FKK Corporation

2014 Catalogue

PLUG HEATER

FKK

Contents

Corporate Profile

Address	11 Tsutsumisoto-cho Kisshoin Minami-ku, 601-8399 Kyoto, JAPAN TEL: 075-314-8760 FAX: 075-314-4167
Establishment	1954/02
Capital	1,0000000 JPY
Founder	CEO Genjiro KAWATA
Employees	150 (2014/04)
Main site	Head Office (Kyoto), Fukuchiyama plants (2 plants)
Representative office	Tokyo, Osaka, Sendai
Branch	Shanghai, Seoul
Member organization	Japan Industrial Association of Gas and Kerosene Appliances (JGKA) Kyoto Chamber of commerce

Corporate philosophy
At FKK we are constantly thinking about how to contribute to today's environmental challenges via solutions and systems to save energy and create a brighter world. We are constantly looking for innovative and smarter solutions and achieve our goal through customer's satisfaction.We are building harmony between people, foster a supportive and dynamic workplace, and deal sincerely with all tasks and people we encounter. We believe in prospering by bringing prosperity to society as a whole. With every new challenge, we seek to develop unique solutions from a fresh perspective, driving the growth and advancement of our company. We achieve this through strong principles to ensure a permanent and responsible prosperity, considering human, human development and its relation with environment as the center of our business strategy.

Environment
In a world where our natural environment is a bit more threatened every day, FKK have always been committed to nature. Considering the environmental protection as an essential purpose, in compliance with environmental standards (ISO 14001, REACH and RoHS) FKK designs and develops solutions that are more respectful of nature.

Quality
FKK gain the satisfaction and trust of the customer by drawing on unique technology and skills. We take customer's point of view all the time and constantly improving customer satisfaction, responsiveness and the ability to take prompt and effective action. FKK put the quality management system (ISO 9001) to effective use and constantly improve the quality of products and services.

History

1954.02: Foundation of Fuji Industries in Kyoto, Japan
1957.02: Production of spark plug for agricultural machinery
1970.02: First production of igniters for oil burner
1985.02: The headquarter moved to Kisshoin, Kawata Genjiro becomes president of the group
1988.04: New factory built in Fukuchiyama
2003.02: Establishment of Shanghai subsidiary
2005.05: Obtained ISO 9001 certification
2006.02: Award of the best top 300 Japanese SME from the Japanese Ministry of Industry
2006.02: Award for the Best 21st century's SME from Kyoto prefecture
2007.06: Obtaining the ISO 14001 certification. Fuji Industries becomes FKK Corporation, a new headquarters is built
2010.02: New plant in Fukuchiyama
2011.07: Production of igniters and busbar for fuel cell appliances. International development start
2012.08: Partnership bind in UK, Belgium and Russia
2013.01: Fukuchiyama ignition electrode plant is automated
2013.11: Biomass igniter PSx series count 16 different models from 100V to 240V.

2014CATALOG-V.EN2014/04/20

Network

Head office / Sales

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Minami-ku, 601-8399 Kyoto,
JAPAN

PH Department
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Fukuchiyama plant

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1-17-17 Nishi Ku, 550-0002 Osaka,
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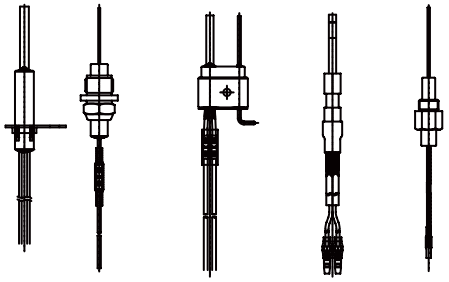
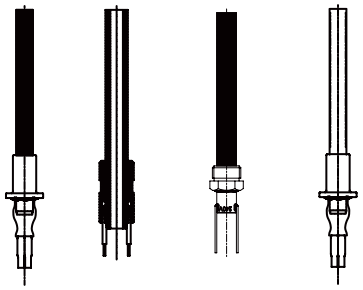
Starting international development in 2011, FKK is nowaday present in Europe, Russia, Asia and exporting products worlwide on all continents.

