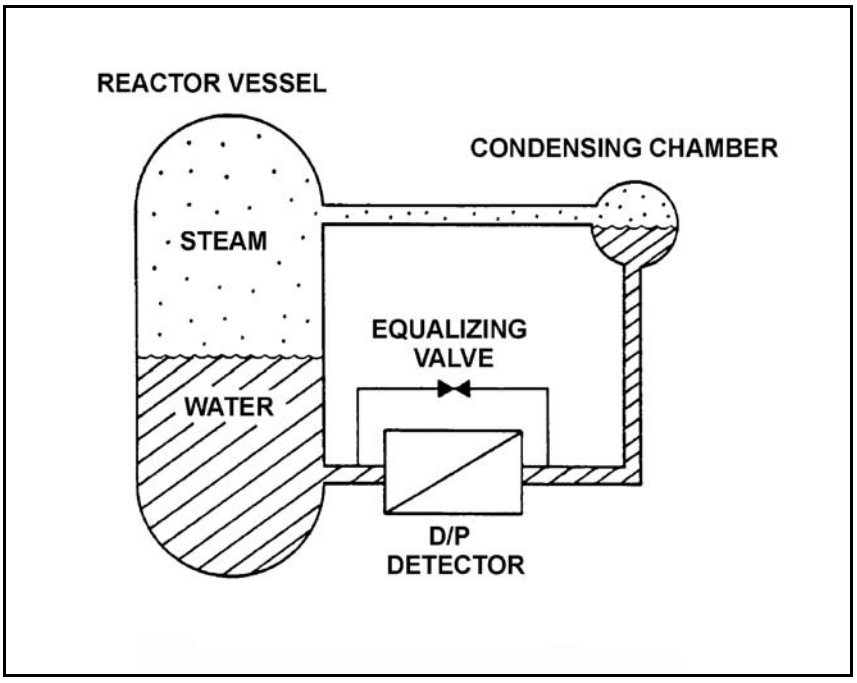
A. The reactor pressure increases by 100 psig.

B. The D/P cell equalizing valve leaks by.

C. The reference leg flashes to steam.

D. The temperature of the reference leg decreases by 20°F.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B1410

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system (see figure below).

Which one of the following events will result in a reactor vessel level indication that is greater than actual level?

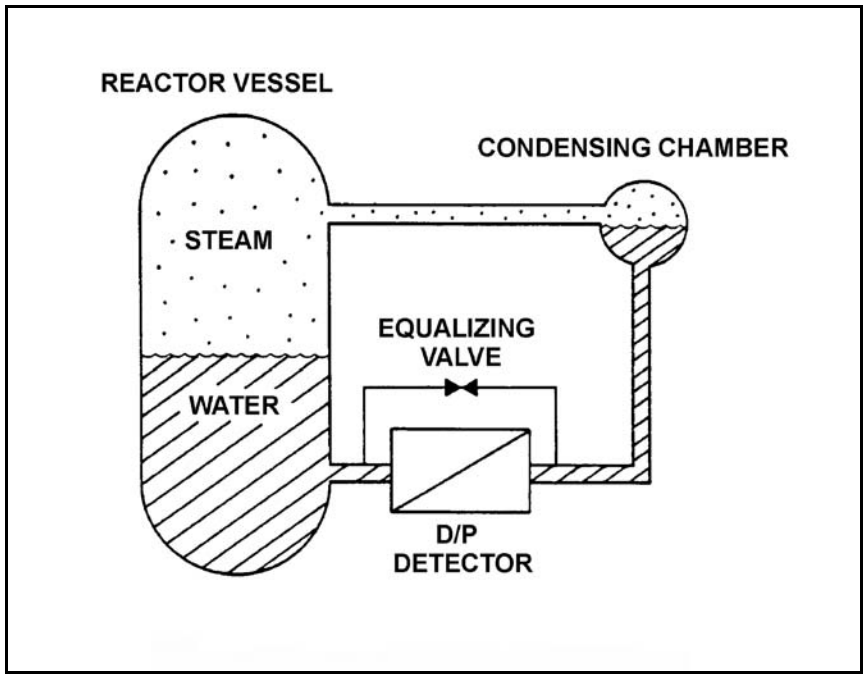
A. The external pressure surrounding the D/P detector decreases by 2 psi.

B. Reactor vessel pressure increases by 10 psi with no change in actual water level.

C. Actual vessel level increases by 6 inches.

D. The temperature of the reference leg increases by 20°F.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B2308 (P2308)

Refer to the drawing of a reactor vessel differential pressure (D/P) level detection system that was calibrated at normal operating conditions (see figure below).

A reactor vessel cooldown has resulted in a decrease in reactor vessel pressure from 900 psia to 400 psia in one hour. Without density compensation of the level instrumentation, at the end of the cooldown, reactor vessel level indication would indicate _____ than actual level because the density of the water in the _____ has changed significantly.

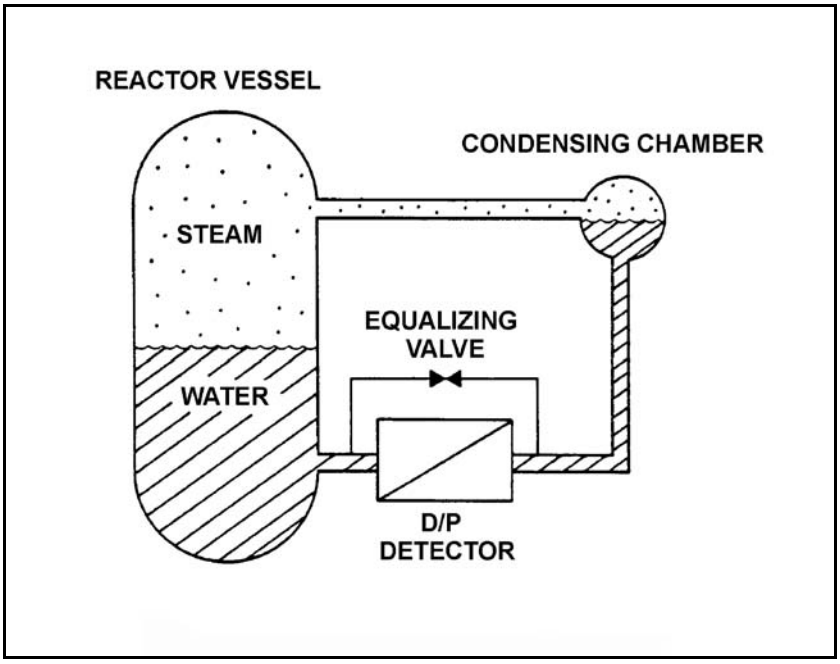
A. higher; reference leg

B. higher; reactor vessel

C. lower; reference leg

D. lower; reactor vessel

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B2709

Refer to the drawing of a reactor vessel (RV) differential pressure (D/P) level detection system (see figure below).

The reactor vessel is supplying steam at normal operating temperature and pressure and the level instrumentation has just been calibrated. Which one of the following events will result in a vessel level indication that is lower than actual level?

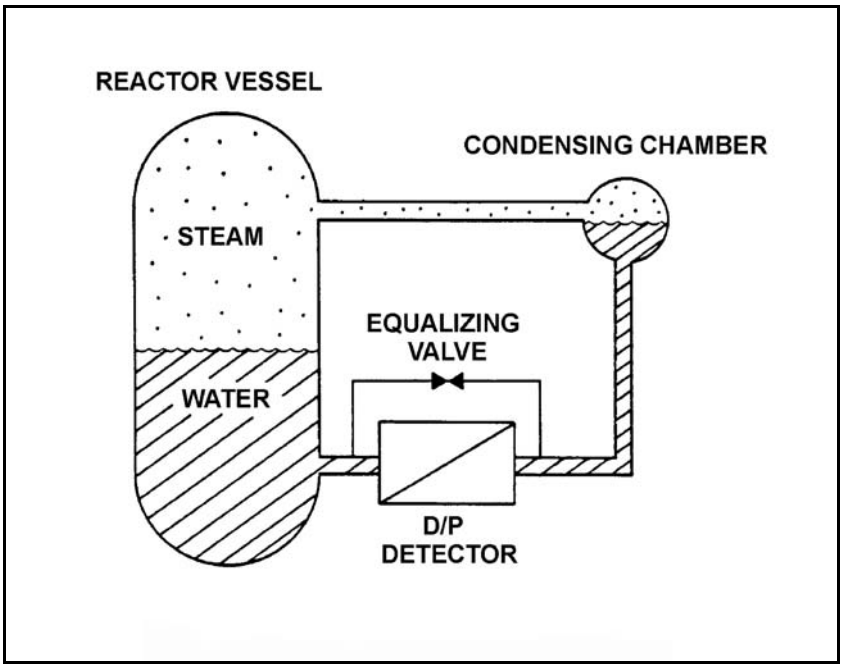
A. RV saturation pressure increases by 50 psi.

