

# Resistance Thermometers

## Measuring Insert

rigid • Model TR001  
flexible • Model TR002

### Electronic Temperature Measurement

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#### Services intended

Exchangeable measuring insert for all industrial and laboratory applications.

#### General

The measuring inserts for resistance thermometers described here are designed for installation in a protection assembly. Operation without thermowell is only recommended in certain applications.

#### Model TR001

This model series features a rigid insert tube in which the sensor and connection wires are to be found.

#### Model TR002

In the case of this model series the measuring insert is in flexible, mineral insulated sheathed cable. The sensor is in a rigid tube on the end of the measuring insert. Apart from being flexible this model series is outstanding for the higher resistance to vibration given compared with the model series TR001.

Both model series are spring loaded to ensure that the measuring insert is pressed down on the thermowell bottom and are standardised in DIN 43 762.

Customer specific versions are available apart from the DIN versions, for example:

- with tapered tip
- with mounted tubing for adaptation to the appropriate inner diameter of the thermowell
- without connection socket
- with transmitter

Type and number of sensors, accuracy and method of connection can be selected individually for the appropriate application.

Particular attention must be paid to the dimensions of the measuring insert when combined with a thermowell. Adequate heat transfer between thermowell and measuring insert is only ensured when the measuring insert is of correct length and diameter.

Selection of normal or standard length enables short delivery time and low cost stocking as spare measuring insert for the appropriate standard length.

Intrinsically safe designs are available for applications in hazardous areas. The model series TR001 and TR002 are provided with a conformity certificate for "intrinsically safe" type of protection to EEx ib IIC T6. Manufacturer's certification to NAMUR NE 24 or in accordance with DIN VDE 0165, respectively, is also available.



The range of applications is completed by designs without connection socket for direct transmitter installation. Optionally we can fit analogue or digital transmitters from the WIKA range.

(- analogue, fixed measuring ranges:

Model T20 to data sheet TE 20.01,

- analogue, measuring range selectable with soldered bridges:

Model T21 to data sheet TE 21.01,

- analogue, process industry series: Mod. T31, data sheet TE 31.01,

- digital, Model T12 to data sheet TE 12.01,

- digital, with HART® Protocol: Model T32 to data sheet TE 32.01)

## Sensor

The diameter of the measuring insert should be approx. 1 mm less than the diameter of the thermowell hole in which the measuring insert is to be fitted. Gaps greater than 0.5 mm between hole and measuring insert have a negative effect on the heat transfer. The measuring insert is to have good contact with the bottom of the thermowell and, as a result, is spring loaded to ensure that the measuring insert is pressed down against the bottom of the thermowell.

The diameter of the measuring insert limits the number of sensors and their method of connection.

Where 2 wire connection is concerned, inner wiring resistance appears as fault in the measurement. Therefore, measurement inserts with standard accuracy (limiting error, Class B) should not exceed 1000 mm of measuring insert length with 6 mm diameter measuring insert (or 350 mm with a 3 mm diameter measuring insert). 3 or 4 wire connection should be selected for longer lengths or improved accuracy.

Measuring insert diameter in mm	Sensor / Sensor method of connection						
	2 wire	1 x Pt 100		2 x Pt 100			3 x Pt 100
		3 wire	4 wire	2 wire	3 wire	4 wire	2 wire
3	x	x	x	x	–	–	–
6	x	x	x	x	x	x <sup>1)</sup>	x
8	x	x	x	x	x	x <sup>1)</sup>	x

1) always measuring insert model TR002, sheathed cable design

## Sensor limiting error

- Class A to DIN EN 60 751 (only with 3 wire or 4 wire method of connection)
- Class B to DIN EN 60 751
- 1/3 DIN B at 0 °C

Basic values and limiting errors for the platinum measuring resistors are laid down in DIN EN 60 751.

The nominal value of Pt 100 sensors is 100 Ω at 0 °C.

