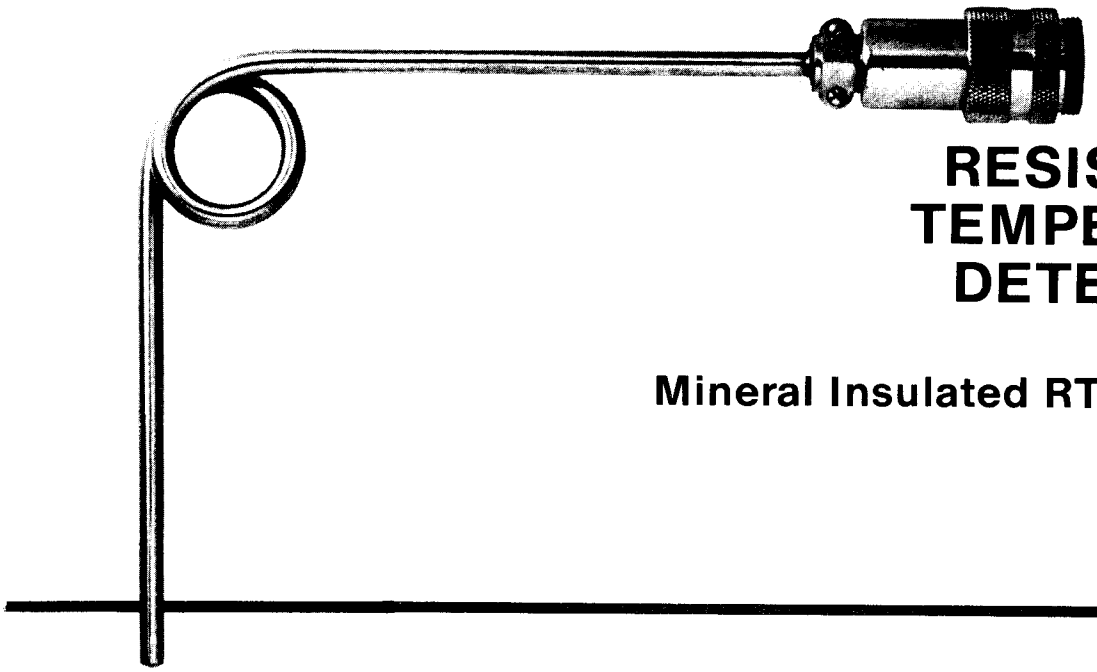


RESISTANCE TEMPERATURE DETECTORS

Mineral Insulated RTD Elements

FEATURES

- Time Constant of 2,2 sec and less
- Temperature Range: -200 to +600°C
- Pressure Range: Vacuum to 3450 Kg/cm^2 Absolute
- Shock Resistance to 1000G in all 3 axis
- Withstand vibration of ±50G, 60 to 2000Hz
- Accuracy: ±0,1ohm at 0°C (±0,1% for 100)
- Reproductibility: ±0,1% of resistance for 100 element
- Very long lengths. Entire length can be exposed to high temperature
- Available with 4-20 mA temperature transmitter/amplifier
- Superior Corrosion Resistance with low carbon 316 ST/ST sheaths
- Can be sharply bent with no change in performance

LABORATORY ACCURACY WITH INDUSTRIAL RUGGEDNESS

Platinum resistance thermometers are used for interpolation between the IPTS-68 fixed temperature points of ice and antimony (0°C to 630.74°C), generally used where accuracy and stability are most important.

The ARiDET approach to RTD's will bring ±0,05° laboratory accuracy to the toughest industrial process - without special handling considerations.

ARi INDUSTRIES, INC. has combined the inherent accuracy of a precisely wound Platinum Resistance element with AerOpak compacted ceramic insulated cable. The result is a low cost yet rugged sensor that will take factory handling — retaining the stability needed for today's process control.

Available with either the 99.999%+ high purity JIS C-1604-81 or 99.99% DIN 43760 temperature vs resistance curve.

