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Pressure Element Selection
Media Application

The media being measured must be compatible with the wetted parts of the pressure instrument. To use the chart below, locate the media whose pressure is to be measured and select a suitable material from those available. This is a simplified chart and assumes the media temperature is below 200°F except for media with a "*" which must be below 100°F. **PLUS!**™ option, throttling devices and/or a liquid-filled instrument are recommended in applications with pulsation or vibration. These recommendations are only a guide, as service life is dependent on temperature, concentrations, catalysts that may be added, or other conditions beyond our control. Consult Stratford, CT customer service for specific applications and any media not listed. Additional corrosion data is available on our web site, **www.ashcroft.com** in the Application Data Section.

MEDIA APPLICATION	Pressure Instrument Material: Brass or bronze	Steel	316 SS	Monel	Diaphragm seals**
Acetone*	•		•	•	
Acetic Acid <40%			•		
Acetic Anhydride					•
Acetylene (Dry)		•	•		
Acrolein 100%					•
Air	•	•	•	•	
Alcohol, Ethyl	•		•	•	
Alum. Chloride >10%					•
Alum. Sulfate 10-50%					•
Ammonia Gas (Dry)		•	•		
Ammonium Chloride <40%					•
Ammonium Nitrate <50%			•		
Ammonium Sulfate <60%					•
Aniline>99%			•		
Argon	•	•	•	•	
Beer			•		
Benzidine >99%					•
Benzene <50%			•	•	
Benzoic Acid <70%					•
Boric Acid <25%			•		
Bromine (Dry)					•
Butane	•	•	•	•	
Butyric Acid <10%					•
Calcium Chloride <80%					•
Calcium Hydroxide <50%					•
Carbon Dioxide	•	•	•	•	
Carbon Monoxide (Dry) >99%	•		•	•	
Chlorine (Dry)					•
Chlorine (Moist)					•
Chloroform (Dry)			•	•	
Chromic Acid					•
Citric Acid 10-50%			•		
Corn Oil			•		
Crude Oil (Sour)				•	
Crude Oil (Sweet)			•	•	
Ethyl Acetate	•		•	•	
Ethylene Oxide >99%*	•		•	•	
Ferric Chloride <40%					•
Ferric Sulfate <10%			•		
Ferrous Chloride <30%					•
Ferrous Sulfate <50%					•
Fluorine Gas (Dry) No Air				•	
Formaldehyde <95%			•	•	
Formic Acid*					•
Freons		•	•		
Furfural <10%					•
Gasoline (Flowing)	•		•		
Glycerin >99%	•	•	•	•	
Hydrobromic Acid					•
Hydrochloric Acid					•
Hydrofluoric Acid					•
Hydrofluosilic Acid					•
Hydrogen(2)	•		•		
Hydrogen Peroxide <50%					•
Kerosene	•	•	•	•	
Lactic Acid <70%*(2)			•		
Magnesium Chloride <40%					•
Mercury >99%			•		
Milk			•		
Naphtha >99%	•	•	•	•	
Naphthalene >99%			•	•	
Nickel Chloride >99%					•
Nitric Acid <95%*			•		
Nitrogen	•	•	•	•	
Oleic Acid	•				•
Oxalic Acid*					•
Oxygen (Gas)(1)	•		•	•	
Palmitic Acid >99%*			•		
Phosphoric Acid <80%*			•		
Picric Acid <10%			•		
Propane (Dry) DOT Quality	•	•	•	•	
Sea Water (Flowing)				•	
Silver Nitrate <70%					•
Sodium Bicarbonate <20%			•	•	
Sodium Bisulfate <30%					•
Sodium Carbonate <40%			•	•	
Sodium Chromate <60%	•	•	•	•	
Sodium Cyanide*		•	•		
Sodium Hydroxide < 40%				•	
Sodium Hypochlorite <25%					•
Sodium Phosphate,Tri <60%		•	•	•	
Sodium Silicate <50%		•	•	•	
Sodium Sulfide <50%					•
Stannous Chloride <10%					•
Steam (Use siphon)	•	•	•	•	
Stearic Acid			•		
Sulfur Dioxide (Dry) >99%					•
Sulfur Trioxide (Dry) >99%					•
Sulfuric Acid					•
Tannic Acid <80%		•	•	•	
Tartaric Acid <50%			•	•	
Tin Chloride (ous) <10%					•
Toluene >99%	•	•	•	•	
Turpentine >98%	•	•	•	•	
Water (tap)	•		•	•	
Whiskey			•		
Zinc Chloride <25%*					•
Zinc Sulphate <40%					•

(1) Monel and 316 stainless steel are acceptable for oxygen service, provided the instrument has been cleaned for service and is free from oil. Order variation X6B.