The temperature coefficient  $\alpha$  can be stated simply to be between 0 °C and 100 °C with:

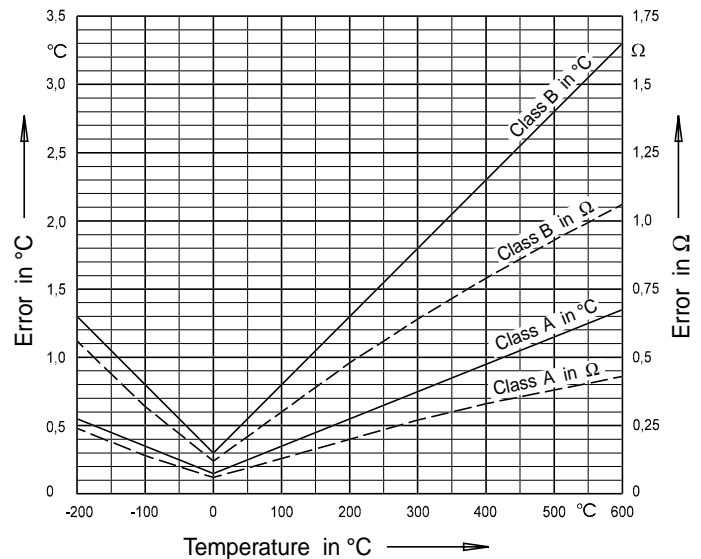
$$\alpha = 3,85 \times 10^{-3} \text{ } ^\circ\text{C}^{-1}$$

The relationship between the temperature and the electrical resistance is described by polynomes which are defined in DIN EN 60 751. Furthermore, this standard lays down the basic values in °C stages.

The limiting error is defined for two classes:

Class	Limiting error in °C
A	$0.15 + 0.002 \cdot  t $ <sup>1)</sup>
B	$0.3 + 0.005 \cdot  t $

1) |t| is the value of the temperature in °C without consideration to the prefix



3163 008.01

Basic values and limiting errors for the platinum measuring resistors per DIN EN 60 751

Temperature		°C	0	100	200	300	400	500	600
Basic value		Ω	100	138.5	175.84	212.02	247.04	280.9	313.59
Limiting error	Class A	K	± 0.15	± 0.35	± 0.55	± 0.75	± 0.95	± 1.15	± 1.35
		Ω	± 0.06	± 0.13	± 0.20	± 0.27	± 0.33	± 0.38	± 0.43
	Class B	K	± 0.3	± 0.8	± 1.3	± 1.8	± 2.3	± 2.8	± 3.3
		Ω	± 0.12	± 0.3	± 0.48	± 0.64	± 0.79	± 0.93	± 1.06

Apart from the limiting errors defined in DIN EN 60 751 still more with a historical background are known such as, for example:

$$\frac{1}{3} \text{ DIN B at } 0 \text{ } ^\circ\text{C}$$

To be noted in this case is that the limiting error restriction to 1/3 does not refer to the entire application range but only to the 0 °C value. Should the restriction in limiting error refer to a temperature range this range must be stated.

**Measuring insert length**

The length of the measuring insert is to be selected so that the measuring insert stands on the thermowell bottom. This ensures good heat transfer.  
 The measuring inserts are spring loaded (spring travel: max. 10mm) to ensure that they are pressed down on the bottom of the thermowell. The mentioned standard lengths are equivalent to the normal lengths and are matched to the nominal length of standard thermometers. This ensures exchangeability with the same measuring certainty. Special lengths are possible.

In the case of customer specific thermometers it is thus expedient to combine the required insertion length with a non-standard extension neck length to again give a standard length for the measuring insert length. Since measuring inserts with standard dimensions can be delivered quicker and are less expensive than special length measuring inserts this will have a positive effect on possible purchasing and stocking of spare parts.