B. Actual RV water level decreases by 6 inches.

C. The external pressure surrounding the D/P detector decreases by 2 psi.

D. The temperature surrounding the reference leg increases by 20°F.

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.09 [3.3/3.3]
QID: B3808

Refer to the drawing of a reactor vessel (RV) differential pressure (D/P) level detection system (see figure below).

A nuclear reactor is shutdown with the reactor coolant system being maintained at 100 psia. The level detector has just been calibrated. Suddenly a rupture in the condensing chamber of the level detector results in a rapid drop of the condensing chamber pressure to atmospheric pressure.

Given the following current conditions:

- The condensing chamber is at atmospheric pressure.
- RV pressure is 98 psia and slowly decreasing.
- Bulk reference leg temperature is 120°F.
- Actual RV level has not changed significantly.

Which one of the following describes the current RV level indication from the detector?

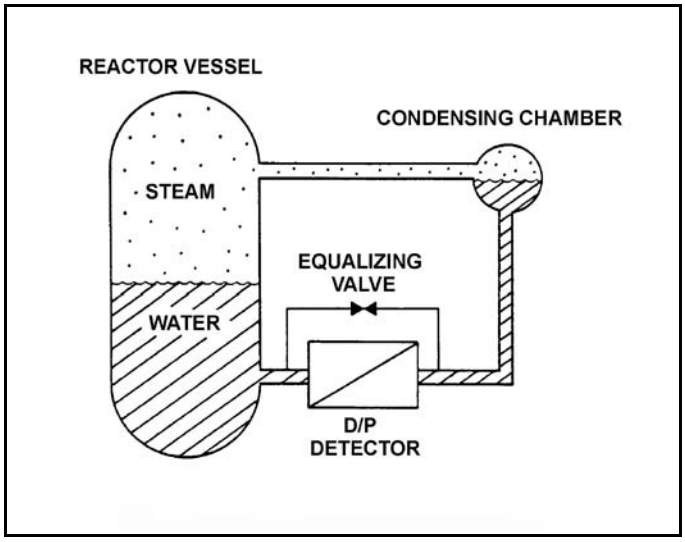
A. Offscale low because the bulk of the water in the reference leg has flashed to steam.

B. Offscale high because the bulk of the water in the reference leg has flashed to steam.

C. Offscale low because the static pressure on the reference leg is much less than the static pressure in the RV.

D. Offscale high because the static pressure on the reference leg is much less than the static pressure in the RV.

ANSWER: D.



TOPIC: 291002
KNOWLEDGE: K1.10 [2.4/2.5]
QID: B410 (P413)

If the pressure sensed by a bourdon tube increases, the curvature of the detector will _____ because the greater force is being applied to the _____ curve of the detector.

A. increase; outer

B. increase; inner

C. decrease; outer

D. decrease; inner

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.10 [2.4/2.5]
QID: B610 (P2610)

Refer to the drawing of a bellows-type differential pressure (D/P) detector (see figure below).

The spring in this detector (shown in a compressed state) has weakened from long-term use. If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

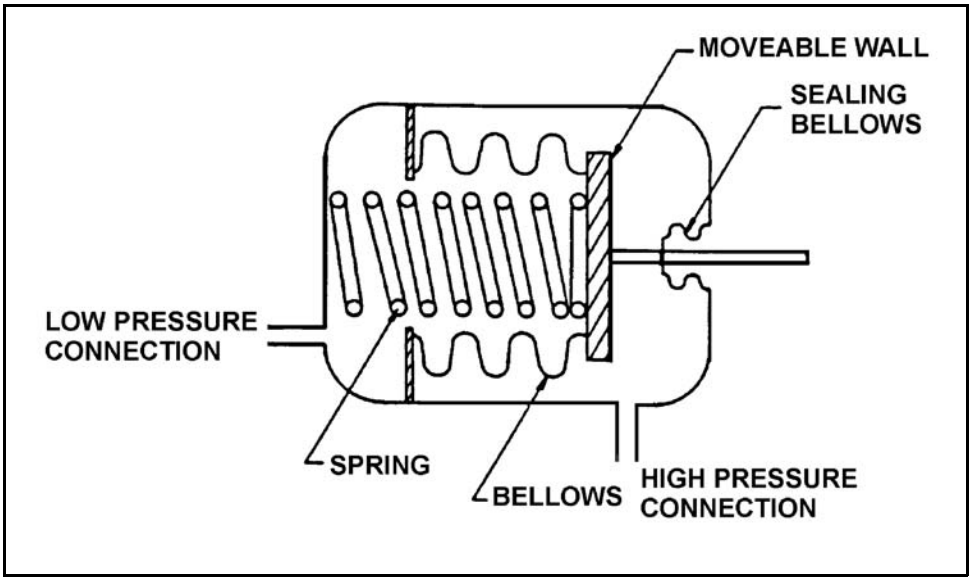
A. Decrease, because the high pressure will compress the spring more

B. Increase, because the high pressure will compress the spring more

C. Decrease, because the spring will expand more

D. Increase, because the spring will expand more

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.10 [2.4/2.5]
QID: B1011 (P1508)

A bourdon tube works on the principle that when the pressure inside the tube decreases, the tube tends to: (Assume detected pressure remains above atmospheric pressure.)

A. coil due to an increased pressure-induced force on the outside of the tube.

B. straighten due to an increased pressure-induced force on the outside of the tube.

C. coil due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

D. straighten due to the spring action of the metal overcoming the pressure-induced force on the inside of the tube.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.10 [2.4/2.5]
QID: B2109 (P2109)

A centrifugal pump is taking suction from the bottom of a vented cylindrical storage tank that contains 100,000 gallons of water at 60°F. A pressure gauge at the inlet to the pump indicates 40 psig. Over the next several days storage tank temperature increases to 90°F with no change in tank water level and no change in head loss in the pump suction line.

Which one of the following is the current pressure at the inlet to the pump?

A. 39.8 psig

B. 37.4 psig

C. 34.6 psig

D. 31.2 psig

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.11 [2.4/2.5]
QID: B210 (P210)

A simple bellows pressure detector is connected to a cooling water system. The detector is located in the reactor containment and has its low pressure side vented to the containment atmosphere. Current system pressure indication is 100 psig.

If a main steam line break raises containment pressure by 40 psig, the system pressure indication will: (Disregard any temperature effect on the pressure detector.)

A. increase by 40 psig.

B. increase by the square root of 40 psig.

C. decrease by 40 psig.

D. decrease by the square root of 40 psig.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.11 [2.3/2.5]
QID: B711 (P710)

Cooling water system pressure is being monitored by a simple diaphragm pressure detector with its low pressure side vented to the containment. If a main steamline rupture raises containment pressure by 20 psi, cooling water system pressure indication will: (Disregard any temperature effect on the detector.)

A. increase by 20 psi.

B. decrease by 20 psi.

C. increase by the square root of 20 psi.

D. decrease by the square root of 20 psi.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.11 [2.3/2.5]
QID: B1310 (P509)

A cooling water system bourdon tube pressure detector is located inside a sealed building and system pressure currently indicates 50 psig. A building ambient temperature increase of 100°F will cause a _____ change in indicated system pressure, and a building pressure increase of 20 psig will cause a _____ change in indicated system pressure.

A. significant; significant

B. negligible; significant

C. significant; negligible

D. negligible; negligible

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.11 [2.3/2.5]
QID: B1908 (P2211)

Refer to the drawing of a bellows-type pressure detector (see figure below).

A bellows-type pressure detector with its low-pressure side vented to containment atmosphere is being used to measure reactor vessel pressure. A decrease in the associated pressure indication will be caused by either a containment pressure _____ or a _____.