(2) Over 1000 psi–entire system must be 316 stainless steel.

*Media temperature must be below 100°F.

**Any standard Bourdon tube or bellows material may be used in conjunction with a diaphragm seal (with bellows use a Viton or Kalrez diaphragm), but the gauge selection should take into consideration the corrosive environment in which it is to operate.

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Conversion Factors for Units of Pressure

TO CONVERT FROM ↓ TO →	psi	mbar	bar	atm	Pa	kPa	cmH_2O @ 20°C	inH_2O @ 20°C	ftH_2O @ 20°C	mmHg @ 0°C	inHg @ 0°C	kg/cm^2	ft sea water
psi	1	68.9476	0.0689476	0.0680460	6894.76	6.8947	70.433	27.730	2.3108	51.7149	2.03602	0.07030686	2.2457
mbar	0.0145038	1	0.001	9.86923×10^{-4}	100	0.100	1.0215	0.40218	0.03352	0.75006	0.0295300	0.00101972	032571
bar	14.5038	1000	1	0.986923	100000	100	1021.5	402.18	33.52	750.06	29.5300	1.019716	32.571
atm	14.6959	1013.25	1.01325	1	101325	101.325	1035.08	407.511	35.959	760.0	29.9213	1.033227	33.002
Pa	$1,45038 \times 10^{-4}$	0.01	0.00001	9.86923×10^{-6}	1	0.001	0.010215	0.0040218	3.352×10^{-4}	7.5006×10^{-3}	2.95300×10^{-4}	1.019716×10^{-5}	3.2571×10^{-4}
kPa	0.145038	10.0	0.010	0.0098692	1000	1	10.215	4.02118	0.3352	7.5006	0.295300	0.0101972	0.32571
cmH_2O @ 20°C	0.014198	0.97891	9.7891×10^{-4}	9.66105×10^{-4}	97.891	0.097891	1	0.3937	0.035281	0.73424	0.028907	9.9821×10^{-4}	0.031884
inH_2O @ 20°C	0.036063	2.4864	0.0024864	2.45392×10^{-3}	248.64	0.24864	2.5400	1	0.083333	1.8650	0.073424	0.0025354	0.080986
ftH_2O @ 20°C	0.432756	29.8368	0.0298368	0.0294470	2983.68	2.98368	30.480	12	1	22.380	0.881089	0.030425	0.97183
mmHg @ 0°C	0.0193368	1.33322	0.0013322	0.00131579	133.322	0.133322	1.3619	0.53620	0.04468	1	0.03937	0.00135951	0.043424
inHg @ 0°C	0.491154	33.8639	0.0338639	0.0334211	3386.39	3.38639	34.593	13.619	1.13491	25.400	1	0.0345316	1.1030
kg/cm^2	14.2233	980.665	0.980665	0.967842	98060.5	98.0665	1001.8	394.41	32.868	735.559	28.959	1	31.9410
ft sea water	0.4453	30.702	0.030702	0.030301	3070.2	3.0702	31.3638	12.3482	1.02900	23.029	0.90664	0.031308	1

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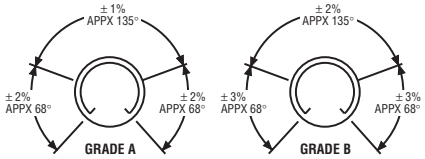
Mechanical Pressure Accuracy Definitions

ACCURACY:

Accuracy – the conformity of indication to an accepted standard or true value. Accuracy is the difference (error) between the true value and the indication expressed as a percent of the span. It includes the combined effects of method, observer, apparatus and environment. Accuracy error includes hysteresis and repeatability errors but not friction error. It is determined under specific conditions. (Normal position, 73.4°F (23°C), and 29.92 in Hg barometric pressure.)

The following tables define the ASME B40.1* accuracy grades used by Ashcroft products.



Accuracy of a pressure gauge may be expressed as percent of span or percent of indicated reading. Percent of span is the most common method. Percent of indicated reading is usually limited to precision test gauges and unless specifically spelled out, it may be assumed that an accuracy of ±½% means ±½% of span.

