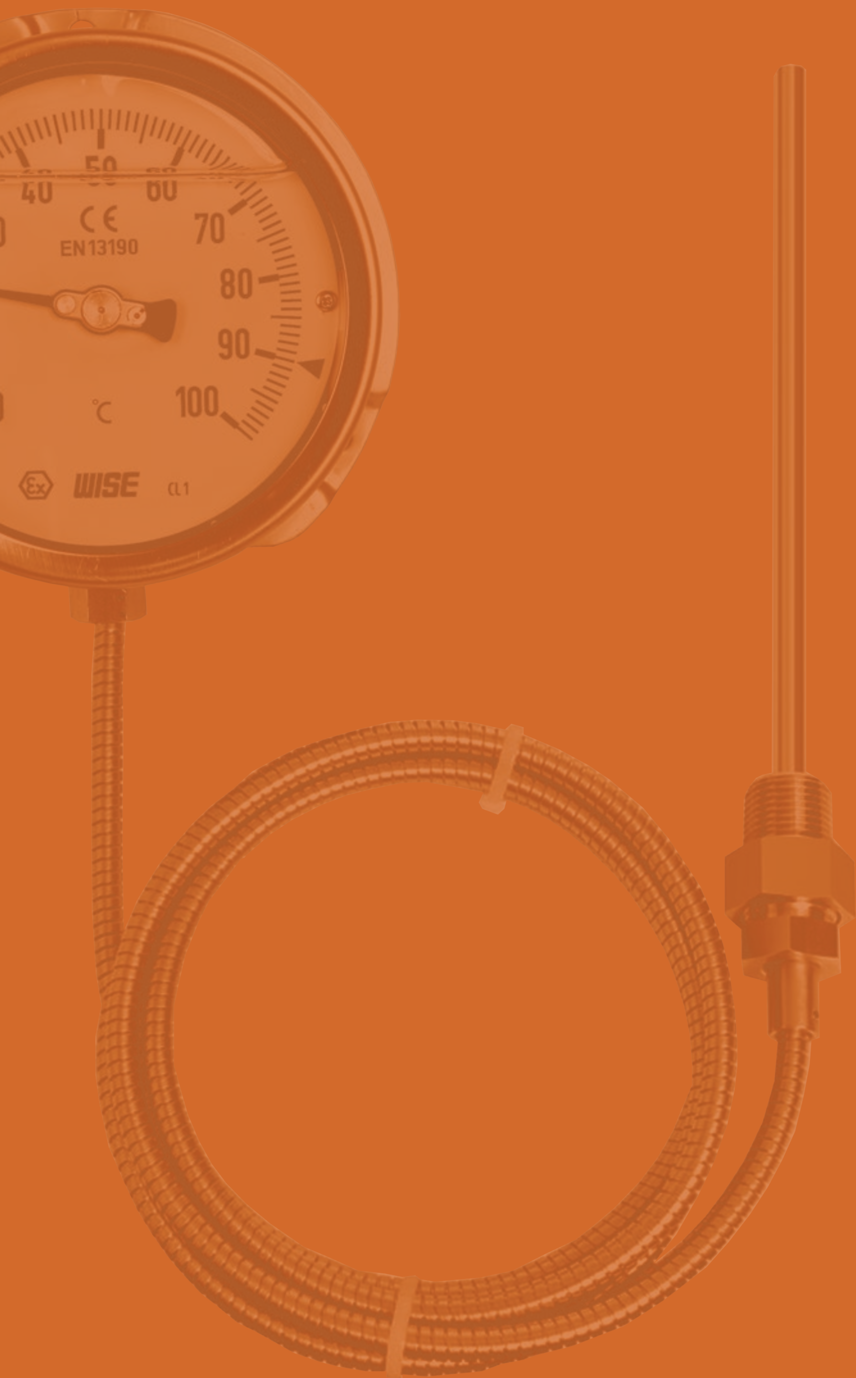


Temperature gauge and Switch

WISE®

Contents

WISE®

Temperature measurement

Bimetal thermometers

Principle :

When a metallic element is submitted to temperature changes, its length varies.