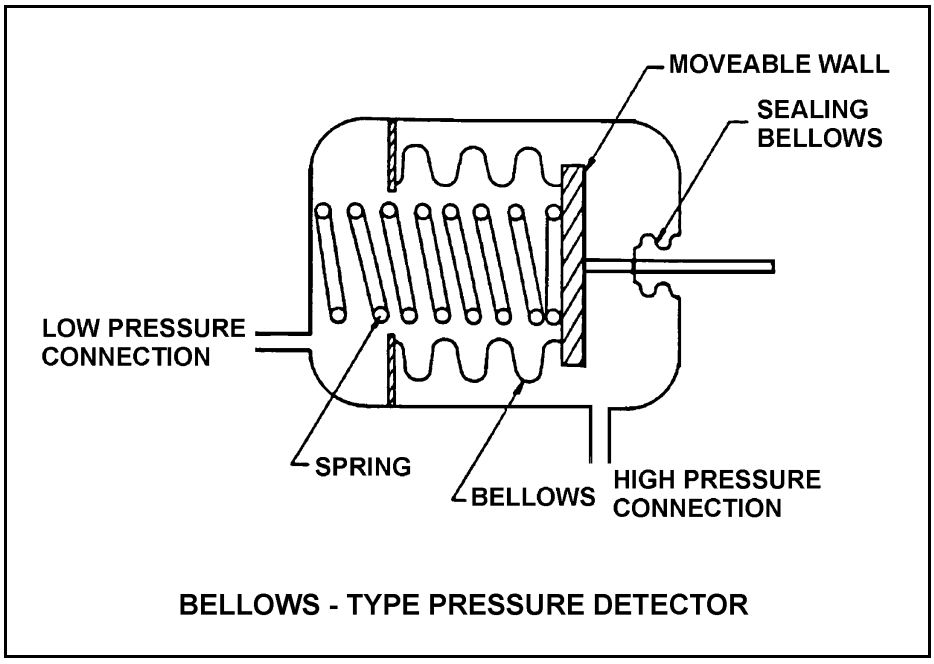
A. increase; ruptured bellows

B. increase; broken spring

C. decrease; ruptured bellows

D. decrease; broken spring

ANSWER: A.



BELLOWS - TYPE PRESSURE DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.11 [2.3/2.5]
QID: B2910 (P1011)

A properly calibrated 0 to 100 psia diaphragm pressure detector is connected to a pressurized system; the low pressure side of the detector is vented to the atmosphere. The detector is currently producing a system pressure indication of 75 psia.

If the detector diaphragm ruptures, indicated pressure will be approximately...

A. 0 psia.

B. 15 psia.

C. 60 psia.

D. 90 psia.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.11 [2.3/2.5]
QID: B2912 (P3509)

The pressure within a cooling water system is 100 psig, as indicated by a bourdon tube pressure detector. The cooling water system and the detector are located inside a reactor containment building. The pressure detector case is vented to the containment building, which is currently at atmospheric pressure.

If a steam line rupture raises the containment building pressure by 20 psi, the cooling water system pressure indication will: (Disregard any temperature effect on the detector.)

A. increase to 120 psig.

B. increase by a small, but indeterminate amount.

C. decrease by a small, but indeterminate amount.

D. decrease to 80 psig.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.12 [2.3/2.5]
QID: B611

Which one of the following parameters requires square root compensation when measured by a differential pressure detector?

A. Reactor vessel level

B. Condenser vacuum

C. Reactor vessel pressure

D. Recirculation pump flow rate

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.12 [2.3/2.5]
QID: B1610 (P510)

Refer to the drawing of a bellows-type differential pressure (D/P) detector (see figure below).

The spring in this detector (shown in a compressed state) has weakened from long-term use. If the actual D/P is constant, how will indicated D/P respond as the spring weakens?

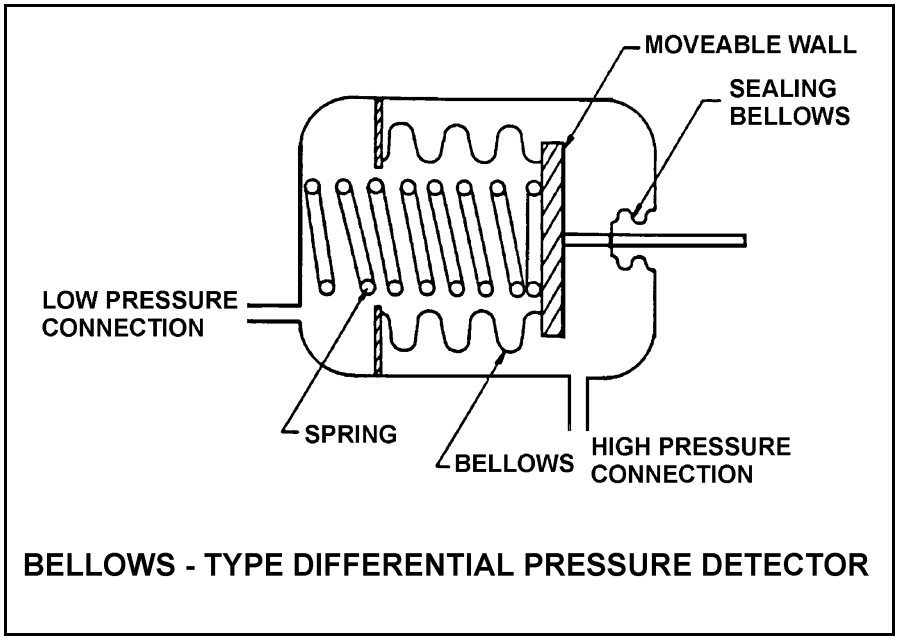
A. Increase, because the spring will expand more

B. Decrease, because the spring will expand more

C. Increase, because the spring will compress more

D. Decrease, because the spring will compress more

ANSWER: C.



BELLOWS - TYPE DIFFERENTIAL PRESSURE DETECTOR

TOPIC: 291002
KNOWLEDGE: K1.13 [2.9/3.1]
QID: B212 (P211)

A bourdon-tube pressure detector was indicating 50% of scale when it was suddenly exposed to a high-pressure transient that caused permanent strain to the bourdon tube. The detector remained intact and actual pressure was restored to its original value.

During the pressure transient, the affected pressure indication initially went off-scale high. After the original pressure was restored, the indication was...

A. unpredictable.

B. less than 50% of scale.

C. 50% of scale.

D. greater than 50% of scale.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B14

Which one of the following describes a characteristic of a thermocouple?

A. A junction between two dissimilar metals will exhibit a change in electrical resistance proportional to temperature.

B. A junction between two dissimilar metals will generate a voltage proportional to temperature.

C. Thermocouples are generally more accurate than resistance temperature detectors.

D. Indication will fail high offscale with an open circuit.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B208 (P414)

If a resistance temperature detector develops an <u>open</u> circuit (bridge circuit remains intact), indication will fail...

A. high.

B. low.

C. as is.

D. to midscale.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B309 (P1510)

In contrast to a thermocouple, a resistance temperature detector...

A. is used in high temperature applications.

B. does <u>not</u> require an external power supply for temperature indication.

C. uses a single type of metal or alloy in the sensing element.

D. is commonly placed in direct contact with the monitored substance.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B310 (P312)

If shorting occurs within a resistance temperature detector, the associated indication will fail...

A. low.

B. high.

C. as is.

D. to midscale.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B1112

An operator suspects that a steam temperature instrument reading is not correct. A recently calibrated pressure gauge, which senses steam pressure for the same steam line, indicates 351 psig.

Assuming the system is operating at saturated conditions, what is the actual steam temperature?

A. 424°F

B. 428°F

C. 432°F

D. 436°F

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B1314 (P1209)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 350°F. A small steam leak occurs that raises reference (cold) junction temperature by 20°F. Assume measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new temperature indication will be...

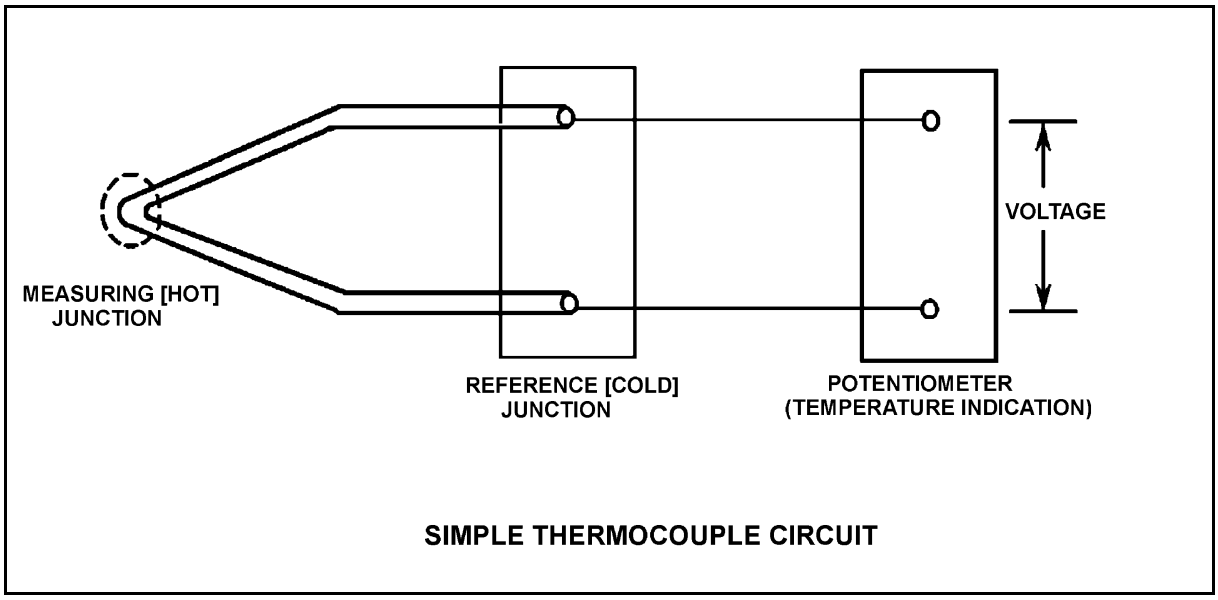
A. 310°F.