GRADE 4A:
gauges offer the highest accuracy and are calibrated to ±0.1% of span over the entire range of the gauge. The gauges are called laboratory precision test gauges and are generally 8½″, 12″ or 16″ dials. These high-accuracy gauges may be temperature compensated. They must be handled carefully in order to retain accuracy.

GRADE 3A:
gauges are calibrated to an accuracy of ±0.25% of span over the entire range of the gauge. The gauges are called test gauges and are generally 4½″, 6″ or 8½″ dials. The gauges are generally not temperature compensated (except Ashcroft Type 1082).

GRADE 2A:
gauges are calibrated to an accuracy of ±0.5% of span over the entire range of the gauge. These gauges are generally used by the petrochemical industry for process pressure measurement. They are often referred to as process gauges and are usually supplied as 4½″ and 6″ cases and are not temperature compensated.

GRADE 1A:
gauges are calibrated to an accuracy of ±1% over the entire range of the gauge. These gauges are high-quality industrial gauges and are supplied in 2½″, 3½″ and 4½″ sizes.

GRADE A:
gauges are calibrated to an accuracy of ±1% of span over the middle half of the scale and ±2% of span over the first and last quarters of the scale. These gauges are often referred to as industrial gauges and are usually supplied in 2½″, 3½″ and 4½″ case sizes.

GRADE B:
gauges are calibrated to an accuracy of ±2% of span over the middle half of the scale and ±3% of span over the first and last quarters of the scale. This accuracy of gauge represents the majority of those manufactured and used for pressure measurement on water pumps, swimming pool filters, air compressors, filter regulations, etc. These gauges are often referred to as commercial or utility gauges and are supplied in 1½″, 2″, 2½″, 3½″ and 4½″ case sizes.

GRADE C:
gauges are calibrated to an accuracy of ±3% of span over the middle half of the scale and ±4% of span over the first and last quarters of the scale. These are used in similar applications as Grade B gauges except that they are less accurate.

GRADE D:
gauges are calibrated to an accuracy of ±5% of span over the entire scale. These 5% gauges are used as indicators when minimal accuracy is required for application on water pumps and pool filters.

ACCURACY EXAMPLES

Range	Accuracy Span	Grade	Permissible Error % of Span	Dial Units
0/100 psi	100 psi	1A	1.0	1 psi
0/400 kPa	400 kPa	2A	0.5	2 kPa
0/1000 bar	1000 bar	B	3 (0/250 & 750/1000 bar)	30 bar
			2 (250/750 bar)	20 bar
–100/400	400 kPa	2A	0.5	2 kPa
30 in.Hg/	44.7 psi	4A	0.1	.045 psi
30 psi				.022 in.Hg

The last item (30 in. Hg/30 psi)deserves some explanation. The span is defined as the algebraic difference between the limits of the scale. 30 in. Hg = –14.7 psi Span = 30 psi -(–14.7) = 44.7 psi. 0.1% of 44.7 psi = .045 psi or .022 Hg.

*ASME B40.1 may be ordered from:
American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016

ACCURACY EXAMPLES

Type of Gauge	Grade	Permissible Error % of Span: Lower 25%	Middle 50%	Upper 25%	Max. Friction (% of Span)
Precision Test (A4A)	4A	0.1	0.1	0.1	See Note
Test (1082)	3A	0.25	0.25	0.25	0.25
Process (1279)	2A	0.5	0.5	0.5	0.5
Industrial/ Hydraulic (1009)	1A	1.0	1.0	1.0	1.0
Industrial/ Hydraulic (1010, 1188, 1490)	A	2.0	1.0	2.0	1.0
Commercial/ Utility (1005, 3005, 1008)	B	3.0	2.0	3.0	2.0

Note: Grade 4A gauges must remain within 0.1% before and after being lightly tapped.