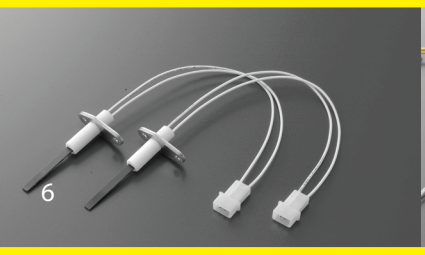
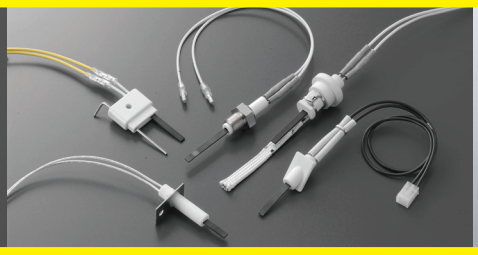
Belgium
China
Italy
Japan
Korea
Russia
UK
USA

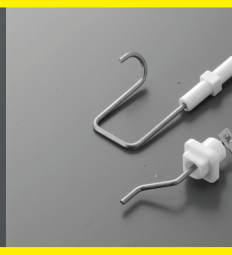
PLUG HEATER LINE UP
Products presentation

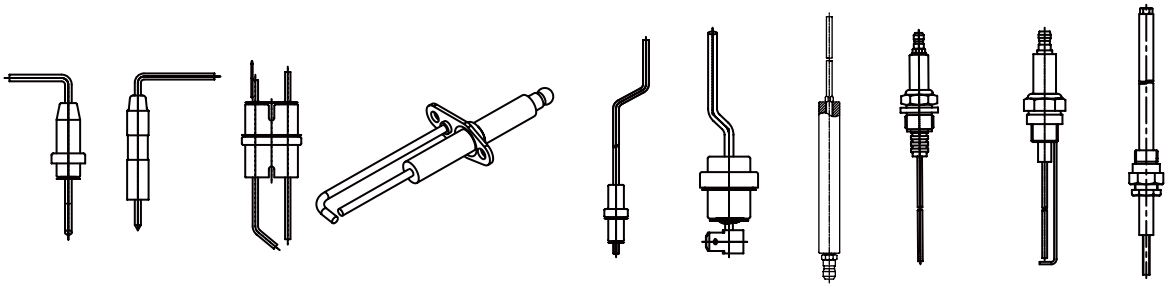
	Hot Surface Igniter (plate type)		Hot Surface Igniter (rod type)		Planar heater
Product type	Silicone Nitride Igniter 1000~1200°C	Silicone Nitride Igniter 1200~1400°C	Biomass pellet /log/ chips/coal igniter 300W	Biomass pellet /log/ chips/coal igniter 240W	Alumina heater for molding press
Materials	Silicone Nitride Flange Alumina 90~99.9% All connector and fitting available	Silicone Nitride Flange Alumina 90~99.9% All connector and fitting available	Metalized Alumina 92% Flange Alumina 90~99.9% All connector and fitting available	Alumina 92% Flange Alumina 90~99.9% All connector and fitting available	Alumina 90~99.9% All connector and fitting available
Application	Boiler/Burner	Burner /Gas Reformer	Stove/Boiler/Burner	Stove/Boiler/Burner	Industrial
Features	High speed 6s to 1000 °C 1200~1350 °C	High temperature 90000 hrs at 1350 °C	High temperature and long rated life 100/120/220~240V	Long rated life Design for 120V market	High speed, high efficieny
Range of temperature	1000~1200 °C	1200~1350 °C	970~1050 °C	950~970 °C	600~1000 °C
Image					
Special order	OK	OK	OK	OK	OK

