A19 and A28 Series Control Point Deviation Remote Bulb, Non-Compensated, Liquid Filled Thermostats

Controls incorporating liquid filled sensing elements operate by the expansion and contraction of the fill, resulting from changes in its temperature. A change in temperature of any part of the fill (in bulb, capillary, or cup) will produce a change in fill volume which will be directly proportional to the temperature change **and** to the portion of total fill affected. Since the bulb contains the major portion of the total fill, it retains principal control of the operating point of any remote bulb thermostat. The capillary and cup affect the operating point only slightly, due to the small amount of fill they contain.

Ambient induced control point shift in a line of controls is affected by:

1. The difference between the ambient temperature at which the control was factory calibrated (75°F, standard) and the ambient temperatures to which the case and capillary will be exposed in the application;
2. The setting (operating control point) of the control; and,
3. The operating range of the particular control.

By choosing the optimum range for the specific application of a Johnson Controls A19 or A28 remote bulb thermostat, the shift due to wide ambient fluctuations can be kept to a low value.

For extremely critical applications operating under severe ambient conditions, Johnson Controls offers special construction with **case** compensation for such conditions at an added cost. Consult Customer Service or the nearest Johnson Controls field sales office.

Note that cross ambient conditions do not make Johnson Controls liquid filled, remote bulb temperature controls inoperative. Likewise, these controls are unaffected by barometric or altitude variations.

> ⚠ CAUTION: Although all brands of non-compensated, liquid filled, remote bulb temperature controls have characteristics similar to those discussed in this bulletin, these curves cannot be used to calculate ambient deviation in other manufacturers' controls.

This data applies only to single bulb Johnson Controls A19 and A28 controls and only for the ranges shown. If information is required on ambient deviation characteristics for other ranges or controls, consult the nearest Johnson Controls field sales office.

Ambient Variation at Control

To determine control point shift due to wide changes in ambient temperature at the control case and/or capillary, compute as follows:

S_t = Total control point shift

S_1 = Cup induced shift

S_2 = Capillary induced shift

D_1 = Deviation factor of cup

D_2 = Deviation factor of capillary

A_1 = Anticipated extreme ambient temperature at cup

A_2 = Anticipated extreme ambient temperature at capillary.

The total shift in control point will be the sum of the shift due to the cup and the shift due to the capillary.

To compute S_1:

1. Find the curve on graph one or two for the particular range involved.
2. Locate the control point setting applicable and the intersection of the vertical line from the setting with the range curve.
3. Follow the horizontal line to the left from the intersection point and determine the cup deviation factor, D_1.
4. Estimate the anticipated extreme ambient temperature the case may be subjected to in the application, A_1.
5. $S_1 = D_1 \times (75 - A_1)$.

To compute S_2:

1. Locate the range of the control on Table 1.
2. Read the capillary deviation factor, D_2.
3. Estimate the extreme average ambient temperature in which the capillary will operate, A_2.

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4. Determine the length of capillary, L.

5. $S_2 = D_2 \times (75-A_1) \times L$.

Total shift in control operating point is: $S_t = S_1 + S_2$.

A **negative value** indicates a **lowered control point**.

A **positive value** indicates a **raised control point**.

Example

Assume a control is required to maintain -5°F with a 115°F extreme ambient temperature of capillary and case, and that a 6 ft. capillary length is required.

On Graph 1, we find ranges of -20 to 10°F, -30 to 50°F.

A. Select range -20 to 10°F.

1. Calculate cup shift, S_1
   a) On Graph 1, our required control set point of -5°F intercepts the -20 to 10°F curve at a D_1 of **.055°F**.
   b) A_1 (case ambient) is **115°F**.
   c) $S_1 = D_1 \times (75-A_1)$

      $= .055 \times (75-115)$

      $S_1 = -2.2$°F.
2. Calculate capillary shift, S_2
   a) Table 1 tells us that range -20 to 10°F has a D_2 of **.0075.**
   b) A_1 (capillary ambient) is **115°F**.
   c) L (capillary length) is 6 ft.
   d) $S_2 = D_2 \times (75-A_2) \times L$

      $= .0075 \times (75-115) \times 6$

      $S_2 = -1.80$°F.
3. The total shift in set point
   a) $S_t = S_1+S_2$

      $= (-2.2) + (-1.8)$

      $S_t = -4.0$°F.
   b) Since S_t is negative, the control point will shift **down** 4°F.