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Bimetal Thermometer Accuracy Definitions

ASME B40.3* STANDARD ACCURACIES:

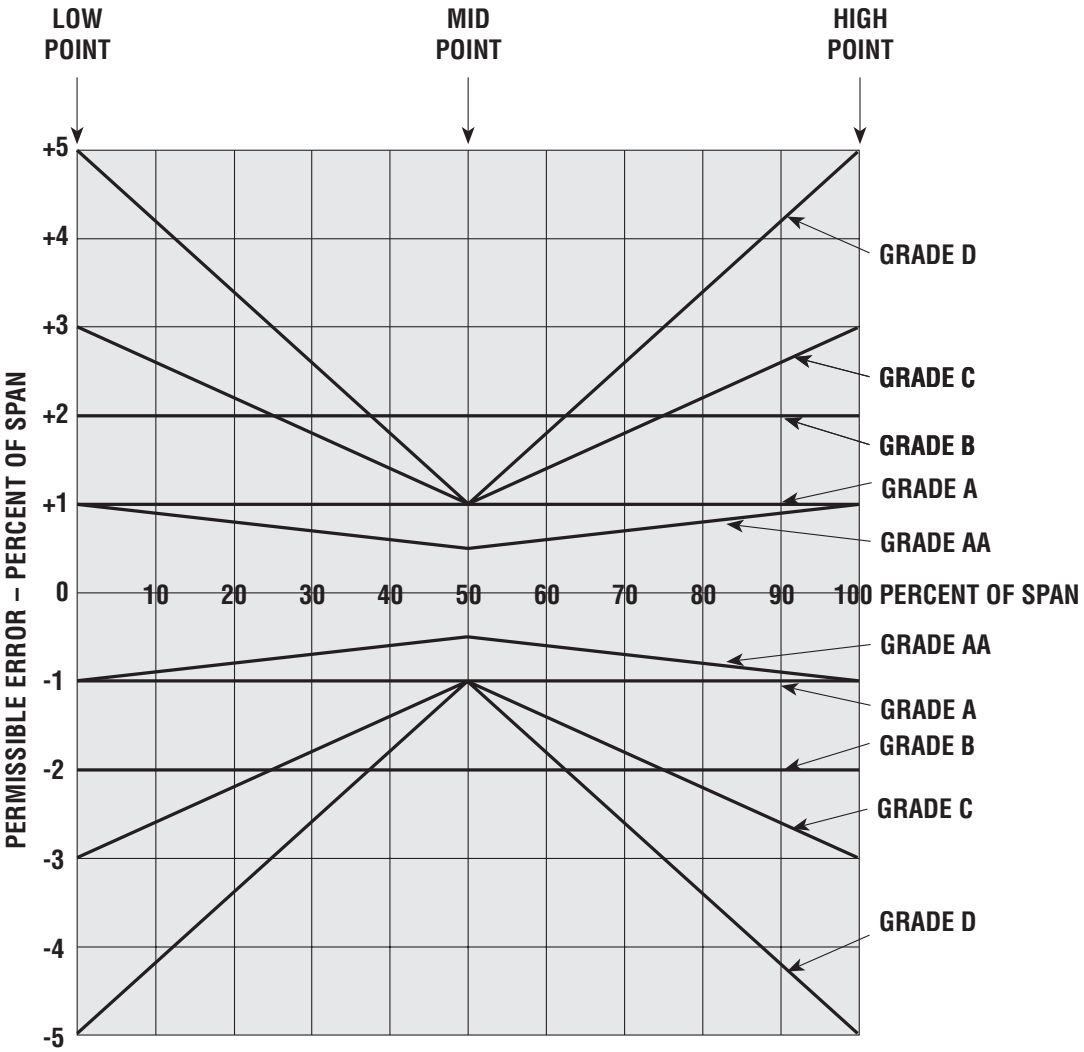
Example #1: Range 0/250°F Grade A
Span = 250-0 = 250°F
Accuracy at 20% of span (50°F) = ±1% = ±2.5°F
Accuracy at 50% of span (125°F) = ±1% = ±2.5°F
Accuracy at 100% of span (250°F) = ±1% = ±2.5°F

Example #2: –40/160°F Grade E
Span = 160-(–40) = 200°F
Accuracy at 20% of span (0°F) = ±3.4% = ±6.8°F
Accuracy at 50% of span (60°F) = ±1% = ±2.0°F
Accuracy at 100% of span (160°F) = ±5% - ±10.0°F

Example #3: Range 50/300°F Grade AA
Span = 300-(–50) = 250°F
Accuracy at 0% of span (50°F) = ±1% = ±2.5°F
Accuracy at 50% of span (175°F) = ±0.5% = ±1.25°F
Accuracy at 70% of span (225°F) = ±0.7% = ±1.75°F

ACCURACY:
Thermometer accuracy is graded as shown in the table below. Adjustment of the case of a thermometer, with an adjustable angle connection, may affect its accuracy. This effect should not exceed 0.5% of span .

