RR

GROUP 2A - Heating elements for air and/or immersion

2A.1 Straight annealed elements in stainless steel piping

General features

- Reinforced tubular elements in annealed stainless steel AISI 304 or AISI 321, Ø8mm, insulated heating element with electrofused magnesium oxide and compressed by flat-rolling.
- Terminal M4. Direct screw on heating element output.
- Each element comes with 6 M4 nuts and 8 washers for connection.
- Standard voltage ~230 V

Usual applications

- **Working in air. Up to 100 °C in still air atmospheric temperature. For higher working temperatures forced air is recommended. Please consult our Technical Department in the event of queries.**
- **Working in immersion. The connection terminals must first be made water-tight. Can be used in water with low chlorine content (natural water). Also for neutral and alkaline aqueous solutions (PH > 7), heat-transfer oils (maximum working temperature depending on the oil quality). Do not use in wells or in water that has circulated through copper piping.**

Fig. 1

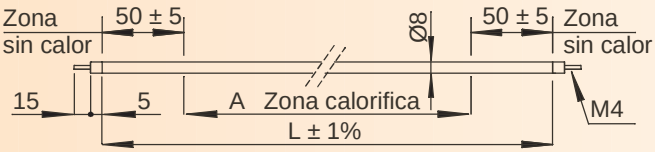
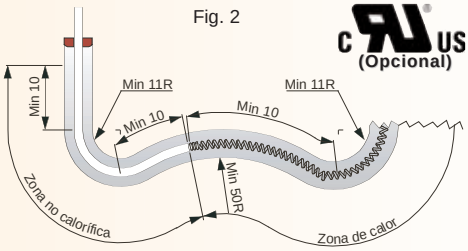


Fig. 2



(Opcional)

These heating elements can be bent up to a radius of 11 mm.
IMPORTANT: The two ends of the heated area must be kept at least 10mm away from any curve of a radius under 50 mm. as shown in Fig. 2.
CURVE ON THE ENDS: on the two ends of the pipe at least 10mm must be left without bending.

Código	Dimensiones en mm		Tipo sellado	Clase térmica constructiva Electricfor	Watios	W/cm²	Peso En Kg
	A	L					
RR0,5S	400	500	Silicona 200	T-700-T	500	5	0,10
RR0,75S	650	750	Silicona 200	T-700-T	750	4,6	0,16
RR1S	900	1000	Silicona 200	T-700-T	1000	4,5	0,22
RR1,5S	1400	1500	Silicona 200	T-700-T	1500	4,3	0,32
RR2S	1900	2000	Silicona 200	T-700-T	2000	4,2	0,43
RR2,5S	2400	2500	Silicona 200	T-700-T	2500	4,2	0,54
RR3S	2900	3000	Silicona 200	T-700-T	3000	4,2	0,64
RR0,5R150	400	500	Resina 150	T-600-S	500	5	0,10
RR0,75R150	650	750	Resina 150	T-600-S	750	4,6	0,16
RR1R150	900	1000	Resina 150	T-600-S	1000	4,5	0,22
RR1,5R150	1400	1500	Resina 150	T-600-S	1500	4,3	0,32
RR2R150	1900	2000	Resina 150	T-600-S	2000	4,2	0,43
RR2,5R150	2400	2500	Resina 150	T-600-S	2500	4,2	0,54
RR3R150	2900	3000	Resina 150	T-600-S	3000	4,2	0,64
RR0,5R250	400	500	Resina 250	T-600-H	500	5	0,10
RR0,75R250	650	750	Resina 250	T-600-H	750	4,6	0,16
RR1R250	900	1000	Resina 250	T-600-H	1000	4,5	0,22
RR1,5R250	1400	1500	Resina 250	T-600-H	1500	4,3	0,32
RR2R250	1900	2000	Resina 250	T-600-H	2000	4,2	0,43
RR2,5R250	2400	2500	Resina 250	T-600-H	2500	4,2	0,54
RR3R250	2900	3000	Resina 250	T-600-H	3000	4,2	0,64

RTR

NEW

GROUP 2A - Heating elements for air and/or immersion

2A.2 One-pipe straight elements vulcanised in stainless steel

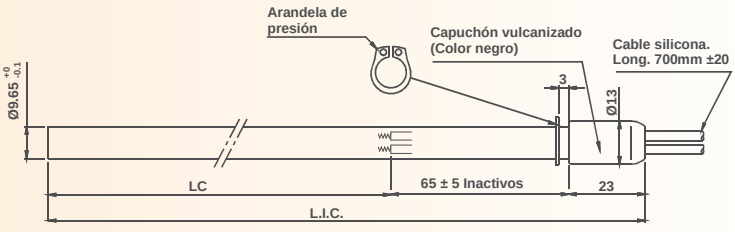
General features

- One-pipe elements reinforced in AISI 304 stainless steel, Ø9.65 mm, insulated heating element with electrofused magnesium oxide compressed by flat-rolling.
- Vulcanised cap with IP-65 protection
- Finishings with silicon cables 700mm long.
- Standard voltage ~230 V