Measuring insert dia. in mm	Standard length in mm												
	3 <sup>1)</sup>	145	205	275	290	315	375	405	435	525	555	-	-
6	-	-	275	-	315	375	405	435	525	555	655	735	1025
8	-	-	275	-	315	375	405	435	525	555	655	735	1025

1) only sheathed cable design, model TR002; sensor 2 x Pt100 not possible with method of connection 3 wire or 4 wire

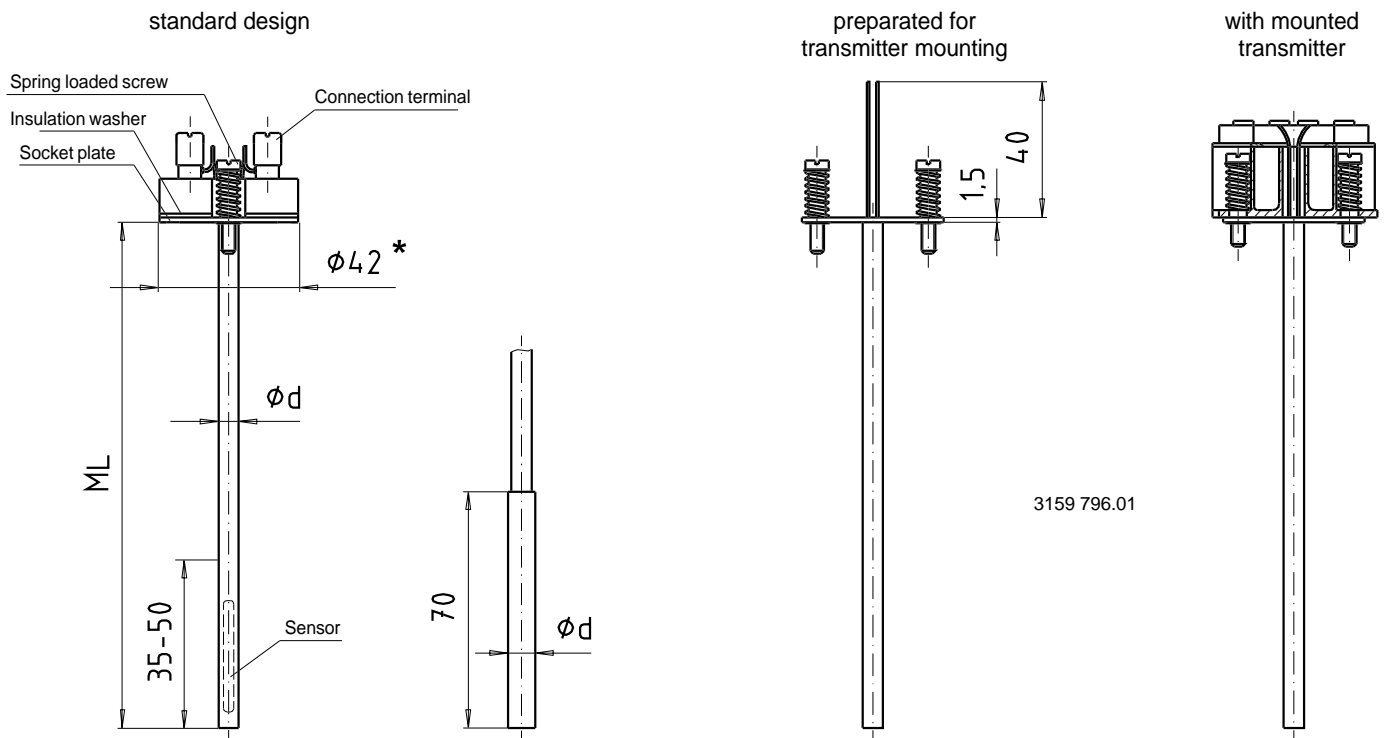
**Material**

Model TR001, tube: stainless steel 1.4571  
 Model TR002, cable sheath: stainless steel 1.4571  
 other on request

**Connection socket**

- 42 mm diameter, max. 6 connection terminals (standard, not possible with 2 x Pt 100 in 4 wire connection)
  - 45 mm diameter (standard with 2 x Pt 100 in 4 wire connection, only possible with connection head model BSZ, BSZ-H, BSS, BSS-H)
  - 25 mm diameter, max. 4 connection terminals (on request)
  - without (measuring insert prepared for transmitter mounting)
- other on request