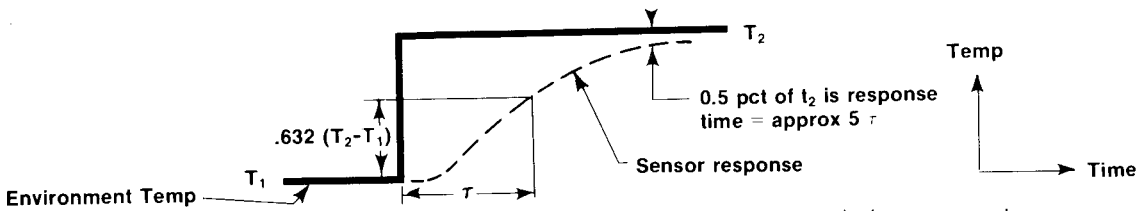
See temperature vs resistance tables for how to obtain laboratory accuracy.

TIME RESPONSE CHARACTERISTICS

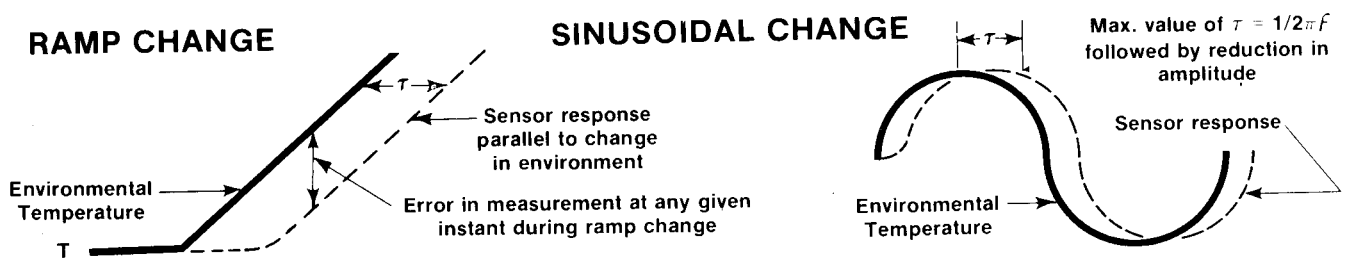
The response of an ARi Resistance Temperature Detector is defined by two notable characteristics when exposed to an instantaneous (step) change in environment temperature. These are:

a. Time constant (τ). The time to reach 63,2 pct of the complete step change in temperature.
b. Response time. Time to reach within 0,5 pct of final temperature in a step change. This is approximately equal to 5 times the Time Constant.

The response of a temperature sensor to a step change in environment temperature tends to follow a second order differential equation. However, this is approximate, since if the mass of the sensor is small in relation to the mass of the fluid passing over it (such as in the case of a liquid), the response may approach a first order differential equation. A typical response is as follows:



Time Constant has application for more common experiences in process control, ie, ramp change or sinusoidal changes in environmental temperature. The response of a sensor under these conditions are:



Time constant has application for more common experiences in process control, i.e. ramp change or sinusoidal changes in environmental temperature. The response of a sensor under these conditions is:

Knowing the time constant (τ) for a given sensor at one given set of conditions, it can be computed for another set of conditions.

Time constant data for ARi ARiDET® Resistance Temperature Detectors are as follows:

Condition 1: In water at a flow rate of 1 metre per second and T_2—T_1=88°C, perpendicular to axis of sensor.

SENSOR DIAMETER (mm)	3,17	4,75	6,35
TIME CONSTANT (seconds)	0,8	1,6	2,2

Condition 2: In air at a flow rate of 20m/sec and density of 0,769kg/m³. Mass velocity of 5lbm/m²sec and T_2—T_1=16°C. Flow perpendicular to axis of sensor.