Usual applications

- Support elements for Fan-Coil
- **Working in air.** Always with forced ventilation and inserted in heat exchange battery with flaps. Please consult our Technical Department if you have any queries.
- **Working in immersion.** Can be used in water with low chlorine content (natural water).

Also for neutral and alkaline aqueous solutions (PH > 7), heat-transfer oils (maximum working temperature depending on the oil quality). Do not use in wells or in water that has circulated through copper piping.



Código	Dimensiones en mm		Clase térmica constructiva Electricfor	Watios	W/cm²	Peso En Kg
	L.I.C.	LC				
F81436	388	300	T-300-E	530	6,1	0,20
F81701	1188	1100	T-300-E	1970	6,0	0,50
F81702	788	700	T-300-E	530	2,5	0,35
F81703	988	900	T-300-E	750	2,8	0,20

THERMELEC

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RKF flat tubular elements have a wide range of applications. Its oval-shaped cross-section is particularly adapted to contact heating. The larger contact surface area of these resistors compared to round-tube resistors enables production of shorter resistors with higher load densities.

For oil heating, it is possible to install greater power with the same length as a round-tube resistor. As a result of its good flexibility, these elements can be bent to give shape to almost any application.

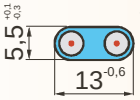
Common applications

- Gas or air heaters
- Fluid heating
- Oil heating
- Driers
- Friers
- Mould heating
- Filters
- Liquid containers
- Conveyor-belt heating
- **Special applications:** Railway and tramway heaters; needle changes.

General characteristics

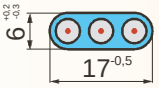
- Flat tubular elements with stainless-steel AISI 321 sleeve, 80-20 grade nickelchromium alloy resistive wire insulated from the sleeve with highly compacted magnesium oxide of very good thermal conductivity.
- Ohmic values:
  - Minimum: 8 Ω per metre
  - Maximum: 1500 Ω per metre for a resistor of 2 conductors.
- Maximum length:
  - RKF 13 → 7000 mm
  - RKF 17 → 5,000 mm
  - RKF 22 → 5,000 mm
- Length tolerance: ±1% with a minimum of ±5 mm
- Inactive zone: Due to the production process, all RKF flat tubular elements have an inactive zone at the connections side of a minimum of 45 mm and at the tube end of a minimum of 25 mm.
- Connections: Smooth outlet Ø1.8 x 30 mm. Other connection possibilities on request.
- Special fabrications: RKF flat tubular elements can be supplied with longer inactive zones. They can also be fabricated with different power distributions over the length.

Sections



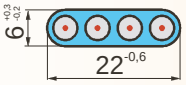
- **RKF 13. Section 13 x 5.5 mm**

In this section, the resistor has an approximate surface area of 3.3 cm² per cm of length. The maximum length is 7000 mm. In railway heating applications, we can supply standard models with different power densities and sealed connection.



- **RKF 17. Section 17 x 6 mm**

In this section, the resistor has an approximate surface area of 4.1 cm² per cm of length. The maximum length is 5,000 mm. This is the most commonly used model in industrial applications. Its greater length enables a wide variety of shapes to be produced, as well as different internal resistor layouts and power distributions.



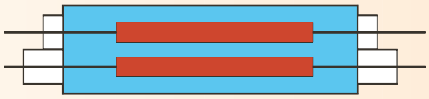
- **RKF 22. Section 22 x 6 mm**

In this section, the resistor reaches an approximate surface area of 5.1 cm² per cm of length. The maximum length is 5,000 mm. As with type RKF 17, it is possible to produce a wide variety of internal resistor layouts.

Internal resistor layout

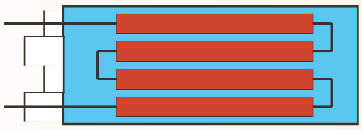
The RKF flat tubular elements can be fabricated with different internal resistor layouts. We can obtain different power levels in the same element by means of connections. The following illustrations show the connection possibilities for each model.