This physical property has been used and developed to build temperature sensitive bimetallic measuring devices.
The bimetallic sensor is made of two coils twisted together, and welded at their end being selected on purpose with very different thermal expansion coefficients, the two materials will generate a torque at their free end when submitted to temperature changes.

Applications :

- Designed for standard industrial uses, bimetal thermometers are mainly used because :
  - They are easy to install and use
  - They are more rugged than glass thermometers
  - No power supply required
  - Fairly large temperature range covered

Gas expansion thermometers

Principle :

A gas actuated thermometer is made of a cylindrical bulb filled with gas at high pressure (nitrogen) connected to a pressure sensitive, pressure gauge type, indicating device. Gas pressure changes inside the bulb due to temperature changes, are sensed by a special helicoid bourdon tube, which, connected to an amplifying device will give the pointer, movement proportional to the temperature.

The physical properties used will enable linear readings on the dial from the origin to full scale.
When the reading is remote from the sensing point, a capillary is then used for transmission between the bulb and the thermometer head. Capillary armoring is common practice in industrial environments.

Applications :

Gas expansion thermometers give a 1 % accuracy, which is maintained at ambient temperatures between-10 °C and +50 °C due to a built-in temperature compensating device.
Designed for industrial use, where a good accuracy is required, these thermometers are the natural answer because of :
- No need for a power supply
- Possibility for remote reading from temperature source
- Rugged design.

Thermal system

Operating principle		Volumetric principle			
Type and class		Liquid filled system class I		Mercury filled system class V	
		Class IA	Class IB	Class VA	Class VB
Low temp. limited		-300 ℉ (-184.4 ℃)		-38 ℉, -65 ℉ (-38.9 ℃, -53.9 ℃)	
High temp. limited		600 ℉ (315.6 ℃)		1,200 ℉, 600 ℉ (648.9 ℃, 315.6 ℃)	
Longest span		600 ℉ (315.6 ℃)		1,000 ℉, 600 ℉ (537.8 ℃, 315.6 ℃)	
Shortest span		25 ℉ (-3.9 ℃)		40 ℉ (4.4 ℃)	
Bulb size	Long span	Smallest		Intermediate	
	Short span	Intermediate		Large	
Dial or chart division		Equal	Equal	Equal	Equal
Max. capillary length		Approx 61 m	Approx 4.5 m	Approx 67.1 m	Approx 7.6 m
Capillary temperature compensation		Dual capillary and bourdon	None	Compensated capillary or dual capillary and bourdon	None
Case temperature compensation		Second bourdon	Bimetal strip	Second bourdon	Bimetal strip
Bath elevation error overrange capacity		Negligible varies with length 200 % ~ 0 % range	Negligible 100 % of range	Generally small 100 % of range	Negligible 100 % of range
Speed of response		Slowest in water intermediate		Intermediate in water negligible	
Barometric error		Negligible	Negligible	Negligible	

Operating principle		Volumetric principle	
		Vapor filled system class II	Gas filled system class III
Type and class		Class IIA / B / C / D	Class IIIA / B
Low temp. limited		-40 ℉ (-40 ℃)	-400 ℉ (-240 ℃)
High temp. limited		500 ℉ (260 ℃)	1,500 ℉ (815.6 ℃)
Longest span		300 ℉ (148.9 ℃)	1,000 ℉ (537.8 ℃)
Shortest span		40 ℉ (4.4 ℃)	100 ℉ (37.9 ℃)
Bulb size	Long span	Intermediate	Large
	Short span	Intermediate	Large
Dial or chart division		Large at range top	Equal
Max. capillary length		Approx 61 m	Approx 61 m
Capillary temperature compensation		None necessary	Generally none rarely, dual capillary and bourdon
Case temperature compensation		None necessary	Bimetal strip rarely and second negligible
Bath elevation error overrange capacity		Frequently large generally small	Varies with range up to 300 % of range varies widely with bulb diameter
Speed of response		Fastest to intermediate	Usually small
Barometric error		Usually small	