SENSOR DIAMETER (mm)	3,17	4,75	6,35
TIME CONSTANT (sec)	7,5	14,5	20,5

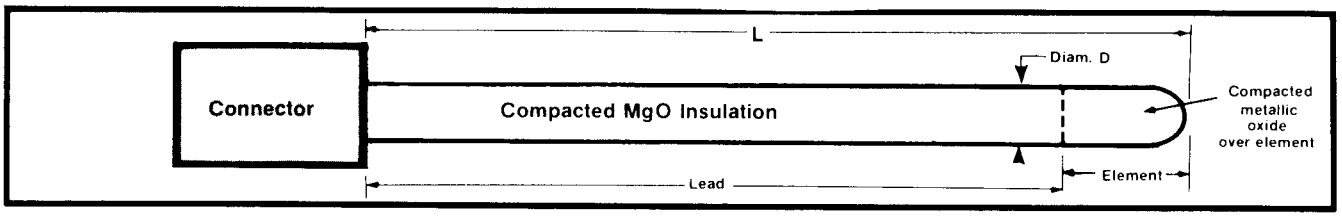
SELECTION / MATCHING

Complete probes may be matched in pairs to the nearest 0,01 ohm at 0°C for differential temperature measurements to 0.05°C.

Complete probes may be supplied with selected ice point resistances within a narrow band to eliminate the need for compensation in indicating circuits.

SPECIFICATIONS

ARi ARiDET® consists of a specially installed platinum resistance element completely encased in compacted metallic oxide insulation of high thermo-conductivity to ensure minimum temperature differential between the sensor surface and the element. Standard sensors have 3 constantan equi-resistance lead wires in lead portion with compacted MgO insulation. Sheath material is 316 L st/st in fully annealed condition. Performance specifications are shown for the element portion and the lead portion.



	LEAD	ELEMENT
Accuracy		•0,01 obm at 0°C
Stability Maximum ice point shift after long thermal cycling		−130 to +93°C ±0,05% −130 to 315°C ±0,1% 315 to 600°C ±0,5%
Temperature Range	−250 to +1000°C	−200 to +600°C
Measuring Current		10 milliamps DC max.
Vibration Shock	Vibration: ±50G, 60 to 2000 Hz Shock: 1000G Along all three mutually perpendicular axes when correctly mounted.	
Temp/Res Curve (0 to 100°C)		0,00385Ω/Ω/°C per DIN 43760 0,003916Ω/Ω/°C per JIS C 1604-81
Individual Calibration		to nearest ±0,01 ohm @ 0°C
Self Heating Error		Less than 0,02°C/MW
Maximum External Pressure	3510kg/cm²	
Stock Length L	610mm	

SENSOR PARAMETERS			
Diameter (mm)	3,18	4,78	6,35
Temperature Sensitive Length (mm)	28,0	28,0	28,0
Bending Restriction, Distance from tip to be left straight (mm)	53,3	53,3	53,3
Minimum Bending Radius (mm)	12,7	19,0	25,4
Maximum Length (metres)	213	91	53
Minimum Length (mm)	102	102	102
Constantan 3 Wire Leads, Resistance in ohms per 25,4mm -each wire	0,061	0,025	0,015

TYPICAL 3 WIRE MEASURING CIRCUIT FOR RTD'S

A 3-wire system may be used to eliminate the effect of lead wire resistance changes by introducing RL (lead wire resistance) into each leg of a bridge. The third lead wire is added to the detector circuit without affecting bridge balance. The resultant circuit is sensitive only to resistance element temperature changes.

$R_{L1} = R_{L2} = R_{L3}$ (Lead Wire Resistance)