B. 330°F.

C. 370°F.

D. 390°F.

ANSWER: B.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B1510 (P2212)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Circuit temperature indication is currently 350°F. The reference (cold) junction temperature decreases by 10°F. Assume the measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new temperature indication will be...

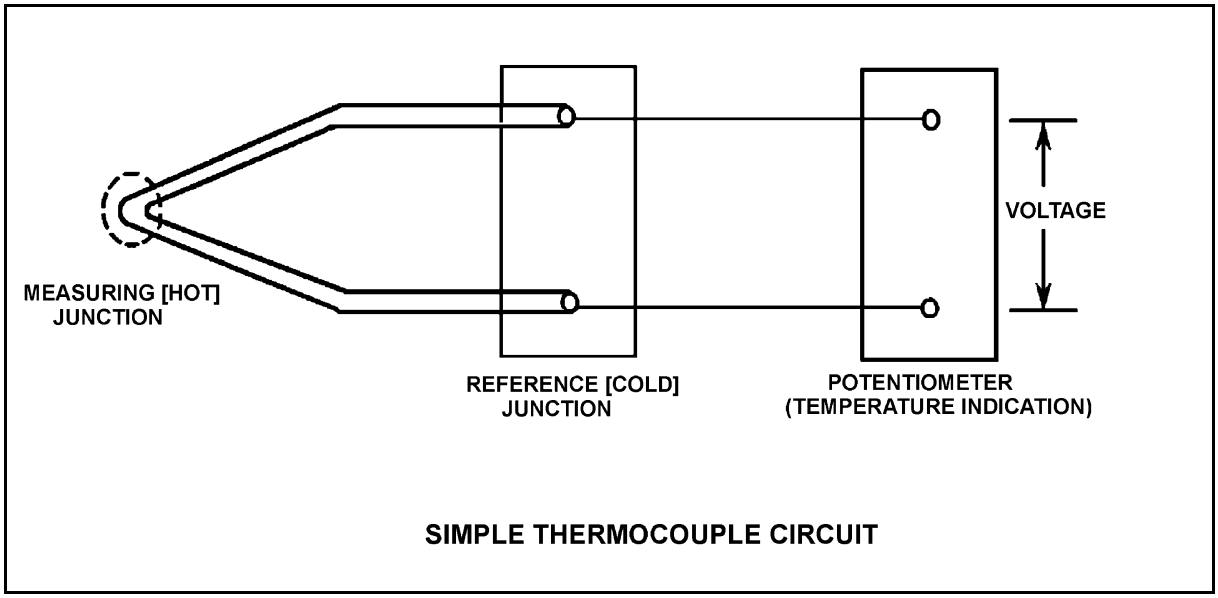
A. 340°F.

B. 350°F.

C. 360°F.

D. 370°F.

ANSWER: C.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B1710 (P1710)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 150°F. A small steam leak occurs that raises both the measuring (hot) junction and reference (cold) junction temperatures by 20°F. Without temperature compensation for the reference junction, the new temperature indication will be...

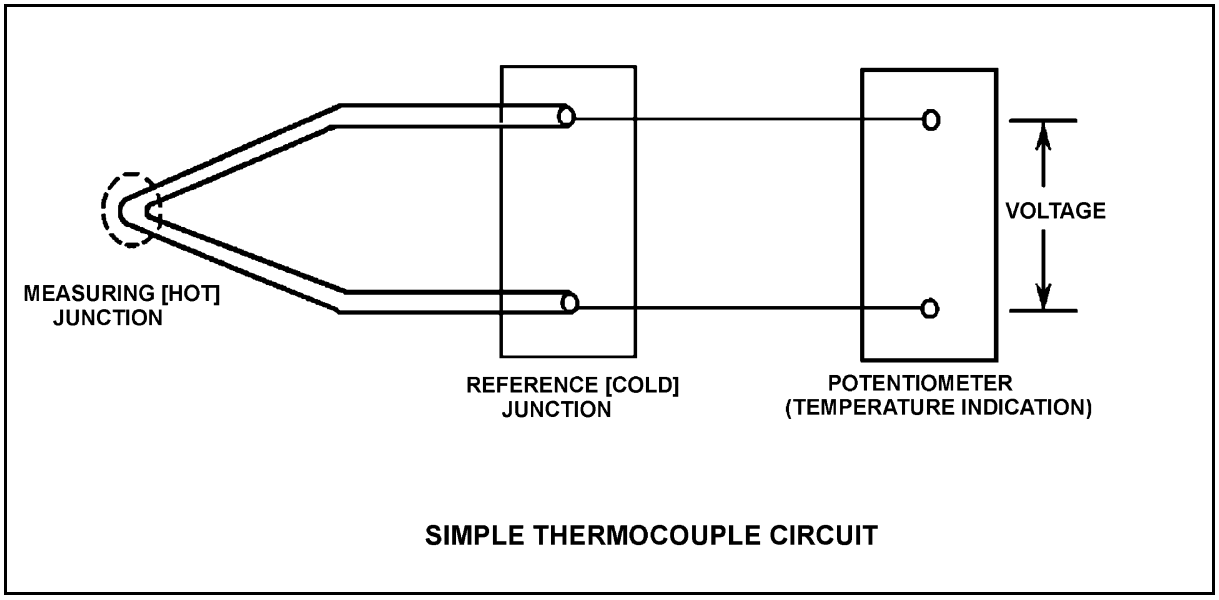
A. 130°F.

B. 150°F.

C. 170°F.

D. 190°F.

ANSWER: B.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B2009 (P2011)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 150°F. Reference junction temperature is currently 90°F. Indicator range is from 0°F to 2000°F.

If one of the thermocouple extension wires loosens and becomes dislodged from its terminal in the reference junction panel, which one of the following temperature indications will occur?

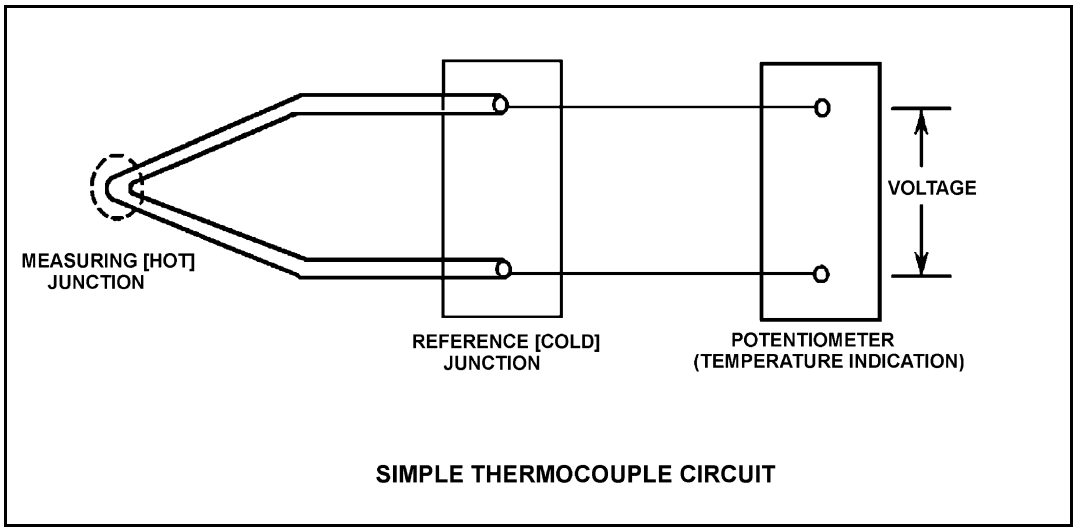
A. Minimum instrument reading (0°F)

B. 60°F

C. 90°F

D. Maximum instrument reading (2000°F)

ANSWER: A.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B2412 (P2409)

What is the purpose of the reference junction panel that is provided with many thermocouple circuits?