- **Profile type:** RKF 13 / RKF 17 / RKF 22
- **Description:** Single-phase resistor with two outputs at one end

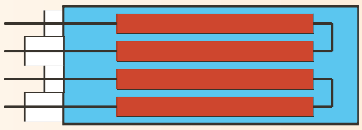


- **Profile type:** RKF 13 / RKF 17 / RKF 22
- **Description:** Two single-phase resistors with outputs at both ends

- **Profile type:** RKF 17 / RKF 22
- **Description:** Three single-phase resistors with outputs at both ends



- **Profile type:** RKF 22
- **Description:** Single-phase resistor with two outputs at one end



- **Profile type:** RKF 22
- **Description:** Two single-phase resistors with four outputs at one end.

Maximum voltage 400 V

Bending

RKF flat tubular elements are supplied straight unless specified otherwise. On request, these elements can be supplied bent according to the instructions given by the client, always taking into account the minimum radii of curvature.

In order to achieve maximum torsion of 90°, a minimum length of 25 mm is required. It is not recommended to change the shape of the resistor in any way between the inactive zone and the connection.

The following minimum radii of curvature must be taken into account when bending the resistor:

Minimum radius of curvature

	RKF 13	RKF 17	RKF 22
Flat-face curves	10 mm	12,5 mm	18 mm
Curves at edges	20 mm	25 mm	75 mm

Protection against explosions - Introduction

In the chemical and petrochemical industries, industrial processes, oil rigs and military installations there are materials which are stored, processed or produced in areas where the atmosphere is potentially explosive and in which explosion-proof heating elements are required. In these cases we must take preventive measures to reduce the risk of explosion of these materials. These preventive measures are based on three principles that they should be applied in the following order:

- **Substitution:** Substitution means replacing flammable material for non-fammable material.
- **Control**: Control means to reduce the amount of flammable material; avoid, minimize or control the leaks, avoid the formation of an explosive atmosphere, containment of leaks, avoid ignition sources, etc...
- **Reduction:** Reduction means to reduce the number of people exposed, measures to prevent the explosion's spread, reduction or elimination of the explosion pressure, providing personnel protective equipment, etc...

Once the principles of replacement and control are applied, the remaining hazardous locations are divided into zones according to the possibility an explosive zone could be present. This classification allows to determine the protection levels for the material and the suitable protection modes for each location.

For an explosion to occur, is necessary to coexist an explosive atmosphere and an ignition source.

The purpose of protective measures on Electricfor's ATEX heating elements is to reduce, until an acceptable level, the probability that the heating elements could become a source of ignition, both surface temperature and electric arc.

For the purposes of Directive 94/9/CE, an explosive atmosphere is defined as a mixture with the air in the atmospheric conditions of inflammable substances in the form of gases, steam, clouds or dust, in which, after igniting, combustion spreads to the total amount of the non-burnt mixture. According to the standard, it is understood as normal atmospheric conditions when:

- The temperature is within the range -20 ° C to +60 ° C
- The pressure is within the range 0.8 bar to 1.1 bar
- The air has a normal oxygen content (typically 21%)

The use of electrical equipment in atmospheric conditions out of this range requires special consideration and may require additional evaluation and testing.

Classification of the dangerous zones (According to EN 60079-10)

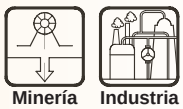
Explosive atmospheres are classified by zones according to EN 60079-10 Classification by zones depends on the time and spatial probability of a dangerous explosive atmosphere occurring.

Zone Classification		Criterion
Gas	Dust	
Zone 0	Zone 20	Presence of permanent, prolonged, or frequent explosive atmosphere (> 1000 hours a year)
Zone 1	Zone 21	Presence of occasional explosive atmosphere in normal conditions (10 - 1000 hours a year)
Zone 2	Zone 22	Presence of abnormal and brief explosive atmosphere (< 10 hours a year)

Material groups

Electrical material in Group I is applied in mines with danger of firedamp occurring.

Electrical equipment Group II is intended for use in locations with explosive gas atmosphere different from mines susceptible to firedamp. We assimilate it to industry.



Equipment Protection Level (EPL)

Protection level is assigned to the material according to their risk of becoming a source of ignition and which recognize the differences between explosive gas atmospheres, explosive dust atmospheres and explosive atmospheres in mines susceptible to firedamp

- Mines: Ma y Mb
- Gases: Ga, Gb y Gc
- Dust: Da, Db y Dc

Electrical equipment group II (Industry) is subdivided according to the nature of the explosive gas atmosphere for which it is intended. This subdivision is based on the maximum experimental safe gap (MESG) or the ratio of minimum ignition current (MIC ratio) of explosive gas atmosphere in which you can install the material. Examples of some representative gases:

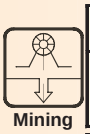
Gases groups

Electrical equipment group II (Industry) is subdivided according to the nature of the explosive gas atmosphere for which it is intended. This subdivision is based on the maximum experimental safe gap (MESG) or the ratio of minimum ignition current (MIC ratio) of explosive gas atmosphere in which you can install the material.