$R_1 = R_2$

R_3 = Variable Resistance, Equal to RT Range

G = Glavonometer

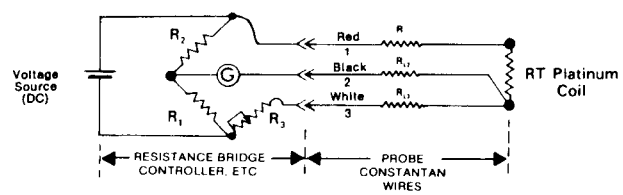


Table 1
COLD END TERMINATIONS

SEE PAGE 12

Table 2
SHEATH DIAMETERS

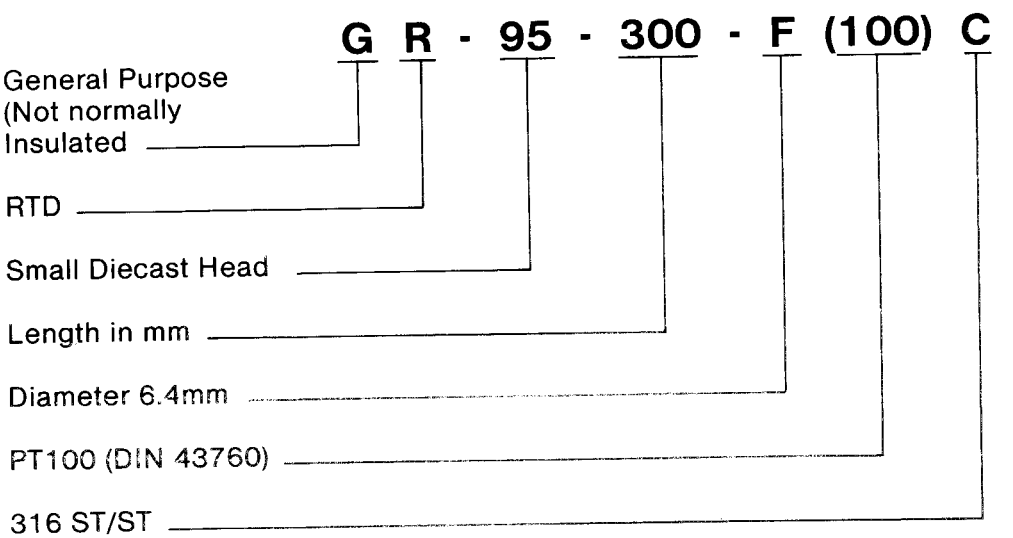
D	3.18mm
E	4.74mm
F	6.4mm
G	8.0mm

For metric equivalents of the above use suffix 'M' i.e. FM = 6,0mm.

Table 3
SHEATH MATERIALS

C = AISI 316 ST/ST
T = COPPER

TYPICAL ORDERING NUMBER



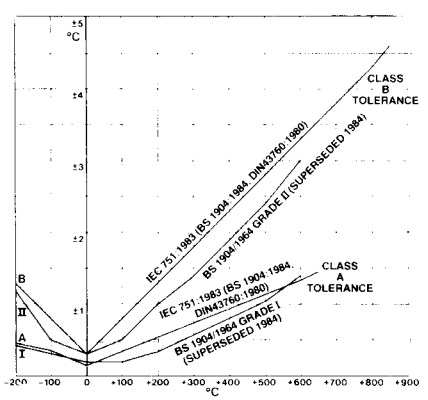
Platinum Resistance Thermometry:
Resistance vs Temperature relationship, tolerances, connection schematics, measuring circuits