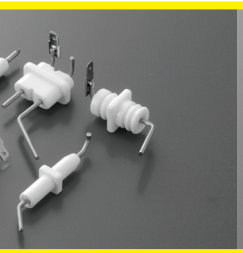
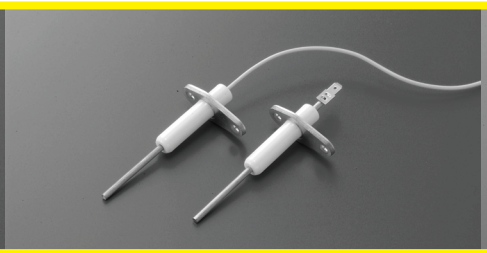
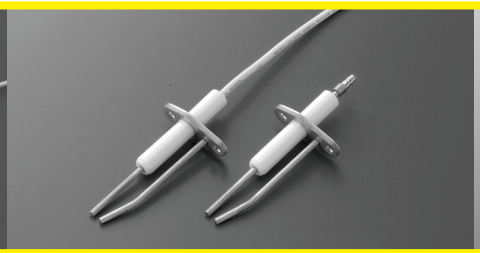
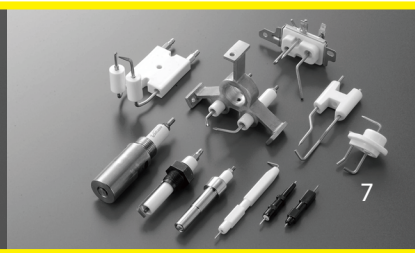
To the essence of heat

Ignition components are essential in the design of heating application and burner. Seek efficiency in ignition is our job revolutionize industry is our goal.