B. Select range -30 to 50°F.

1. Calculate cup shift, S,
   a) On Graph 1, our set point of -5°F intercepts the -30 to 50°F curve at a D_1 of .043°F.
   b) A_1 is **115°F**.
   c) $S_1 = D_1 \times (75-A_1)$

      $= .043 \times (75-115)$

      $S_1 = -1.72$°F.
2. Calculate capillary shift, S_2
   a) Table 1 gives a D_2 of **.005** for the range -30 to 50°F.
   b) A_2 is 115°F.
   c) L is 6 ft.
   d) $S_2 = D_2 \times (75-A_2) \times L$

      $= .005 \times (75-115) \times 6$

      $S_2 = 1.2$°F.
3. The total shift in set point
   a) $S_t = D_1 + S_2$

      $= (-1.72) + (-1.2)$

      $S_t = -2.92$°F.
   b) The control point will shift **down** 2.92°F.

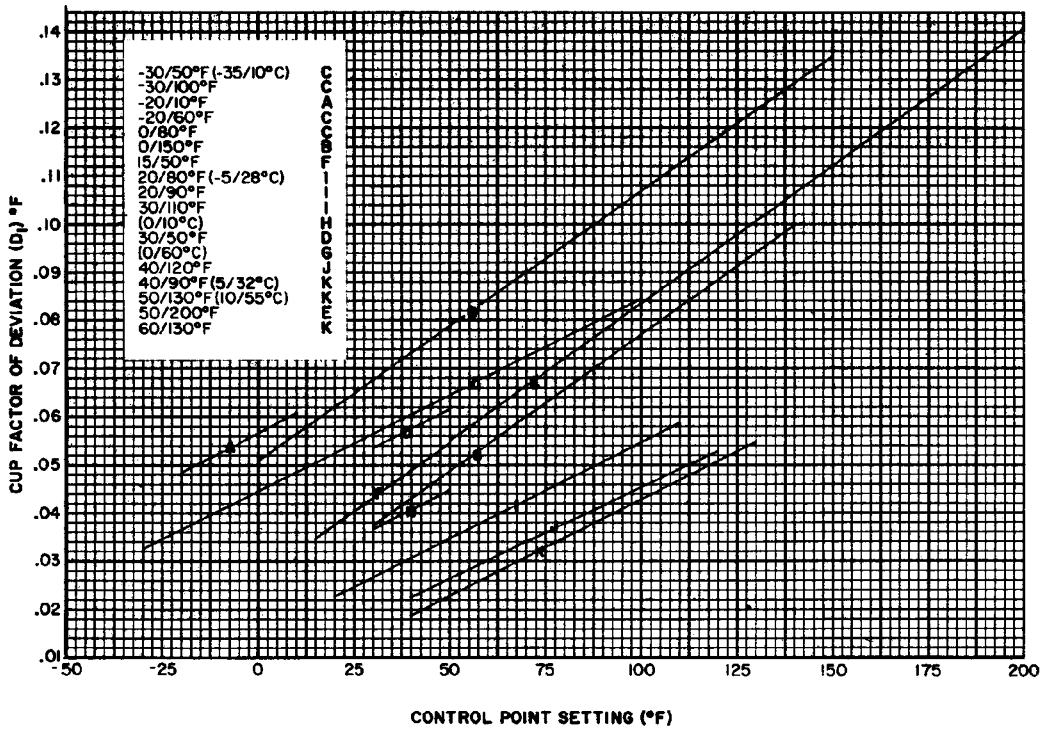
For the least amount of ambient shift, it is obvious that the -30 to 50°F range is the correct selection.