**Dimensions in mm**

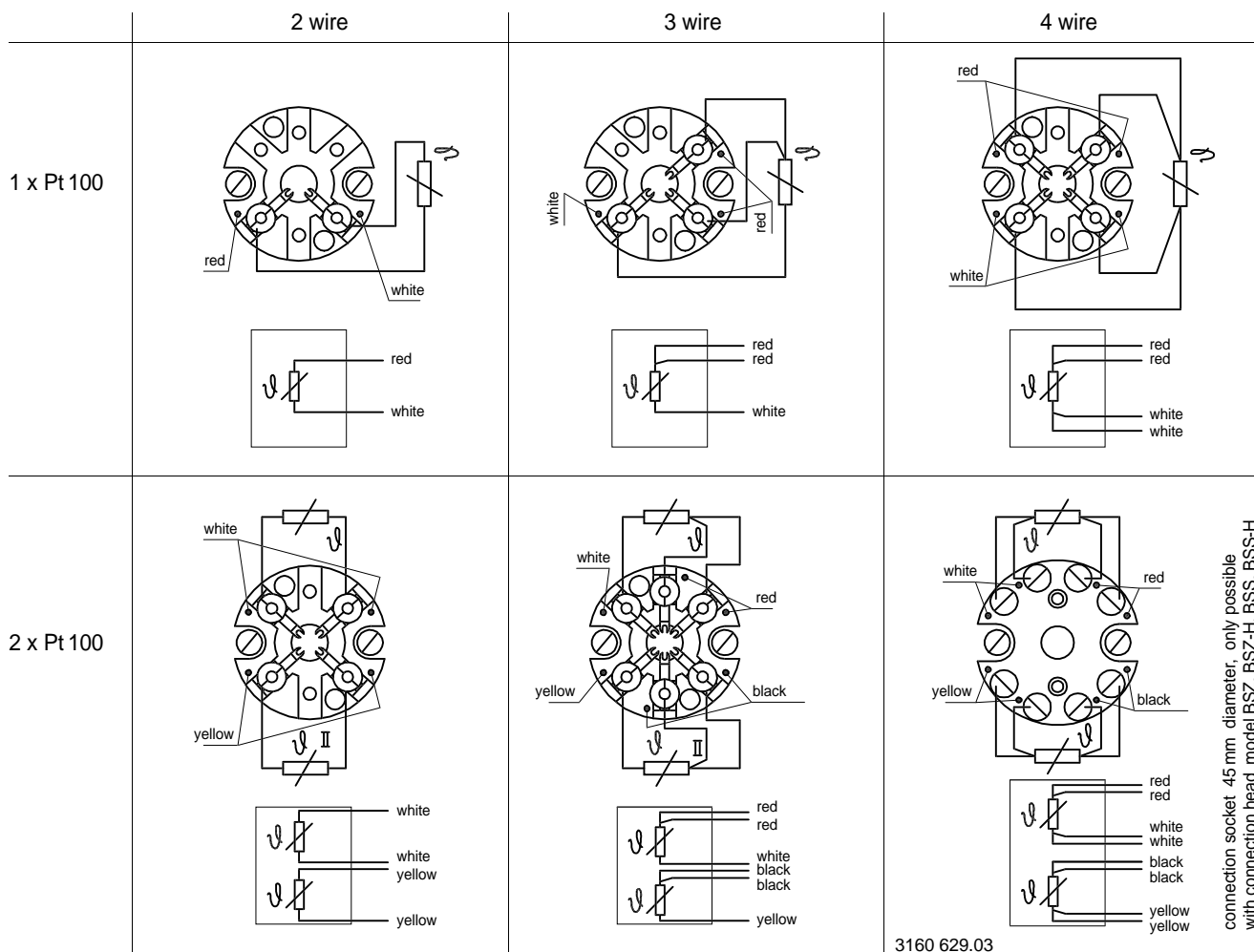


\* 45mm diameter with 2 x Pt100 in 4 wire connection

Measuring insert with tube (model TR002  $\phi d = 8\text{ mm}$ )

Legend:  
 ML Measuring insert length  
 $\phi d$  Measuring insert diameter

## Terminal appropriation and marking



### Transmitter (optional)

A transmitter can be mounted on the measuring insert. In this case the transmitter is fastened directly to the measuring insert socket plate instead of to the connection socket, see Page 3. Two transmitters on request.