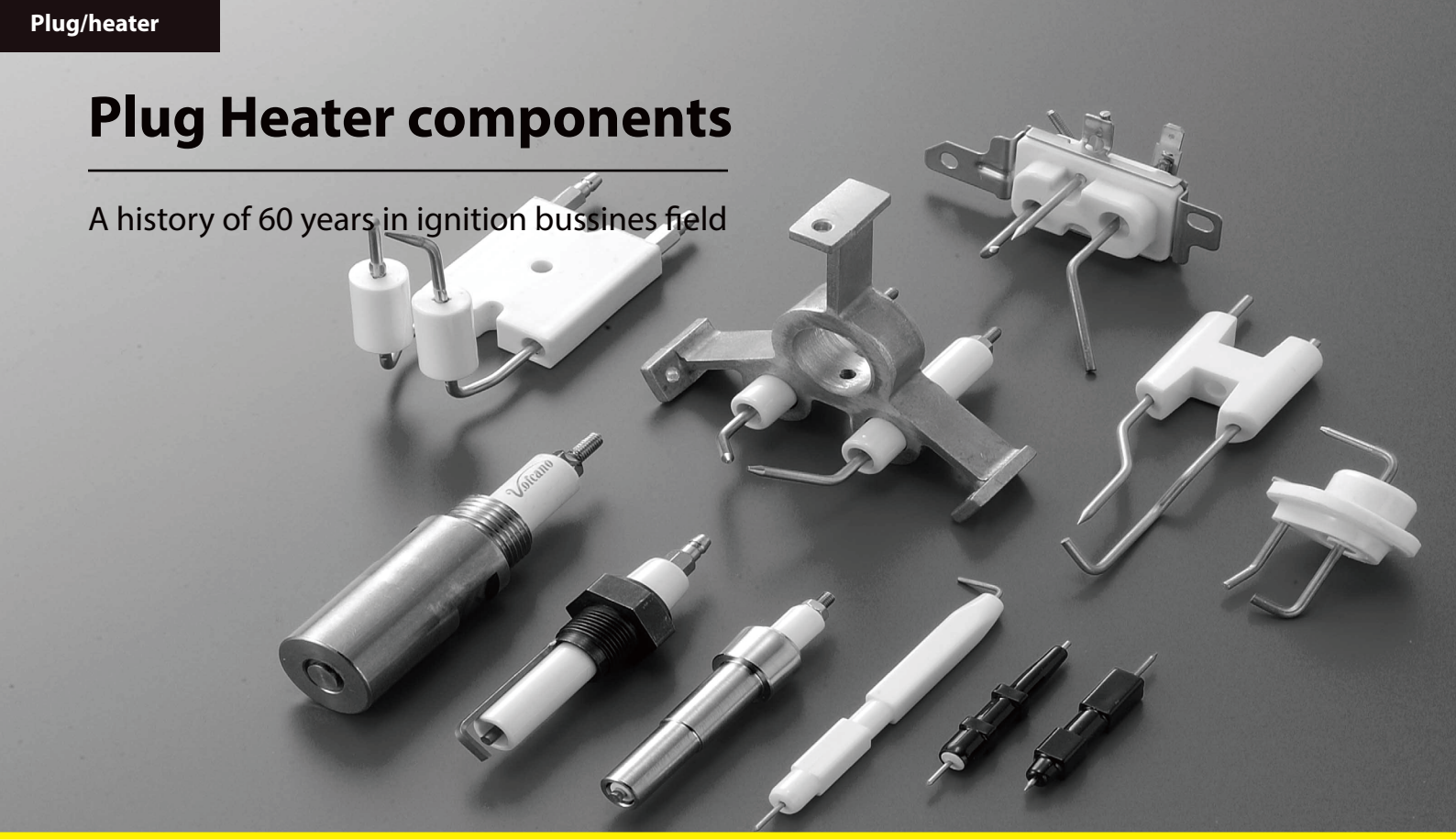


	Ignition Electrode		Ionization prob and flame sensor rod		Spark rod
Product type	Ignition electrode Simple	Ignition electrode Assembly	Flame sensor rod	Ionization rod with fitting	Industrial size spark rod
Materials	Alumina 90~99.9% Kanthal, Hitachy SYTT, Stainless steel, Steel All connector available	Alumina 90~99.9% Kanthal, Hitachy SYTT, Stainless steel, Steel All connector and fitting available	Alumina 90~99.9% Kanthal, Hitachy SYTT, Stainless steel, Steel All connector and fitting available	Alumina 90~99.9% Kanthal, Hitachy SYTT, Stainless steel, Steel All connector and fitting available	Alumina 90~99.9% Kanthal, Hitachy SYTT, Stainless steel, Steel All connector and fitting available
Application	Cooktop/water heater	Water heater	Cooktop/Burner	Burner	Industrial
Possible size (mm)	All lengths possible from 30 to 1800 mm, all electrode diameters possible				
Range of temperature	600 to 1400 °C				
Image					

Plug Heater components

A history of 60 years in ignition bussines field



Every day in Asia, Europe or America, FKK is present in the lives of millions of people around the world through boilers, water heaters and stoves components.

In Japan FKK has led the way in designing and manufacturing high quality components for over 60 years. Today, we offer engineers solutions to diverse temperature control, gas, oil wood as well as Fuel cell and othr renewable energy appliance ignition and heat detection systems.

• Over 60% of the Japanese market of gas, oil and fuel cell boiler and water heater electrodes and spark ignition components
• Number one supplier of the biggest Japanese companies for gas, oil and fuel cell (sofc, PEFC, CHP) systems: Toshiba, Hitachi, Panasonic, Mitsubishi, Osaka Gas, Eneos, etc..
• 2/3 of water boilers and stoves in Japan
• First provider of ceramic hot surface igniter for CHP fuel cell high temperature burner/reformer
• 18000000 components produced per year (over than 600 different model produce every year)
• 3 assembly plants

Among the major FKK customers: Hitachi, Panasonic, Rinnai, Paroma, Kyocera, Toshiba, Tokyo Gas, Osaka Gas.

Products

- ignition electrodes
- single electrodes
- double electrodes
- blocks of electrodes
- electrode assemblies
- single or multiple pole ignition electrode
- flame monitoring pole
- flame sensor rods
- ionisation electrodes
- ceramics hot surface igniter
- double plan igniter
- pellet stove igniter
- cathode and anode
- spark plug
- interference suppressors
- temperature sensors
- advanced ceramics

Application

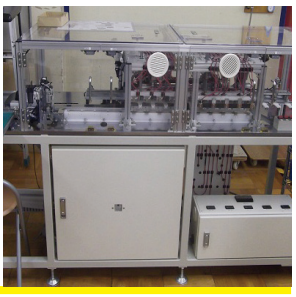
Gas	Bath heater / gas water heating equipment
	Furnace/burner heating equipment
	Boiler
	Table stove
	Table top burner
	Commercial kitchen equipment
	Industrial heating Equipment
Oil	Oil hot water equipment
	Heating equipment
	Portable stove
	Furnace/burner
	Fan heater
	Boat and small aircraft engines (ignition plug)
Renewable energy	Pellet stove/boiler/burner igniter
	Stirling engine igniter
	MCHP Fuel Cell SOFC/PEFC burner igniter
	Fuel Cell reformer component

Automated Line

Better. Faster.

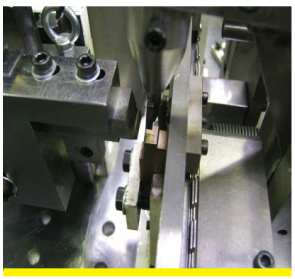
A part of standard production is fully automated. Automaziation have been implemented to increase quality while reducing cost for customers. Workers can now concentrate on increasing tailor made products quality.