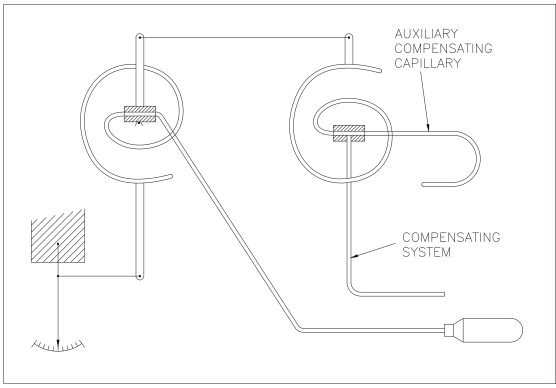
SAMA standard thermal class

Class ○ ○

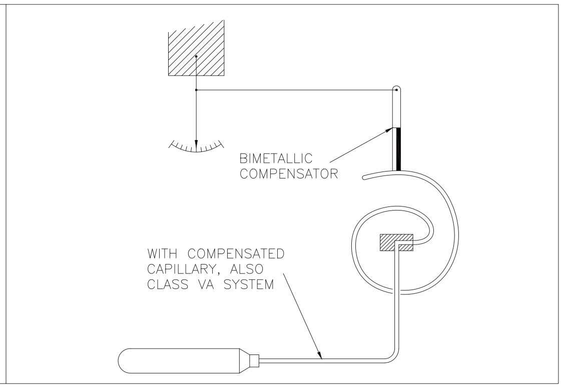
A Fully compensated liquid
B Case compensated liquid

Volumetric principle
Class I Liquid filled system
Class V Mercury filled system

Pressure principle
Class II Vapor filled system
Class III Gas filled system



Fully compensated liquid, mercury or gas filled thermal system - Class IA, IIA or VA



Case compensated liquid, mercury or gas filled thermal system - Class IB, IIB or VB

Temperature conversion formula

Fahrenheit temperature (℉)	Celsius temperature (℃)	Absolute temperature
1.8 X C + 32	C = K - 273.15	Kelvin degree(°K) K = C + 273.15

Temperature conversion table

℃	℉	℃	℉	℃	℉	℃	℉
-200	-328	65	149	410	770	790	1,454
-180	-292	70	158	420	788	800	1,472
-160	-256	75	167	430	806	810	1,490
-140	-220	80	176	440	824	820	1,508
-120	-184	85	185	450	842	830	1,526
-100	-148	90	194	460	860	850	1,562
-95	-139	95	203	470	878	900	1,652
-90	-130	100	212	480	896	950	1,742
-85	-121	110	230	490	914	1,000	1,832
-80	-112	120	248	500	932	1,050	1,922
-75	-103	130	266	510	950	1,100	2,012
-70	-94	140	284	520	968	1,150	2,102
-65	-85	150	302	530	986	1,200	2,192
-60	-76	160	320	540	1,004	1,250	2,282
-55	-67	170	338	550	1,022	1,300	2,372
-50	-58	180	356	560	1,040	1,350	2,462
-45	-49	190	374	570	1,058	1,400	2,552
-40	-40	200	392	580	1,076	1,450	2,642
-35	-31	210	410	590	1,094	1,500	2,732
-30	-22	220	428	600	1,112	1,550	2,822
-25	-13	230	446	610	1,130	1,600	2,912
-20	-4	240	464	620	1,148	1,650	3,002
-15	5	250	482	630	1,166	1,700	3,092
-10	16	260	500	640	1,184	1,750	3,182
-5	23	270	518	650	1,202	1,800	3,272
0	32	280	536	660	1,220	1,850	3,362
5	41	290	554	670	1,238	1,900	3,452
10	50	300	572	680	1,256	1,950	3,542
15	59	310	590	690	1,274	2,000	3,632
20	68	320	608	700	1,292	2,050	3,722
25	77	330	626	710	1,310	2,100	3,812
30	86	340	644	720	1,328	2,150	3,902
35	95	350	662	730	1,346	2,200	3,992
40	104	360	680	740	1,364	2,250	4,082
45	113	370	698	750	1,382	2,300	4,172
50	122	380	716	760	1,400	2,350	4,262
55	131	390	734	770	1,418	2,400	4,352
60	140	400	752	780	1,436	2,450	4,442