Model	Description	Explosion protection	Data sheet
T20	analogue transmitter with fixed measuring range	optional	TE 20.01
T21	analogue transmitter, measuring range selectable with soldered bridges	without	TE 21.01
T31	analogue transmitter, process industry series	optional	TE 31.01
T12	digital transmitter, configurable	optional	TE 12.01
T32	digital transmitter with HART-Protocol, configurable	optional	TE 32.01

### Explosion protection (optional)

Suitability for Ex i use can be certified in different ways:

- to DIN EN 50 014 / DIN EN 50 020 in accordance with CENELEC. Such measuring inserts are approved with a conformity certificate for "intrinsically safe" type of protection to EEx ib IIC T6 for use in Zone 1. Fitted transmitters have their own conformity certificate.
- in accordance to NAMUR NE 24 with manufacturer's certification
- in accordance to DIN VDE 0165/2.91 with manufacturer's certification

Field No.	Code	Instrument design	
		<b>Explosion protection</b>	
	Z	without	
	X	Ex ib IIC T6 to PTB No. Ex-97.D.2006 X	
	B	intrinsically safe with manufacturer's certification to NAMUR NE 24	
1	C	intrinsically safe with manufacturer's certification, DIN VDE 0165	
		<b>Type and number of sensors</b>	
	1	1 x Pt 100 application range -50 ... +250 °C	
	2	2 x Pt 100 application range -50 ... +250 °C	
	3	1 x Pt 100 application range -200 ... +600 °C	
	4	2 x Pt 100 application range -200 ... +600 °C	
2	?	other	
		<b>Sensor limiting error</b>	
	A	Class A to DIN EN 60751	
	B	Class B to DIN EN 60751	
	C	1/3 DIN B at 0 °C	
3	?	other	
		<b>Sensor method of connection</b>	
	1	2 wire <i>not with sensor limiting error, Class A</i>	
	2	3 wire	
4	3	4 wire	
		<b>Measuring insert diameter</b>	
	1	3 mm <i>not with sensor 2 x Pt 100 with method of connection 3 wire or 4 wire</i>	
	3	6 mm	
	4	8 mm <i>tubing</i>	
5	?	other	
		<b>Measuring insert length</b>	
	1	275 mm	
	9	290 mm	
	2	315 mm	
	3	375 mm	
	4	405 mm	
	5	435 mm	
	6	525 mm	
	7	555 mm	
	8	655 mm	
6	?	other	
		<b>Cable sheath material</b>	
	1	stainless steel 1.4571	
7	?	other	
		<b>Connection socket</b>	
	1	42 mm diameter for connection head form B	
	?	other	
8	2	transmitter instead of connection socket <i>see field no. 9 and no. 10</i>	
		<b>Transmitter</b>	
	ZZ	without	
	A0	model T20, without explosion protection <i>sensor method of connection 4 wire is not connectable</i>	
	A2	model T20, with explosion protection EEx ia <i>sensor method of connection 4 wire is not connectable</i>	
	A4	model T20, with explosion protection EEx ib <i>sensor method of connection 4 wire is not connectable</i>	
	B0	model T21, without explosion protection <i>sensor method of connection 4 wire is not connectable</i>	
	C2	model T31, with explosion protection EEx ia <i>sensor method of connection 4 wire is not connectable</i>	
	C4	model T31, with explosion protection EEx ib <i>sensor method of connection 4 wire is not connectable</i>	
	D0	model T12, without explosion protection <i>configured to customer specification</i>	
	D2	model T12, with explosion protection EEx ia <i>configured to customer specification</i>	
	D4	model T12, with explosion protection EEx ib <i>configured to customer specification</i>	
	E0	model T32, without explosion protection <i>configured to customer specification</i>	
	E2	model T32, with explosion protection EEx ia <i>configured to customer specification</i>	
	E4	model T32, with explosion protection EEx ib <i>configured to customer specification</i>	
9	??	other	
		<b>Transmitter measuring range</b>	
	ZZ	without	
	KK	customer's specification <i>only transmitter model: T12, T32 please use sheet "help to order"</i>	
		standard range <i>only transmitter model: T20, T21, T31 code see price list</i>	
10	??	special range <i>only transmitter model: T20, T21, T31 please state as additional text</i>	
		<b>Quality certificates</b>	
	Z	without	
11	1	with <i>Please state in clearly understandable text !</i>	
		<b>Additional order details</b>	
	YES	NO	
12	T	Z	additional text <i>Please state in clearly understandable text !</i>