Production process



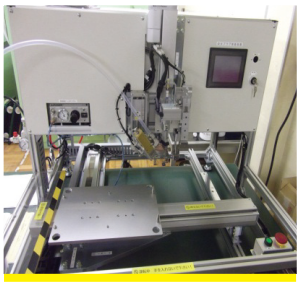
Insulation tester

All ceramic body are tested before the begining of the production.
Robot apply 15KV for few seconds inside the ceramic body



Croping machine

Kanthal, SYTT Hitachi Metal, FCHW made electrode are crope automatically

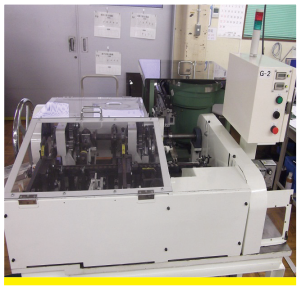


Ceramic sealant bonder

Robot seal the electrode and ceramic insulator with FKK Corporation made ceramic compound

Oven and trail

After sealing process the trail go to oven to solidy the sealant.

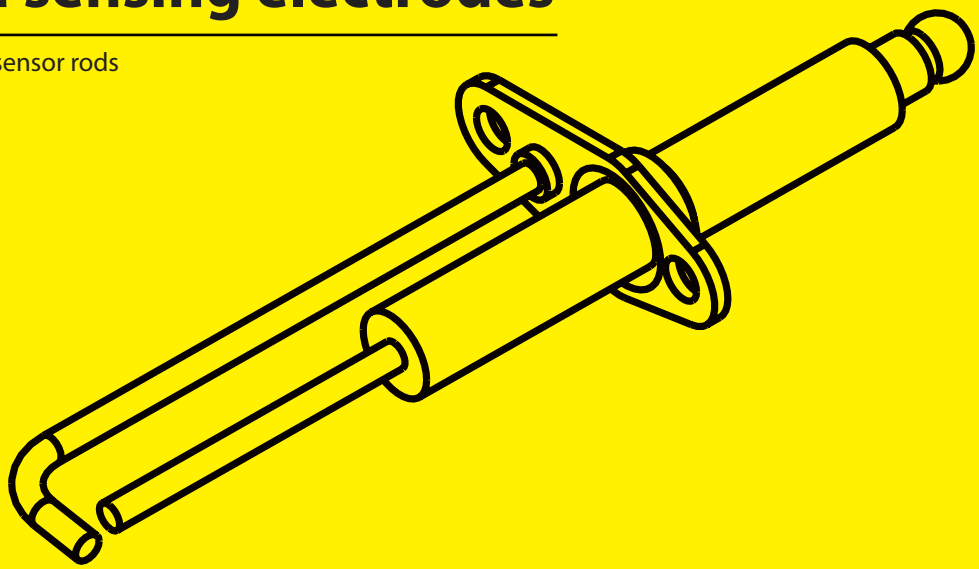


Bending machine

Bending machine perform the bending of the electrode from 1 to 4 bending points.

Ignition and sensing electrodes

Ignition electrodes and flame sensor rods



Ignition electrodes used for the ignition and temperature control in gas and oil combustion equipment, work on the principle of ignition by high voltage flashover.

FKK Corporation ignition electrodes, flame sensor rods and assemblies come in over infinite configurations.

If your application requires an electrode or sensing rod, we can provide one of our model or design it and produce it for you.