Ohms BS 1904:1964 (Superseded 1984)	Temperature	Ohms IEC 751:1983 (BS 1904:1984, DIN 4376:1980)				
0	°C	0	2	4	6	8
18,56	—200	18,49				
22,83	—190	22,80	21,94	21,08	20,22	19,36
27,11	—180	27,08	26,23	25,37	24,52	23,66
31,34	—170	31,32	30,47	29,63	28,78	27,93
35,54	—160	35,53	34,69	33,85	33,01	32,16
39,72	—150	39,71	38,88	38,04	37,21	36,37
43,88	—140	43,87	43,04	42,21	41,38	40,55
48,01	—130	48,00	47,18	46,35	45,52	44,70
52,12	—120	52,11	51,29	50,47	49,64	48,82
56,21	—110	56,19	55,38	54,56	53,74	52,92
60,28	—100	60,25	59,44	58,63	57,82	57,00
64,32	—90	64,30	63,49	62,68	61,87	61,06
68,34	—80	68,33	67,52	66,72	65,91	65,11
72,35	—70	72,33	71,53	70,73	69,93	69,13
76,34	—60	76,33	75,53	74,73	73,93	73,13
80,32	—50	80,31	79,51	78,72	77,92	77,13
84,29	—40	84,27	83,48	82,169	81,89	81,10
88,23	—30	88,22	87,43	86,64	85,85	85,06
92,16	—20	92,16	91,37	90,59	89,80	89,01
96,09	—10	96,09	95,30	94,52	93,73	92,95
100,00	—0	100,00	99,22	98,44	97,65	96,87
100,00	0	100,00	100,78	101,56	102,34	103,12
103,90	10	103,90	104,68	105,46	106,24	107,02
107,79	20	107,79	108,57	109,35	110,12	110,90
111,67	30	111,76	112,45	113,22	112,99	114,77
115,54	40	115,54	116,31	117,08	117,85	118,62
119,40	50	119,40	120,16	120,93	121,70	122,47
123,24	60	123,24	124,01	124,77	125,54	126,31
127,07	70	127,07	127,84	128,60	129,37	130,13
130,89	80	130,89	131,86	132,42	133,18	133,94
134,70	90	134,70	135,46	136,22	136,98	137,74
138,50	100	138,50	139,26	140,02	140,77	141,53
142,29	110	142,29	143,04	143,80	144,55	145,31
146,06	120	146,06	146,81	147,57	148,32	149,07
149,82	130	149,82	150,57	150,31	152,08	152,83
153,57	140	153,58	154,32	155,07	155,82	156,57
157,31	150	157,31	158,06	158,81	159,55	160,30
161,04	160	161,04	161,79	62,53	163,27	164,02
164,79	170	164,76	165,50	166,24	166,98	167,72
168,46	180	168,46	169,20	169,94	170,68	171,42
172,16	190	172,16	172,90	173,63	174,37	175,10
175,83	200	175,84	176,57	177,31	178,04	178,78
179,50	210	179,51	180,24	180,97	181,71	182,44
183,16	220	183,17	183,90	184,63	185,36	186,09
186,82	230	186,82	187,54	188,27	189,00	189,72
190,45	240	190,45	191,18	191,90	192,63	193,35
194,07	250	194,07	194,80	195,52	196,24	196,96
197,69	260	197,69	198,41	199,13	199,85	200,57
201,29	270	201,29	202,01	202,72	203,44	204,16
204,88	280	204,88	205,59	206,31	207,02	207,74
208,46	290	208,45	209,17	109,88	210,59	211,31
212,02	300	212,02	212,73	213,44	214,15	214,88
215,58	310	215,57	216,28	216,99	217,70	218,41
219,12	320	219,12	219,82	220,53	221,24	221,94
222,26	330	222,65	223,35	224,06	224,76	225,46
226,18	340	226,17	226,87	227,57	228,27	228,97
229,69	350	229,67	230,37	231,07	231,77	232,47
233,19	360	233,17	233,87	234,56	235,26	235,96
236,68	370	236,65	237,35	238,04	238,74	239,43
240,16	380	240,13	240,82	241,51	242,20	242,90
243,61	390	243,59	244,28	244,97	245,66	246,35
247,08	400	247,04	247,73	248,41	249,10	249,79
250,52	410	250,48	251,16	251,85	252,53	253,22
253,95	420	253,90	254,59	255,27	255,95	256,63
257,37	430	257,32	258,00	258,68	259,36	260,04
260,77	440	260,72	261,40	262,08	262,76	263,43
264,17	450	264,11	264,79	265,47	266,14	166,82
267,58	460	267,49	268,17	268,84	269,51	270,19
270,94	470	270,86	271,53	272,20	272,88	273,55
274,29	480	274,22	274,89	275,56	276,23	276,89
277,64	490	277,56	278,23	278,90	279,56	289,23
280,98	500	280,90	281,56	282,23	282,89	283,55
284,31	510	284,22	284,88	285,54	286,21	286,87
287,63	520	287,53	288,19	288,85	289,51	290,17
290,93	530	290,83	291,49	292,14	292,80	293,46
294,22	540	294,11	294,77	295,43	296,08	296,74
297,50	550	297,39	298,04	298,70	299,35	300,00
300,76	560	300,65	301,31	310,96	302,61	303,26
304,02	570	303,91	304,56	305,20	305,85	306,50
307,27	580	307,15	306,69	208,44	309,09	309,73
310,51	590	310,38	311,02	311,66	312,31	312,95
313,72	600	313,59	314,24	314,88	315,52	316,16
316,93	610	316,80	317,44	318,08	318,72	319,36
320,12	620	319,99	320,63	321,27	321,91	322,54
323,31	630	323,18	323,81	324,45	325,08	325,72
326,50	640	326,35	326,98	327,61	328,25	328,88
329,60	650	329,51	330,14	330,77	331,40	332,03
332,80	660	332,66	333,28	333,91	334,54	335,17
335,90	670	335,79	336,42	337,04	337,67	338,29
339,10	680	338,92	339,54	340,16	340,79	341,41
342,20	690	342,03	342,65	343,27	343,89	344,51
345,40	700	345,13	345,75	346,37	346,99	347,60
348,40	710	348,22	348,84	349,45	350,06	350,69
351,50	720	351,30	352,91	352,53	353,14	353,75
354,50	730	354,37	354,98	355,59	356,20	356,81
357,70	740	357,42	358,03	358,64	359,25	359,86
360,60	750	360,47	361,68	362,68	362,29	362,89
363,60	760	363,50	364,10	364,71	365,31	365,91
366,60	770	366,52	367,12	367,72	368,32	368,93
369,70	780	369,53	370,13	370,73	371,33	371,93
372,70	790	372,52	373,12	373,72	374,32	374,91
375,60	800	375,51	376,10	376,70	377,29	377,89
378,70	810	378,48	379,08	379,67	380,26	380,85
381,60	820	381,45	382,04	382,63	383,22	383,81
384,60	830	384,40	384,98	385,57	386,16	386,75
387,50	840	387,34	387,92	388,51	389,09	389,68
390,40	850	390,26				