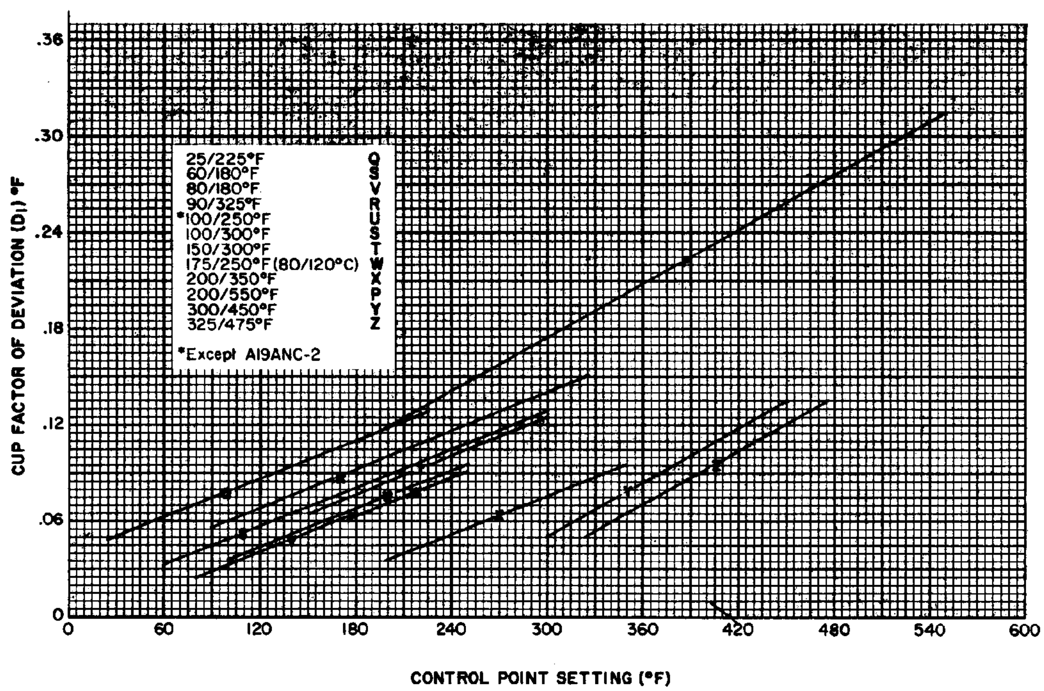
Table 1

Capillary Ambient Deviation

Range	Deviation Factor (D_2) °F/ft.
−30/50°F (−35/10°C)	.0050
−30/100°F	.0050
−20/10°F	.0075
−20/60°F	.0050
0/80°F	.0050
0/150°F	.0078
15/50°F	.0054
20/80°F (−5/28°C)	.0035
20/90°F	.0035
25/225°F	.0075
(0/10°C)	.0050
30/50°F	.0057
30/110°F	.0035
(0/60°C)	.0057
40/90°F	.0029
40/120°F	.0032
50/130°F (10/55°C)	.0036
50/200°F	.0078
60/130°F	.0042
60/180°F	.0050
80/180°F	.0038
90/325°F	.0088
*100/250°F	.0056
100/300°F	.0075
150/300°F	.0095
175/250°F (80/120°C)	.0094
200/350°F	.0056
200/550°F	.0180
300/450°F	.0078
325/475°F	.0078

*Except A19ANC-2 D_2=.0078


-30/50°F (-35/10°C) C
-30/100°F C
-20/10°F A
-20/60°F C
0/80°F C
0/150°F B
15/50°F F
20/80°F (-5/28°C) I
20/90°F I
30/110°F I
(0/10°C) H
30/50°F D
(0/60°C) G
40/120°F J
40/90°F (5/32°C) K
50/130°F (10/55°C) K
50/200°F E
60/130°F K
CUP FACTOR OF DEVIATION (D₁) °F
CONTROL POINT SETTING (°F)


25/225°F Q
60/180°F S
80/180°F V
90/325°F R
*100/250°F U
100/300°F S
150/300°F T
175/250°F (80/120°C) W
200/350°F X
200/550°F P
300/450°F Y
325/475°F Z
*Except A19ANC-2
CUP FACTOR OF DEVIATION (D₁) °F
CONTROL POINT SETTING (°F)

Notes

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