*ASME B40.3 may be ordered from:
American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016



– TABLE 1 –

Primary enclosure characteristics of NEMA standard 250-1979 and equivalents in DIN standard 40050

STANDARDS		PROTECTION LEVEL
IP20	**NEMA 1**	**Fingers**
IP22	NEMA 2	Falling dirt and water
IP53	NEMA 3	Windblown dust, rain, sleet
	NEMA 3R	Falling rain and sleet
	NEMA 3S	Windblown dust, rain, sleet, mechanisims operate when iced over
IP65	**NEMA 4**	**Hosedown**
	NEMA 4X	**Hosedown and corrosion**
	NEMA 5	Dust and falling dirt
IP67	**NEMA 6**	**Temporary submersion**
IP68	NEMA 6P	Occasional prolonged submersion and corrosion
	NEMA 7	Indoor hazardous Class I, Groups A, B, C or D
	NEMA 8	Indoor hazardous Class II, Groups A, B, C or D
	NEMA 9	Indoor hazardous Class II, Groups E, F, G
	NEMA 10	Mine safety
	NEMA 11	Oil seepage and corrosion
	NEMA 12	**Oil seepage**
	NEMA 12K	Oil seepage, has knockouts
	NEMA 10	**Oil sprays**

*Types of greatest interest are italicized.

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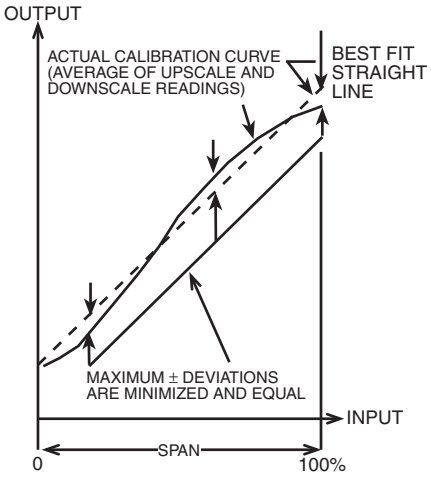
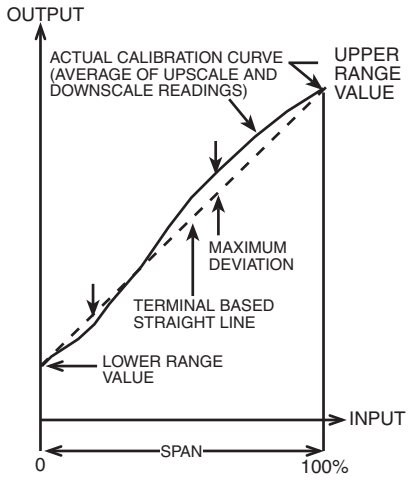
Pressure Transducers/ Transmitters Accuracy Definitions

ACCURACY:
Accuracy is defined as the degree of conformity of a measure to an accepted standard or true value. It is a measure of the actual output deviation from the standard or true value reported as a percentage (±) of output span. Accuracy does account for the effects of linearity, hysteresis and repeatability. In addition, the maximum errors of these effects for Ashcroft Transducers are reported separately.

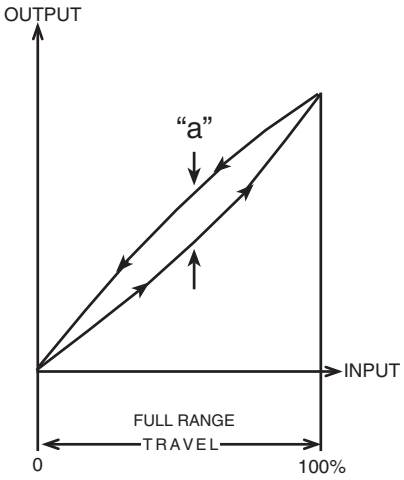
LINEARITY –
BEST FIT STRAIGHT LINE (B.F.S.L.)
The linearity defined as the maximum deviation of the calibration curve (average of upscale and downscale readings) from a straight line so positioned as to minimize the maximum deviation. It is specified as ±% of span.