Nominal Resistance: 100 Ohms @0°C
Fundamental Interval: 38,5 Ω

For measuring circuit schematics see page 40

Tolerance values for 100 ohm elements, 38,5 ohm fundamental interval



Temperature °C	Tolerance IEC 751:1983 (BS 1904:1984, DIN 43760:1980)			
	Class A		Class B	
	±°C	±Ohms	±°C	±Ohms
—200	0,55	0,24	1,3	0,56
—100	0,35	0,14	0,8	0,32
0	0,15	0,06	0,3	0,12
100	0,35	0,13	0,8	0,30
200	0,55	0,20	1,3	0,48
300	0,75	0,27	1,8	0,64
400	0,95	0,33	2,3	0,79
500	1,15	0,38	2,8	0,93
600	1,35	0,43	3,3	1,06
650	1,45	0,46	3,6	1,13
700	—	—	3,8	1,17
800	—	—	4,3	1,28
850	—	—	4,6	1,34

Platinum resistance thermometer detector elements and extension cable for platinum resistance thermometry

In addition to the detector elements described on this page the company offers a ra nge of assemblies from simple probes through to heavy duty industrial assemblies complete with thermowells. These are custom built to meet requirements (see Type 16 and Type 17). Special assemblies not catered for by Types 16 and 17 can be supplied and we will be pleased to make our proposals against receipt of details of your particular requirements.
Our platinum resistance thermometer detector elements are available as either the wire wound or film type.

Wire wound types

These are an environmental resistant combination of strain free platinum wire fully encased in either a high ten expansion matched glass or high purity ceramic envelope. Both single and duplex elements are available.

SPECIFICATIONS

Resistance value: 100 ohms at 0°C. **Fundamental interval:** 38.5 ohms. **Standards:** IEC 751:1983 (BS 1904:1984, DIN 43760:1
NB. Japanese, American and other standards can be supplied on request.

TEMPERATURE RANGE:
Glass encapsulation: −220°C to +550°C. **Ceramic encapsulation:** −220°C to +600°C.

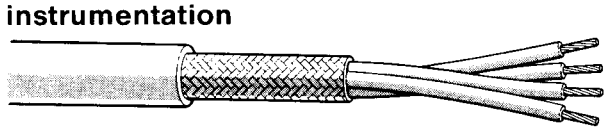
Tolerances available: See following table.