Examples of some representative gases:

Note:

- A unit for Gas Group IIC is suitable also for Groups IIA and IIB
- A unit for Gas Group IIB is also suitable for Groups IIA



Group	Typical atmosphere	Minimum ignitium current (MIC)	Maximum experimental safe gap (IEMS) en mm
I	Methane	Greater	Wide
IIA	Propane	0,8 < CMI	0,9 < IEMS
IIB	Ethylene	0,45 < CMI < 0,8	0,5 < IEMS < 0,9
IIC	Hidrogen/ Acetylene	CMI < 0,45	IEMS < 0,5

Minimum energy for gas ignition: Lesser

Size of flameproof safe gap: Reduced

Dust groups

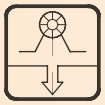
Electrical equipment group II (Industry) is subdivided according to the nature of the explosive dust atmosphere for which it is intended.

Group IIIA	Group IIIB	Group IIIC
Combustible particles in suspension	Nonconductive dust	Conductive dust

Note:

- A material marked with IIC is suitable also for Groups IIA and IIB
- A material marked with IIB is also suitable for Groups IIA

Group and category of equipment

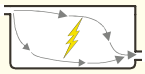
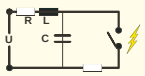


Group	Ambient		Category	Protection level	Zone	EPL
	Gas	Dust				
I	--	--	M1	VERY HIGH	Can be used in Ex atm.	Ma
	--	--	M2	HIGH	Can be disconnected in presence of Ex atm.	Mb
II	G Gas		1	VERY HIGH	0	Ga
			2	HIGH	1	Gb
			3	NORMAL	2	Gc
	D Dust		1	VERY HIGH	20	Da
			2	HIGH	21	Db
			3	NORMAL	22	Dc

Protection against explosions - Introduction

Protection methods

Protection methods are constructive and electrical measurements taken on the material to achieve protection against explosion in potentially explosive atmospheres.

Protection Type	Identification Letter	Diagram Representation	Basic Principle
General requirements			General determinations on the build type and test of electrical material intended for Ex atmospheres
Immersion in oil	**Ex o**		The material or its components are kept immersed in oil and thus separated from the explosive atmosphere
Pressurised	**Ex px Ex py Ex pz**		The ignition source is surrounded by a protective gas under overpressure (min. 0.5 mbar); the external atmosphere cannot penetrate
Pulverulent	**Ex q**		The ignition source is surrounded by fine-grain sand. The Ex atmosphere surrounding the casing cannot be ignited by an arc
Flame proof	**Ex d**		If ignition is produced inside the envelope, the latter will resist the pressure, that is, the explosion will not propagate to the exterior.
Increased safety	**Ex e**		Applicable only to material or its components that in normal circumstances do not generate sparks or electric arcs, cannot reach dangerous temperatures, and whose supply voltage does not exceed 1 kV.
Intrinsic safety	**Ex ia Ex ib Ex ic**		Limiting the energy already in the circuit prevents the onset of excessive temperatures, sparks, or electric arcs
Encapsulated	**Ex ma Ex mb Ex mc**		The ignition source is enclosed inside a mass, and cannot therefore ignite the explosive atmosphere
Non-flammable	**Ex nA Ex nC Ex nR**		Slightly simplified application of the different protection modes of zone 2; "n" means "non-flammable"
By enclosure	**Ex ta Ex tb Ex tc**		The electrical equipment are protected by an enclosure which prevents the ignition of a dust cloud or layer