Order code for Model TR002

TR002	-	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	-	<input type="text"/>
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Additional text: \_\_\_\_\_

# Order code for Measuring Insert, rigid, for Resistance Thermometers Model TR001

Field No.	Code	Instrument design	
		<b>Explosion protection</b>	
	Z	without	
	X	EEx ib IIC T6 to PTB No. Ex-97.D.2006 X	
	B	intrinsically safe with manufacturer's certification to NAMUR NE 24	
1	C	intrinsically safe with manufacturer's certification, DIN VDE 0165	
		<b>Type and number of sensors</b>	
	1	1 x Pt 100 application range -50 ... +250 °C	
	2	2 x Pt 100 application range -50 ... +250 °C	
	3	1 x Pt 100 application range -200 ... +600 °C	
	4	2 x Pt 100 application range -200 ... +600 °C	
2	?	other	
		<b>Sensor limiting error</b>	
	A	Class A to DIN EN 60751	
	B	Class B to DIN EN 60751	
	C	1/3 DIN B at 0 °C	
3	?	other	
		<b>Sensor method of connection</b>	
	1	2 wire <i>not with sensor limiting error, Class A</i>	
	2	3 wire	
4	3	4 wire	
		<b>Measuring insert diameter</b>	
	3	6 mm	
	4	8 mm	
5	?	other	
		<b>Measuring insert length</b>	
	1	275 mm	
	2	315 mm	
6	?	other	
		<b>Tube material</b>	
	1	stainless steel 1.4571	
7	?	other	
		<b>Connection socket</b>	
	1	42 mm diameter for connection head form B	
	?	other	
8	2	transmitter instead of connection socket <i>see field no. 9 and no. 10</i>	
		<b>Transmitter</b>	
	ZZ	without	
	A0	model T20, without explosion protection <i>sensor method of connection 4 wire is not connectable</i>	
	A2	model T20, with explosion protection EEx ia <i>sensor method of connection 4 wire is not connectable</i>	
	A4	model T20, with explosion protection EEx ib <i>sensor method of connection 4 wire is not connectable</i>	
	B0	model T21, without explosion protection <i>sensor method of connection 4 wire is not connectable</i>	
	C2	model T31, with explosion protection EEx ia <i>sensor method of connection 4 wire is not connectable</i>	
	C4	model T31, with explosion protection EEx ib <i>sensor method of connection 4 wire is not connectable</i>	
	D0	model T12, without explosion protection <i>configured to customer specification</i>	
	D2	model T12, with explosion protection EEx ia <i>configured to customer specification</i>	
	D4	model T12, with explosion protection EEx ib <i>configured to customer specification</i>	
	E0	model T32, without explosion protection <i>configured to customer specification</i>	
	E2	model T32, with explosion protection EEx ia <i>configured to customer specification</i>	
	E4	model T32, with explosion protection EEx ib <i>configured to customer specification</i>	
9	??	other	
		<b>Transmitter measuring range</b>	
	ZZ	without	
	KK	customer's specification <i>only transmitter model: T12, T32 please use sheet "help to order"</i>	
		standard range <i>only transmitter model: T20, T21, T31 code see price list</i>	
10	??	special range <i>only transmitter model: T20, T21, T31 please state as additional text</i>	
		<b>Quality certificates</b>	
	Z	without	
11	1	with <i>Please state in clearly understandable text !</i>	
		<b>Additional order details</b>	
	YES	NO	
12	T	Z	additional text <i>Please state in clearly understandable text !</i>

## Order code for Model TR001

	1	2	3	4	5	6	7	8	9	10	11	12	
TR001	-	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	-	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	-	<input type="text"/>

Additional text: \_\_\_\_\_

Specifications and dimensions given in this leaflet are correct at the time of printing. Modifications may take place and materials specified may be replaced by others without prior notice.



INGENIEROS ASOCIADOS DE CONTROL S.L.

Tel.: 913831390  
comercial@iac-sl.es