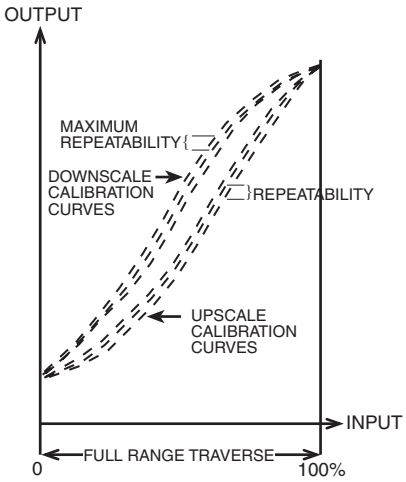
LINEARITY – TERMINAL POINT (T.P.)
The linearity defined as the maximum deviation of the calibration curve (average of upscale and downscale readings) from a straight line positioned to pass through the upper and lower range values. It is specified as ±% of span.



HYSTERESIS
The maximum difference in output ("a" below) within the range when the value is approached with increasing pressure and then with decreasing pressure for full range traverses. It is specified as ±% of span.



REPEATABILITY
The closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions, approaching from the same direction, for full range traverses. It is specified as ±% of span.

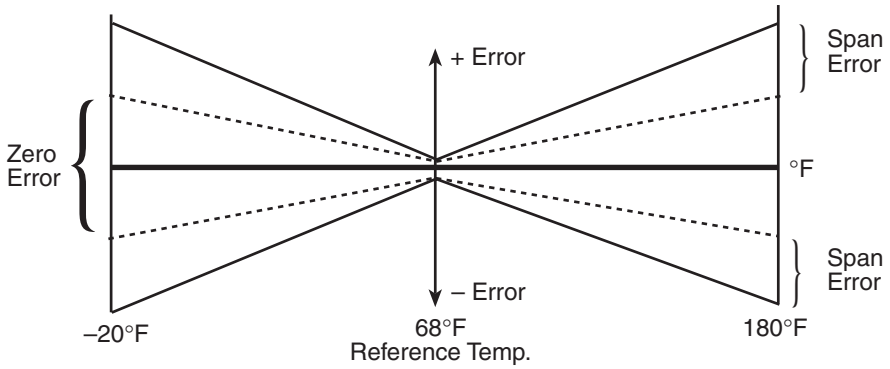


TEMPERATURE ERROR
The maximum change in output at any input value within the range when the product is changed from room (reference) temperature to specified temperature extremes. Temperature errors are specified in two ways defined as follows:

THERMAL COEFFICIENT DATA

Thermal Coefficient of Zero – the zero shift due to changes in temperature from room (reference) temperature to the specified limits of the operating range. Specified as ±% of span/°F. (over a temperature range).

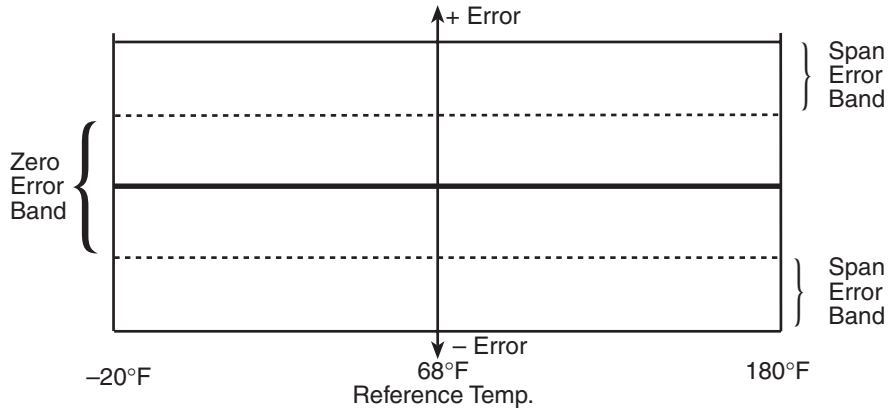
Thermal Coefficient of Span – the span shift due to changes in temperature from room (reference) temperature to the specified limits of the operating range. Specified as ±% of span/°F. (over a temperature range).



THERMAL ERROR DATA

Thermal Error of Zero – the zero shift due to changes in temperature from room (reference) temperature to the specified limits of the operating range. Specified as ±% of span (over a temperature range).

Thermal Error of Span – the span shift due to changes in temperature from room (reference) temperature to the specified limits of the operating range. Specified as ±% of reading (over a temperature range).



Note: Definitions are in accordance with:
ANSI/ISA S51.1 - 1993 “Process Instrumentation Terminology”
ANSI/ISA S37.1 - 1982 “Electrical Transducer Terminology”