A. Ensures that thermocouple output is amplified sufficiently for use by temperature indication devices.

B. Ensures that temperature changes away from the thermocouple measuring junction do not affect thermocouple temperature indication.

C. Ensures that electrical noise in the thermocouple extension wires does not affect thermocouple temperature indication.

D. Ensures that different lengths of thermocouple extension wires do not affect thermocouple temperature indication.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B2712 (P2711)

Unlike a resistance temperature detector, a typical thermocouple...

A. uses a single type of metal in the sensing element

B. requires a temperature-controlled reference junction.

C. can provide temperature input to a valve controller in a cooling water system.

D. requires an external power supply to provide indication of temperature.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B2911 (P1412)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is currently 390°F. A small steam leak occurs that raises reference (cold) junction temperature by 20°F. Assume measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new temperature indication will be...

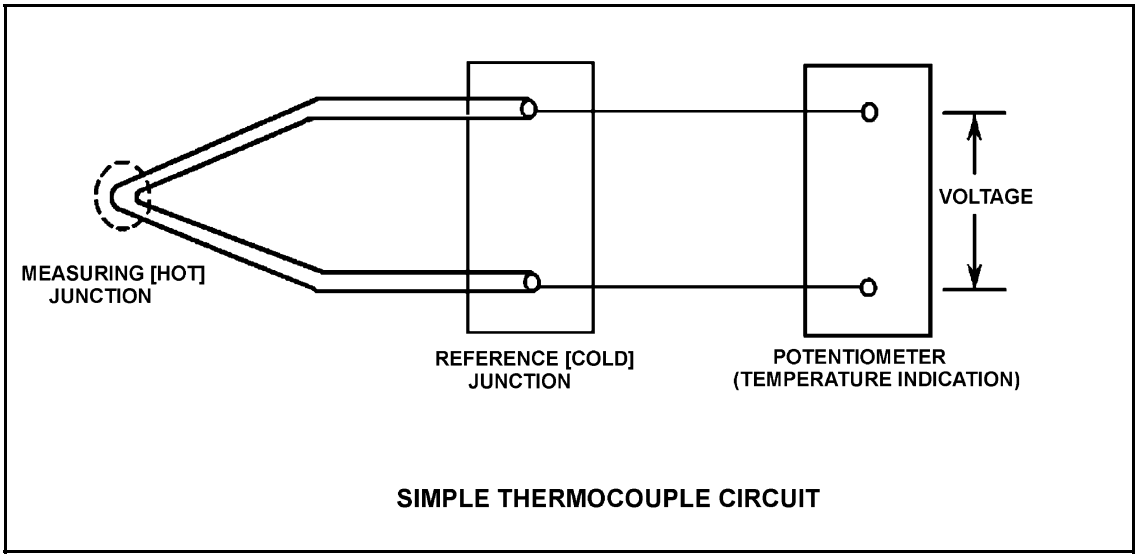
A. 370°F.

B. 390°F.

C. 400°F.

D. 410°F.

ANSWER: A.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B3013 (P3011)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Thermocouple temperature indication is 410°F with the reference (cold) junction at 125°F. An ambient temperature decrease lowers reference junction temperature to 110°F. Assume the measuring junction temperature remains constant. Without temperature compensation for the reference junction, the new thermocouple temperature indication will be...

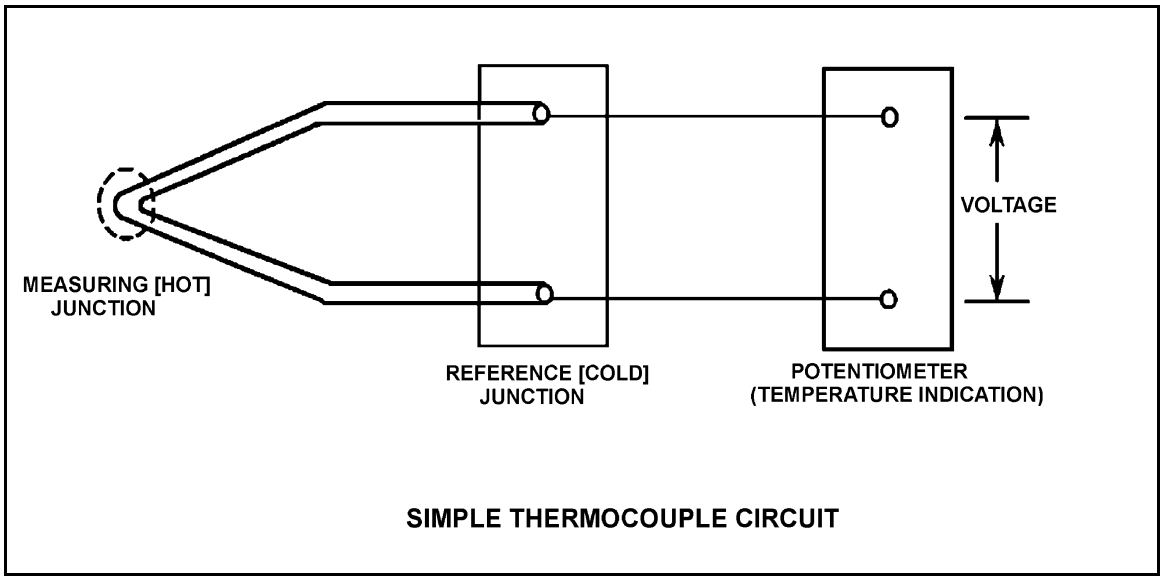
A. 380°F.

B. 395°F.

C. 410°F.

D. 425°F.

ANSWER: D.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B4206 (P4206)

Refer to the drawing of a simple thermocouple circuit (see figure below).

Given that the temperatures at the measuring and reference junctions remain constant, if a ventilation system malfunction causes the temperature of the temperature indication panel to increase by 10°F, indicated temperature will...

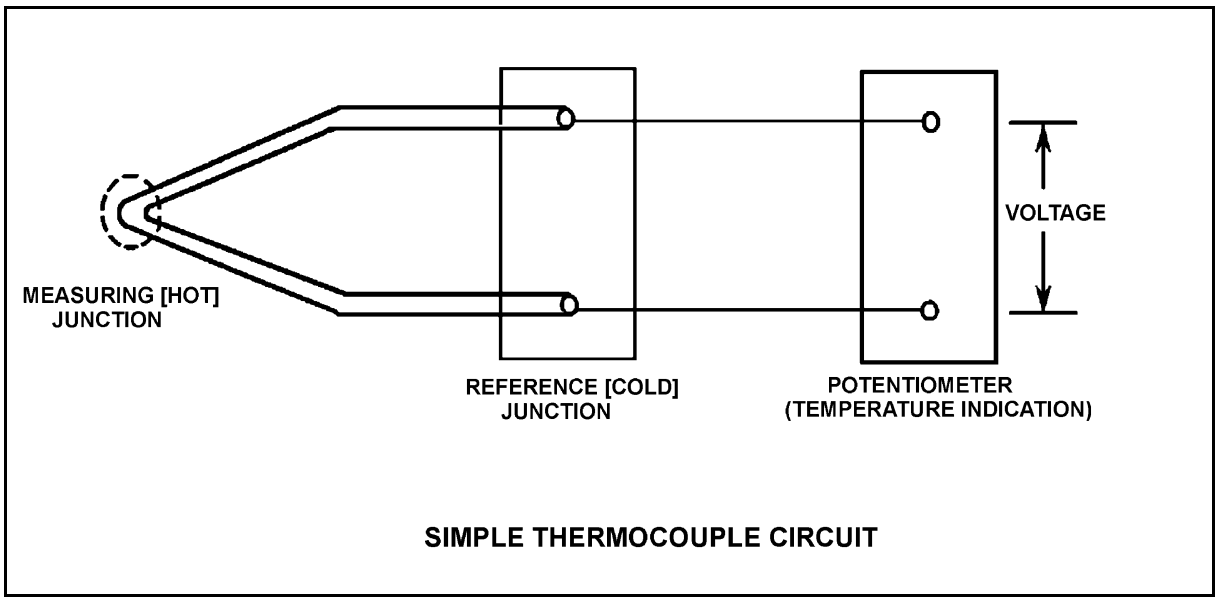
A. not be affected.