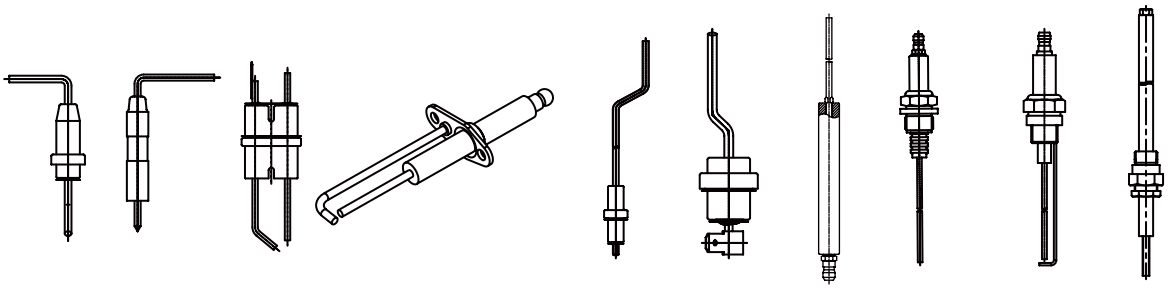
Application

Gas	Gas boiler / water heating equipment Furnace/burner heating equipment Table stove / Table top burner Commercial kitchen equipment Commercial burner Industrial burner equipment
Oil	Oil hot water equipment Heating equipment Portable stove Furnace/burner Industrial burner equipment

- High sparking efficiency
- Long rating life
- High quality
- Moisture resistant
- From small quantity

Specification

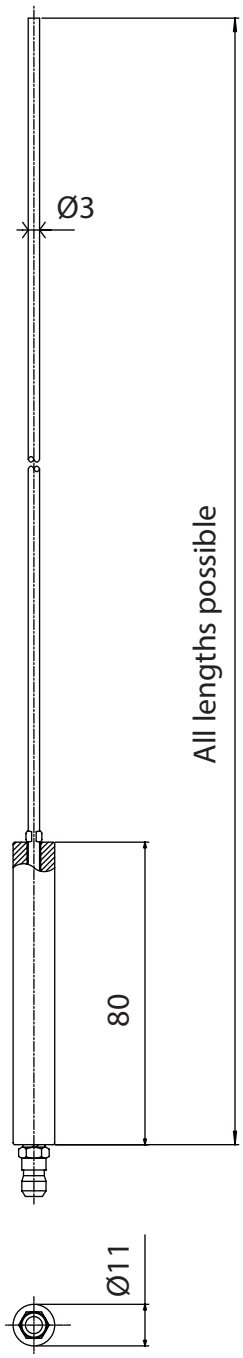
- Inusulator material available: Mullite, Steatite, Heat Resistant Resin, Alumina 90~99.6%
- Electrode material available: Kanthal A, C, D , Hitachi Metals Ltd. YSS-SYTT, PYROMAX, FCHW1/FCHW2, SUS304/310/316, Inconel, Various Ni-Cr alloy wire
- Wiring and connector available: all type
- Ceramic insulator size available: length 10 to 1800 mm, diameter 3 to 15mm
- Heat resistance range 700 to 1400°C