Relationship between modes of protection and the EPLs

EPL	Protection mode	Code	Standard
Ga	Intrinsic safety	"ia"	IEC 60079-11
	Encapsulated	"ma"	IEC 60079-18
	Two independent protection modes each one according to EPL "Gb"		IEC 60079-26
	Protection of equipment and transmission systems which use optical radiation		IEC 60079-28
Gb	Flameproof enclosures	"d"	IEC 60079-1
	Increased safety	"e"	IEC 60079-7
	Intrinsic safety	"ib"	IEC 60079-11
	Encapsulated	"m" "mb"	IEC 60079-18
	Immersion in oil	"o"	IEC 60079-6
	Pressurised enclosures	"p" "px" "py"	IEC 60079-2
	Pulvurulent	"q"	IEC 60079-5
	Concept intrinsically safe fieldbus (FISCO)		IEC 60079-27
	Protection of equipment and transmission systems which use optical radiation		IEC 60079-28
Gc	Intrinsic safety	"ic"	IEC 60079-11
	Encapsulated	"mc"	IEC 60079-18
	No sparks producer	"n" "nA"	IEC 60079-15
	Restricted breathing	"nR"	IEC 60079-15
	Power limitation	"nL"	IEC 60079-15
	Material that produces sparks	"nC"	IEC 60079-15
	Pressurised enclosures	"pz"	IEC 60079-2
	Concept Fieldbus non-incendive		IEC 60079-27
	Protection of equipment and transmission systems which use optical radiation		IEC 60079-28
Da	Intrinsic safety	"ia"	IEC 60079-11
	Encapsulated	"ma"	IEC 60079-18
	Protection by enclosure	"ta"	IEC 60079-31
Db	Intrinsic safety	"ib"	IEC 60079-11
	Encapsulated	"mb"	IEC 60079-18
	Protection by enclosure	"tb"	IEC 60079-31
	Pressurised enclosures	"pD"	IEC 61241-4
Dc	Intrinsic safety	"ic"	IEC 60079-11
	Encapsulated	"mc"	IEC 60079-18
	Protection by enclosure	"tc"	IEC 60079-31
	Pressurised enclosures	"pD"	IEC 61241-4

Temperature classes

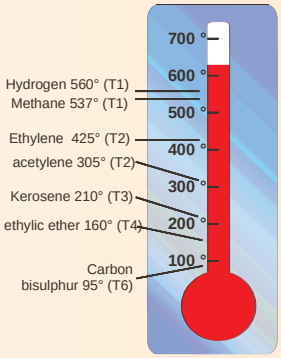
The ignition temperature of an inflammable gas or dust is the lowest temperature on a hot surface from which ignition of the gas/air or steam/air mixture occurs.

Therefore, the maximum surface temperature of a material must always be lower than the inflammatory temperature of the surrounding atmosphere.

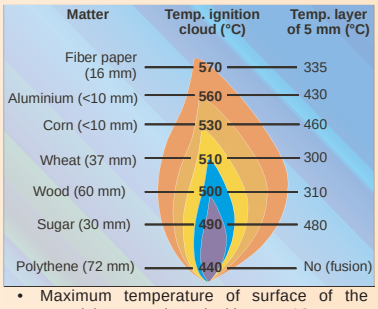
To that end we identify indicating the maximum surface temperature they can reach. In gases is indicated by T1 to T6 (see table below) and for dust we directly indicate this temperature.

Temperature class	Maximum material surface temperature	Flammable substances ignition temperatures
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C
T3	200 °C	> 200 °C
T4	135 °C	> 135 °C
T5	100 °C	> 100 °C
T6	85 °C	> 85 °C

Temperature class GAS



Temperature class DUST



- Maximum temperature of surface of the material < Temp. layer ignition -75 °C
- Maximum temperature of surface of the material < 2/3 xs Temp. ignition cloud

ATEX Marked

See below in the explaining the meaning of the following ATEX marked based on example:

CE 0163 Ex II 2 GD - Ex d IIC T4 Gb - Ex tb IIIC T135ºC Db

The marked is divided into three parts:

- General according to Directive
- Specific for gases
- Specific for dust

94/9/CE Directive	**CE 0163 Ex II 2 GD**		
	CE	⇨	CE Marked - Product manufactured according to Directive 94/9/CE
	0163	⇨	ATEX Notified Body Number (LOM)
	Ex	⇨	Specific mark of electrical equipment for explosive atmospheres
	II	⇨	Industry (not mines susceptible to firedamp)
	2	⇨	HIGH Protection Level
	G	⇨	Suitable for gases, vapors and fogs
	D	⇨	Suitable for dust

GASES	**EX d IIC T4 Gb**		
	Ex	⇨	Symbol that indicates the material is according to a standard protection mode
	d	⇨	Flameproof enclosure "d"
	IIC	⇨	Suitable for IIC group gases
	T4	⇨	Temperature class (T1 to T6)
	Gb	⇨	Material for explosive gas atmospheres with a HIGH protection level

DUST	**Ex tb IIIC T135ºC Db**		
	Ex	⇨	Symbol that indicates the material is according to a standard protection mode
	tb	⇨	Protection mode has an enclosure that protects against the penetration of dust and provides means to limit the surface temperature. Suitable for EPL Gb
	IIIC	⇨	Type of dust: Conductive dust
	T135ºC	⇨	Maximum surface temperature
	Db	⇨	Material for explosive dust atmospheres with a HIGH protection level