B. increase by 10°F.

C. decrease by 10°F.

D. change in an unpredictable manner.

ANSWER: A.



SIMPLE THERMOCOUPLE CIRCUIT

TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B5305 (P5305)

Refer to the drawing of a simple thermocouple circuit (see figure below).

The measuring and reference junctions are located inside the reactor containment building while the potentiometer is located in a remote location outside the containment building. Thermocouple temperature indication is initially 500°F.

An ambient temperature decrease outside the containment building lowers the temperature of the potentiometer by 10°F while the measuring and reference junction temperatures remain constant. Thermocouple temperature indication at the lower ambient temperature will be...

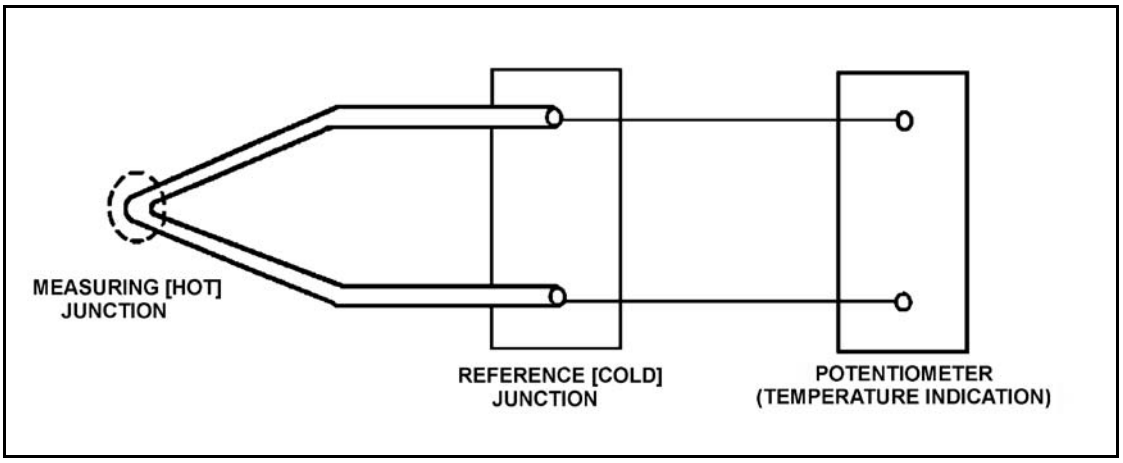
A. 490°F.

B. 500°F.

C. 510°F.

D. unpredictable.

ANSWER: B.



TOPIC: 291002
KNOWLEDGE: K1.15 [2.6/2.8]
QID: B5507 (P5505)

Refer to the drawing of a Chromel-Alumel thermocouple circuit (see figure below).

What is the effect on the thermocouple reference junctions if the chromel and alumel extension wires from the thermocouple connection head to the reference junction panel are replaced with copper wires?

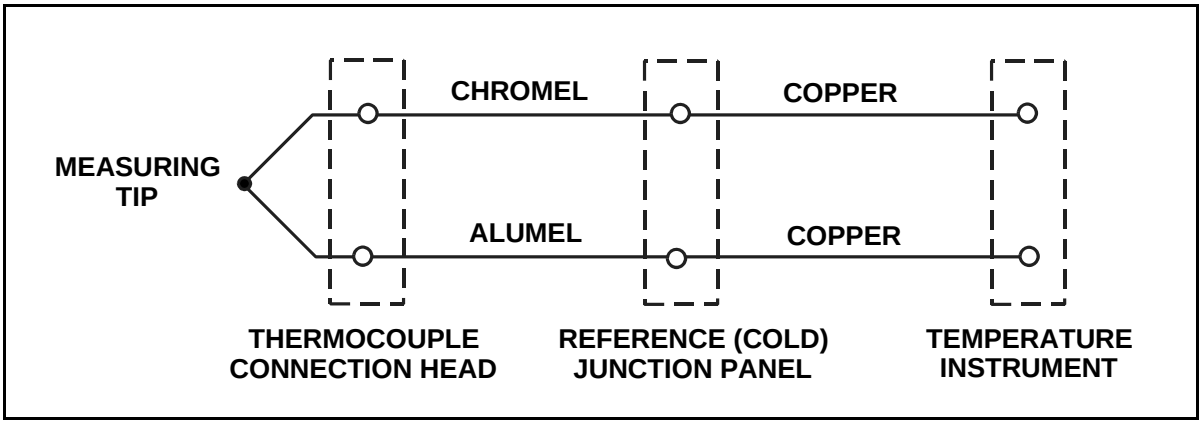
A. The reference junctions will be located in the thermocouple connection head.

B. The reference junctions will still be located in the reference junction panel.

C. The reference junctions will be located in the temperature instrument.

D. There will no longer be any reference junctions.

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.16 [2.5/2.7]
QID: B812 (P813)

What is the most common type of sensor used to provide remote position indication of a valve that is normally either fully open or fully closed?

A. Limit switch

B. Reed switch

C. Servo transmitter

D. Linear variable differential transformer

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.16 [2.5/2.7]
QID: B1712 (P1313)

Which one of the following devices is commonly used to provide remote indication of valve position on an analog meter in units of "percent of full open"?

A. Limit switch

B. Reed switch

C. Linear variable differential transformer

D. Resistance temperature detector

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.16 [2.5/2.7]
QID: B2611

Reed switches are being used in an electrical measuring circuit to monitor the position of a control rod in a nuclear reactor. The reed switches are mounted in a column below the reactor vessel such that the control rod drive shaft passes by the reed switches as the control rod is withdrawn.

Which one of the following describes the action that causes the electrical output of the measuring circuit to change as the control rod is withdrawn?

A. An ac coil on the control rod drive shaft induces a voltage into each reed switch as the drive shaft passes by.

B. A metal tab on the control rod drive shaft mechanically closes each reed switch as the drive shaft passes by.

C. The primary and secondary coils of each reed switch attain maximum magnetic coupling as the drive shaft passes by.

D. A permanent magnet on the control rod drive shaft attracts the movable contact arm of each reed switch as the drive shaft passes by.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.16 [2.5/2.7]
QID: B2811 (P2813)

Refer to the simplified drawing of a control rod position detector circuit (see figure below).

A magnet on the control rod extension (or drive) shaft sequentially closes individual reed switches mounted vertically adjacent to the control rod drive housing. A constant +5 dc volts is supplied to the input of the resistor network at resistor R_1.

A control rod is initially fully inserted such that all reed switch contacts are open; then the rod is withdrawn until reed switch contact S_1 is closed. Compared to the initial circuit currents, the current through resistor R_5 after the rod withdrawal will be _____, and the output current of the resistor network to the amplifier will be _____.

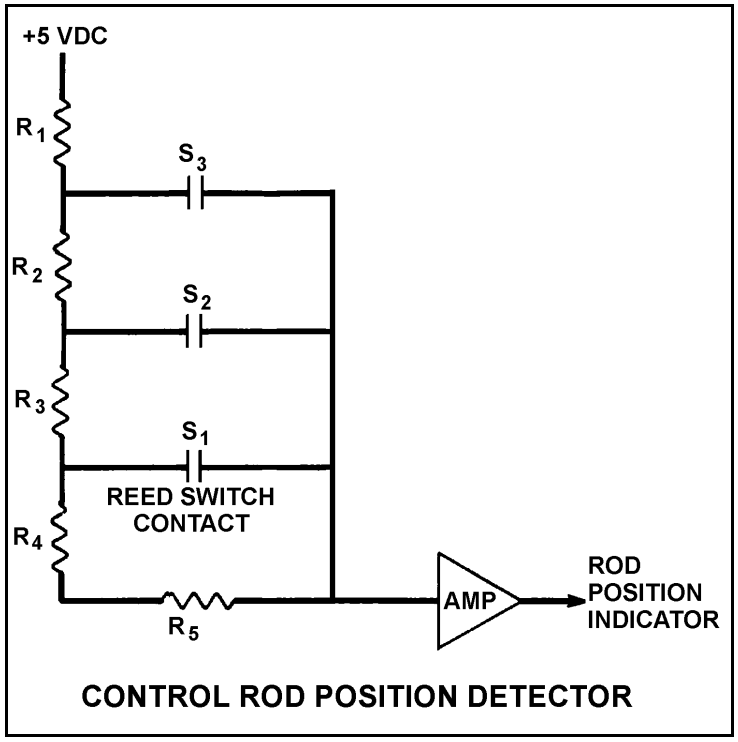
A. lower, higher

B. lower, lower

C. higher, higher

D. higher, lower

ANSWER: A.