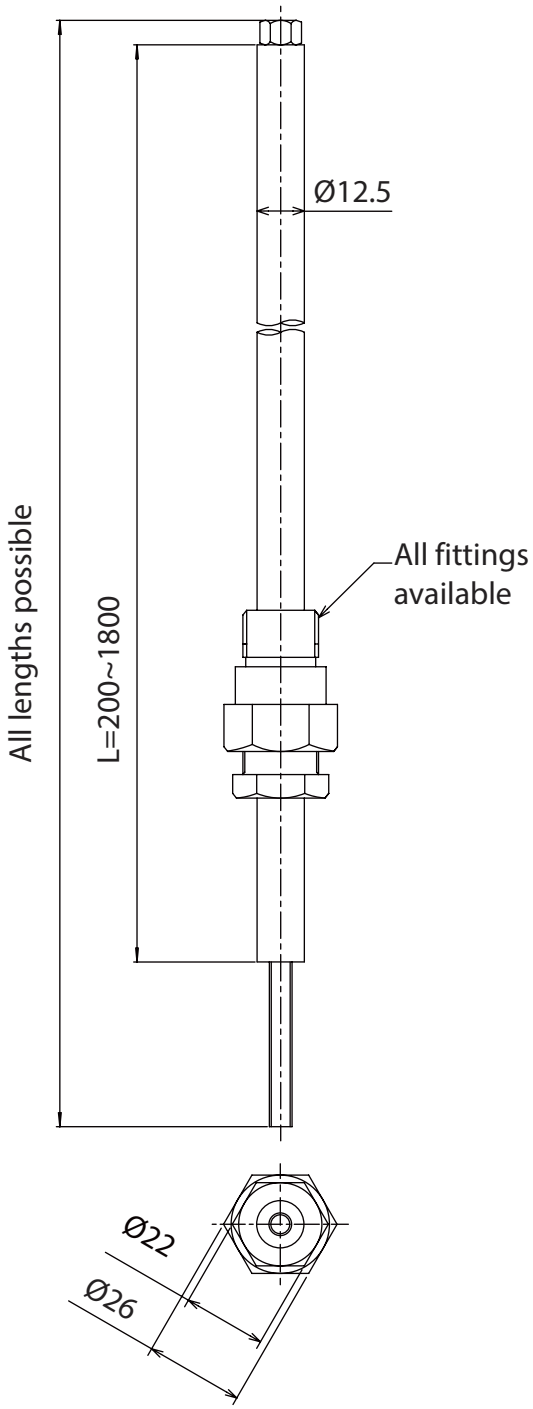


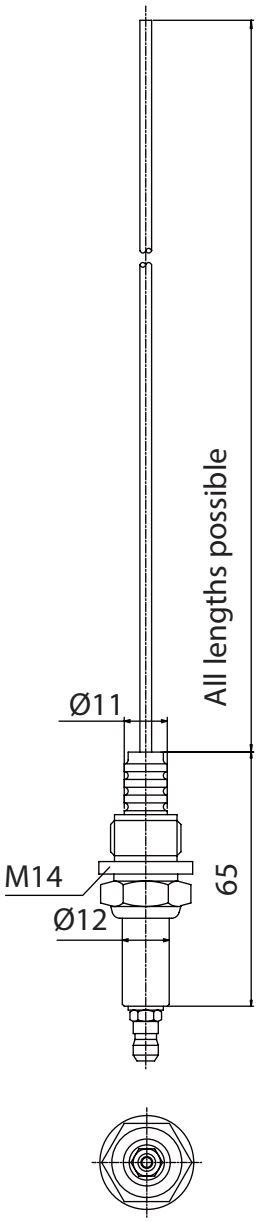
Overview of ignition and sensing electrodes

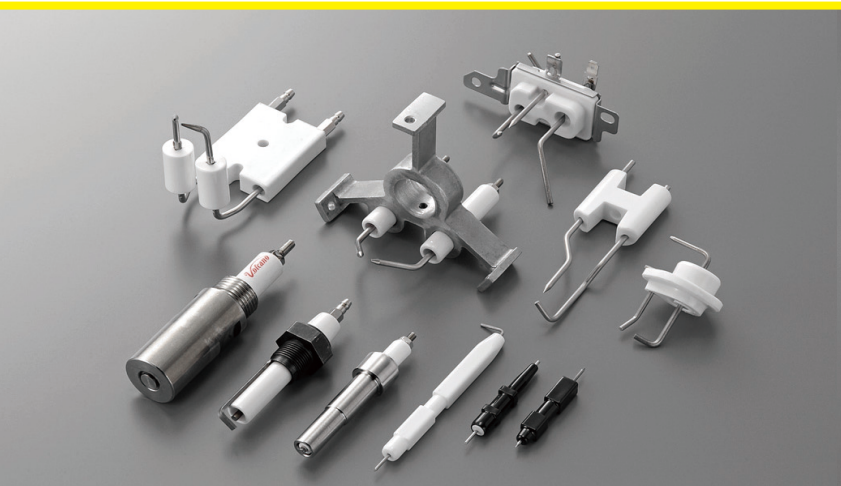
Examples of industrial ignition and sensing rods

Unit (mm)