Code	Encapsulation	Element	Sketch & dimensions mm	Leads		Lead materials	Available tolerances					Measuring Current limit per element mA
				Length mm	Diameter mm		IEC 751:1983		Fraction of 0.1% accuracy at 0°C.			
							Class B	Class A	1/3	1/5	1/10	
GS1	Glass	Single	3 diam. 25	15	0.3	Platinum ferro nickel	YES	YES	NO	NO	NO	5
GS2	Glass	Single	1·9 diam. 20	15	0.3	Platinum ferro nickel	YES	YES	NO	NO	NO	5
GD1	Glass	Duplex	4 diam. 40	15	0.3	Platinum ferro nickel	YES	YES	NO	NO	NO	5
CS1	Ceramic	Single	3 diam. 30	10	0.45	Platinum	YES	YES	YES	YES	YES	5
CS2	Ceramic	Single	1·59 diam. 25	10	0.45	Platinum	YES	YES	YES	YES	YES	5
CS3	Ceramic	Single	1·59 diam. 15	10	0.25	Platinum	YES	YES	YES	YES	YES	3
CS4	Ceramic	Single	0·9 diam. 15	10	0.15	Platinum	YES	YES	YES	YES	YES	1
CS5	Ceramic	Single	2 diam. 6	7	0.25	Platinum	YES	YES	YES	YES	YES	1
CS6	Ceramic	Single	5 diam. 4	10	0.45	Platinum	YES	YES	YES	YES	YES	3
CD1	Ceramic	Duplex	3 diam. 30	10	0.25	Platinum	YES	YES	YES	YES	YES	3
CD2	Ceramic	Duplex	1·59 diam. 25	10	0.25	Platinum	YES	YES	YES	YES	YES	3

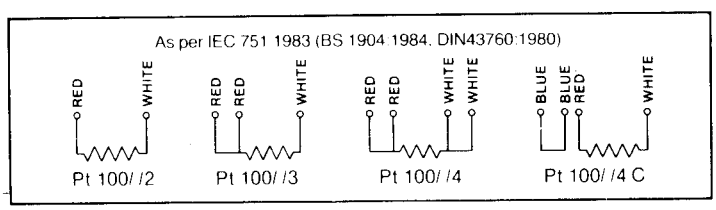
For glass encapsulated elements the 100 ohms at 0°C resistance value is given at the end of the leads.

On the ceramic encapsulated elements this value is given at a point 5mm from the encapsulation.

Interconnection cable for platinum resistance thermometer assemblies and associated instrumentation



Typical Connection Schematics for 2,3 & 4 wire lead configuration for Resistance Thermometer Detectors



Type A Heat resistant PVC(105°C) Insulation

General Description
4 cores of stranded silver plated copper conductors. Each core PVC insulated. Insulated cores wormed together, tinned copper braid screened and overall PVC sheathed.

No. of Cores: 4 x 7 stranded silver plated

Each Core:
7/0,2mm diameter, 7/0,008"diameter, 7/36 SWG 7/32 B & S or AWG,0,22mm²

Core Insulation; Heat resistant PVC

Type B Teflon* (260°C insulation)

General Description
4 cores of stranded silver plated copper conductors.Each core Teflon*insulated.Insulated cores wormed together,silver plated copper braid screened and overall Teflon*sheathed.

No. of Cores: 4 x 7 stranded silver plated

Each Core:
7/0,2mm diameter, 7/0,008" diameter, 7/36 SWG, 7/32 B & S or AWG, 0,22mm²

Core Colours:
To international standards

Screen: Tinned copper braid

Overall Insulation:
Extruded heat resistant PVC

Overall jacket colour: Grey

Temperature Rating:
105°C continuous/short term

Core Insulation: Teflon*

Core colours:
To International Standards

Screen:
Silver plated copper braid

Overall Insulation: Teflon*

Overall Jacket Colour: Orange

Temperature Rating:
260°C short term