TOPIC: 291002
KNOWLEDGE: K1.19 [3.0/3.1]
QID: B213 (P214)

Most of the electrons collected in a fission chamber are released as a result of ionizations caused directly by...

A. fission fragments.

B. fission gammas.

C. fission betas.

D. fissionable materials.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.19 [3.0/3.1]
QID: B612

Gamma radiation contributes to the output of a fission chamber mainly by interacting with the...

A. detector gas.

B. detector leads.

C. center electrode.

D. U-235 coating on the detector walls.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.19 [3.0/3.1]
QID: B1113 (P1909)

Which one of the following is the function of the positive electrode in an ion chamber?

A. Produce ions when exposed to a radiation field

B. Release electrons to combine with positive ions

C. Perform gas quenching to maximize detector sensitivity

D. Collect the electrons released during gas ionization

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.19 [3.0/3.1]
QID: B1214

A reactor scrammed due to a loss-of-coolant accident one hour ago. To verify adequate reactor vessel water level, the source range monitors (SRMs) were inserted. As the SRMs entered the core, source range count rate increased and then became relatively stable as the SRMs continued upward into the water-filled region of the core.

If the SRMs enter a voided section of the core, count rate will suddenly...

A. decrease due to increased neutron leakage.

B. decrease due to decreased fast fission.

C. increase due to increased neutron migration length.

D. increase due to decreased moderator neutron absorption.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.19 [3.0/3.1]
QID: B2312

A reactor scrammed due to a loss-of-coolant accident 1 hour ago. To verify adequate reactor vessel water level, the source range monitors (SRMs) were fully inserted into the core.

If the SRMs are currently in a voided section of the core, how will the count rate change when the SRMs are withdrawn below core water level?

A. Decrease due to decreased neutron migration length.

B. Decrease due to increased moderator neutron absorption.

C. Increase due to decreased neutron leakage.

D. Increase due to increased fast fission.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.19 [3.0/3.1]
QID: B3112

Fission chamber detectors are used to monitor reactor power/neutron level in a shutdown reactor as well as a reactor operating at full power (and all power levels in between). At what power level(s) is it necessary to compensate the output of the fission chamber detectors for gamma interactions with the detectors and why?

A. At all power levels, because gamma interactions produce larger detector pulses than neutron interactions.

B. At all power levels, because gamma interactions produce smaller detector pulses than neutron interactions.

C. Only when shutdown or at low power levels, because gamma flux is <u>not</u> proportional to reactor power at low power levels.

D. Only when operating at high power levels, because gamma flux is <u>not</u> proportional to reactor power at high power levels.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.21 [2.8/2.9]
QID: B513

A fission chamber used for reactor neutron monitoring is operating in the ionization region. If the voltage supplied to the fission chamber is continuously increased, which one of the following operating regions will the detector enter next?

A. Proportional

B. Recombination

C. Geiger-Mueller

D. Limited proportional

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.21 [2.8/2.9]
QID: B713

A fission chamber neutron monitoring instrument is operating in the proportional region of the gas ionization curve. If the voltage supplied to the fission chamber is continuously decreased, which one of the following operating regions will the detector enter next?

A. Geiger-Mueller

B. Recombination

C. Limited proportional

D. Ionization

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.21 [2.8/2.9]
QID: B814 (P1812)

A gas-filled radiation detector operating in the proportional region is exposed to a constant gamma radiation field. If the applied voltage is increased but maintained within the proportional region, the rate of ion collection will...

A. increase because more secondary ionizations are occurring in the detector.

B. increase because fewer primary ions are recombining in the detector prior to reaching the electrodes.

C. stay approximately the same because the ion chamber is operating at saturated conditions.

D. stay approximately the same because all of the primary ions were already being collected at the lower voltage.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.21 [2.8/2.9]
QID: B2413 (P2014)

What is the effect on a proportional neutron detector if the detector operating voltage is increased such that the detector operates near the high end of the true proportional region on the gas-filled detector characteristic curve?

A. Neutron-induced pulses will become so large that gamma pulse discrimination is no longer needed, yielding a more accurate neutron count rate.

B. The positive space charge effect will increase and prevent collection of both gamma- and neutron-induced pulses, yielding a less accurate neutron count rate.

C. A high rate of incident gamma radiation will result in the combination of multiple small gamma-induced pulses into larger pulses. The larger combined pulses will be counted as neutron-induced pulses, yielding a less accurate neutron count rate.

D. Detection of any single ionizing event will result in ionizing nearly the entire detector gas volume. The resulting large pulses will prevent the detector from differentiating between radiation types, yielding a less accurate neutron count rate.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.21 [2.8/2.9]
QID: B2613 (P2313)

A gas-filled radiation detector operating in the proportional region is exposed to a constant gamma radiation field. If the applied voltage is decreased but maintained within the proportional region, the rate of ion collection will...

A. stay approximately the same because all primary ions are collected as long as detector voltage remains in the proportional region.

B. stay approximately the same because the detector is still operating at saturated conditions.

C. decrease because a decreased space charge around the positive electrode reduces gas amplification.

D. decrease because fewer secondary ionizations are occurring in the detector.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.21 [2.8/2.9]
QID: B5607 (P5606)

A proportional detector with pulse height discrimination circuitry is being used in a constant field of neutron and gamma radiation to provide source range neutron count rate indication. Assume that the pulse height discrimination setpoint does not change.

If the detector's operating voltage is increased but maintained within the true proportional operating region, count rate indication will increase because...

A. a single neutron- or gamma- induced ionizing event will result in multiple pulses inside the detector.

B. the ratio of the number of neutron-induced pulses to gamma-induced pulses inside the detector will increase.

C. the positive space charge effect will increase and promote the collection of both gamma- and neutron-induced pulses.

D. all detector pulses will increase in amplitude and previously uncounted gamma pulses will be added to the total count rate.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.22 [3.0/3.1]
QID: B511 (P1514)

A fission chamber reactor neutron monitoring instrument is operating in the proportional region. If a complete loss of fission chamber gas pressure occurs, the instrument indication will fail...

A. upscale.

B. downscale.

C. as is.

D. to midscale.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.22 [3.0/3.1]
QID: B613

Which one of the following will cause an upscale failure of a fission chamber neutron detector?

A. The detector electrode high voltage power supply output has decreased by 5% due to setpoint drift.

B. The detector chamber has become flooded with water due to leakage around the electrodes.

C. A power supply fuse in the amplifier circuit for the neutron monitoring instrument drawer has opened.

D. The uranium-235 in the detector coating has been transformed to uranium-236 by neutron absorption.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.22 [3.0/3.1]
QID: B3414

Two identical fission chamber neutron detectors (operating in the proportional region) are being used to monitor the neutron flux during a reactor startup. Detector A has developed a tiny leak and the argon fill gas pressure has decreased to approximately 25% of the gas pressure in detector B. When the reactor reaches criticality, the neutron level indicated by detector A will be _____ than the neutron level indicated by detector B, primarily because the incident neutrons result in _____ .

A. larger; more fissions in detector A

B. smaller; fewer fissions in detector A

C. larger; more ionizations in the detector A gas

D. smaller; fewer ionizations in the detector A gas

ANSWER: D

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B313 (P2013)

An ion chamber radiation detector is exposed to a constant gamma radiation field. If the applied voltage is increased but maintained within the ion chamber region, the rate of ion collection will...

A. increase because more secondary ionizations are occurring in the detector.

B. stay approximately the same because all of the primary ions were already being collected at the lower voltage.

C. increase because less primary ions are recombining in the detector prior to reaching the electrodes.

D. stay approximately the same because the ion chamber is operating at saturated conditions.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B314 (P13)

Scintillation detectors convert radiation energy into light by a process known as...

A. gas amplification.

B. space charge effect.

C. luminescence.

D. photoionization.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B414

Refer to the drawing of a gas-filled detector characteristic curve (see figure below).

Which one of the following statements describes how a gas-filled radiation detector, operating in the "proportional" region, functions?

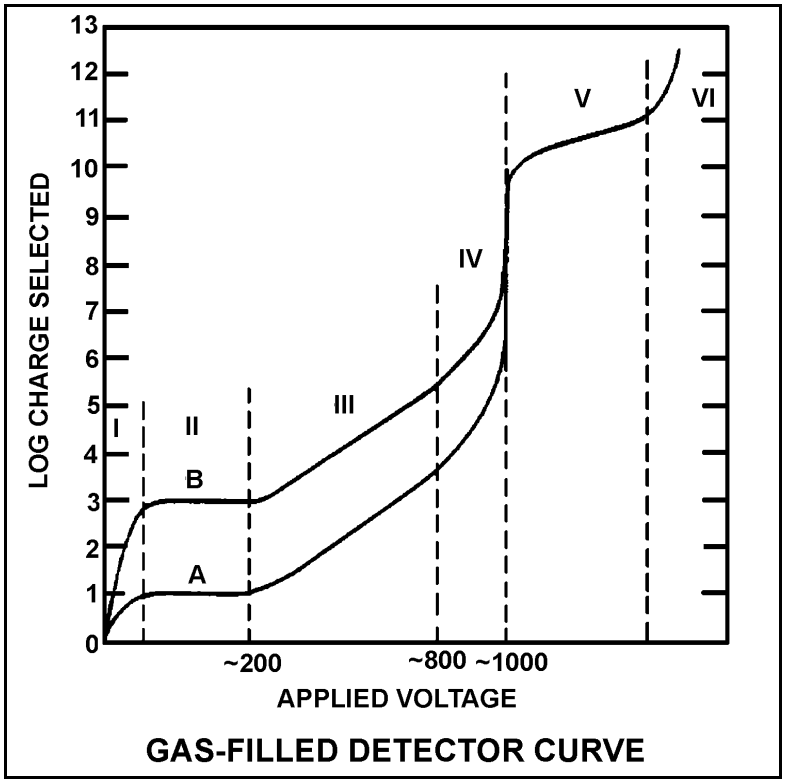
A. Essentially all of the ions from primary ionizations are collected; ions collected from secondary ionizations are independent of applied voltage.

B. Essentially none of the ions from primary ionizations are collected; ions collected from secondary ionizations vary directly with applied voltage.

C. Essentially all of the ions from primary ionizations are collected; ions collected from secondary ionizations vary directly with applied voltage.

D. Essentially none of the ions from primary ionizations are collected; ions collected from secondary ionizations are independent of applied voltage.

ANSWER: C.



TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B714 (P714)

Which one of the following types of radiation is the major contributor to the dose indication on a self-reading pocket dosimeter (SRPD)? (Also called SRD, PIC, and direct reading dosimeter)

A. Alpha

B. Beta

C. Gamma

D. Neutron

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B913 (P1613)

Which one of the following describes a characteristic of a Geiger-Mueller radiation detector?

A. Radiation types can be identified by pulse height and duration.

B. Specific radionuclides can be identified with the use of gamma spectrometry.

C. Small variations in applied voltage will result in large changes in detector output.

D. Any type of radiation that ionizes the detector gas will produce the same magnitude detector output pulse.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B1114 (P2613)

Which one of the following describes the reason for the high sensitivity of a gas-filled ion chamber operating in the Geiger- Mueller region?

A. Any radiation-induced ionization results in a large detector output pulse.

B. Geiger-Mueller detectors are longer than other types of radiation detectors, resulting in greater detector surface area.

C. The detector output is inversely proportional to the applied voltage within the Geiger-Mueller region.

D. High detector voltage allows differentiation between the various radiation types.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B1514 (P1513)

Which one of the following lists the two types of gas-filled radiation detectors whose outputs will be least affected by a small variation (± 10 volts) in the voltage applied to the detectors? (Assume voltage remains within normal range.)

A. Limited proportional and Geiger Mueller

B. Ion chamber and proportional

C. Proportional and limited proportional

D. Geiger Mueller and ion chamber

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B1714 (P1713)

A Geiger-Mueller radiation detector is located in a radiation field consisting of beta, gamma, and fast neutron radiation. Assuming each type of radiation enters the detector gas chamber and ionizes the detector gas, which one of the following describes the resulting detector pulse sizes?

A. Beta radiation will produce a larger pulse size than either gamma or fast neutron radiation.

B. Gamma radiation will produce a larger pulse size than either beta or fast neutron radiation.

C. Fast neutron radiation will produce a larger pulse size than either beta or gamma radiation.

D. Beta, gamma, and fast neutron radiation will produce pulse sizes that are equal in magnitude.

ANSWER: D.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B2414 (P2413)

A gas-filled radiation detector operating in the ionization chamber (IC) region is being exposed to a constant gamma radiation field. If the applied voltage is decreased but maintained within the IC region, the rate of ion collection will...

A. stay approximately the same because all of the primary ions continue to be collected and essentially no secondary ionizations are occurring.

B. stay approximately the same because detector operation in the ionization chamber region is characterized by complete ionization of the detector gas.

C. decrease because fewer primary ionizations are occurring in the detector as detector voltage decreases.

D. decrease because fewer secondary ionizations are occurring in the detector as detector voltage decreases.

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B3714 (P3714)

During reactor power operation, a reactor coolant sample is taken and analyzed. Which one of the following lists three radionuclides that are all indicative of a fuel cladding failure if detected in elevated concentrations in the reactor coolant sample?

A. Lithium-6, cobalt-60, and argon-41

B. Iodine-131, cesium-138, and strontium-89

C. Nitrogen-16, xenon-135, and manganese-56

D. Hydrogen-2 (deuterium), hydrogen-3 (tritium), and oxygen-18

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B3907 (P3906)

A beta particle and an alpha particle enter and cause ionization in a gas-filled radiation detector operating in the Geiger-Mueller region. Which one of the following accurately compares the amplitude of the detector pulses caused by each type of radiation?

A. The beta particle pulse will be larger in amplitude.

B. The alpha particle pulse will be larger in amplitude.

C. The pulses will be identical for both types of radiation.

D. Cannot be determined without particle kinetic energy information.

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B4507 (P4506)

A nuclear power plant has been shutdown for one month. A portable gas-filled radiation detector is needed to monitor shutdown reactor core neutron level from a location outside the reactor vessel. The detector must be able to distinguish between ionizations caused by gamma and neutron radiation.

Which region(s) of the gas-filled detector characteristic curve is/are acceptable for operation of the detector?

A. Geiger-Mueller, Ionization, and Proportional regions are all acceptable.

B. Proportional region is acceptable, and Ionization region also may be usable.

C. Ionization region is acceptable, and Geiger-Mueller region also may be usable.

D. Geiger-Mueller region is acceptable, and Proportional region also may be usable.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B4807 (P4806)

Select the option that correctly fills in the blanks.

Quench gases are added to gas-filled radiation detectors that operate in the _____ region; the quench gases prevent a single ionization event from causing _____ in the detector gas volume.

A. ion chamber; multiple discharges

B. ion chamber; secondary ionizations

C. Geiger-Mueller; multiple discharges

D. Geiger-Mueller; secondary ionizations

ANSWER: C.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B4907 (P4906)

Which one of the following contains the pair of radiation detector types that are the most sensitive to low-energy beta and/or gamma radiation?

A. Geiger-Mueller and scintillation

B. Geiger-Mueller and ion chamber

C. Ion chamber and scintillation

D. Ion chamber and proportional

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B5207 (P5206)

A beta particle and an alpha particle with equal kinetic energies cause ionization in a gas-filled radiation detector. The detector is operating in the ion chamber region of the gas ionization curve. Which one of the following describes the amplitudes of the detector pulses caused by each type of radiation?

A. The beta particle pulse will be larger in amplitude.

B. The alpha particle pulse will be larger in amplitude.

C. The amplitudes of both pulses will be approximately equal for all detector voltages in the ion chamber region.

D. The amplitudes of both pulses will be approximately equal for all detector voltages in the ion chamber region, as well as all detector voltages outside the ion chamber region.

ANSWER: B.

TOPIC: 291002
KNOWLEDGE: K1.23 [2.8/2.9]
QID: B5307 (P5306)

Which one of the following types of radiation detectors is generally not used for measuring a high-intensity beta and gamma radiation field because of a relatively long detector recovery time, or dead time, following each ionization event.

A. Geiger-Mueller

B. Ion chamber

C. Proportional

D. Scintillation

ANSWER: A.

TOPIC: 291002
KNOWLEDGE: K1.24 [3.1/3.2]
QID: B214 (P216)

Which one of the following describes a characteristic of a self-reading pocket dosimeter (SRPD)?

A. The output of an SRPD is a dose rate in mR/hr.

B. SRPDs are primarily sensitive to beta radiation.

C. SRPD readings must be considered inaccurate when they are dropped.

D. SRPDs hold their charge indefinitely when removed from a radiation field.

ANSWER: C.