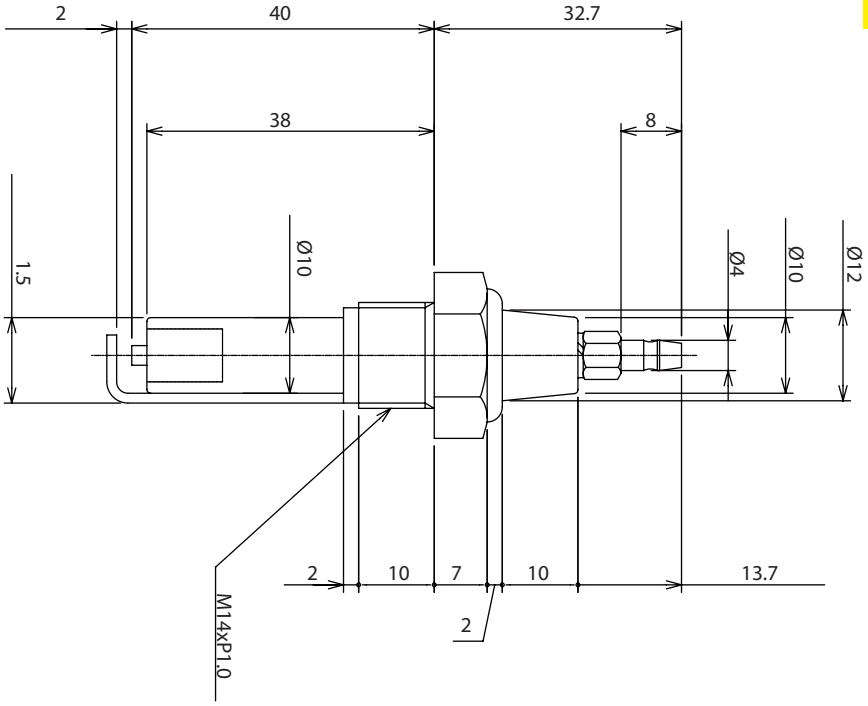
Ignition and sensing electrodes

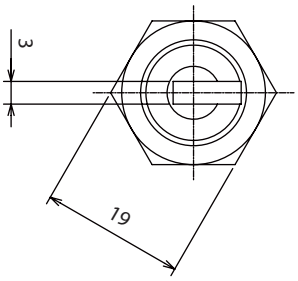
Ignition electrodes and flame sensor rods standard products

Line up

M14xP1.0

M14xP1.0 Compression nut

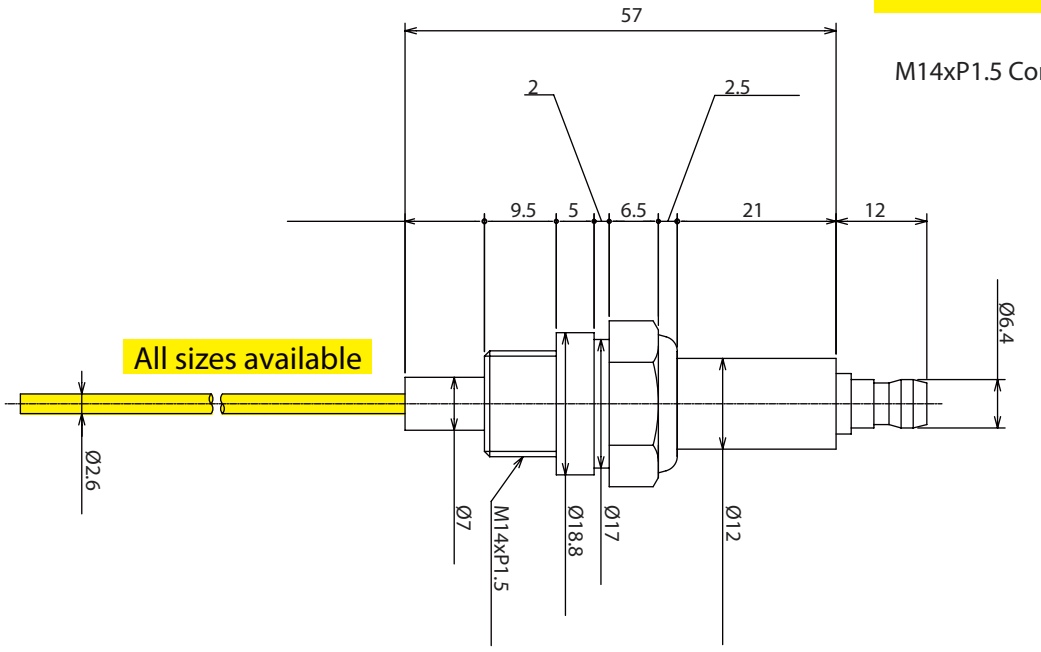


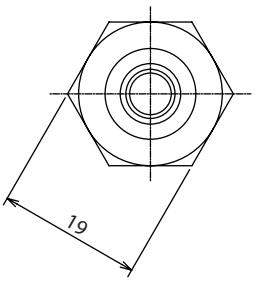


M14xP1.5

M14xP1.5 Compression nut

All sizes available



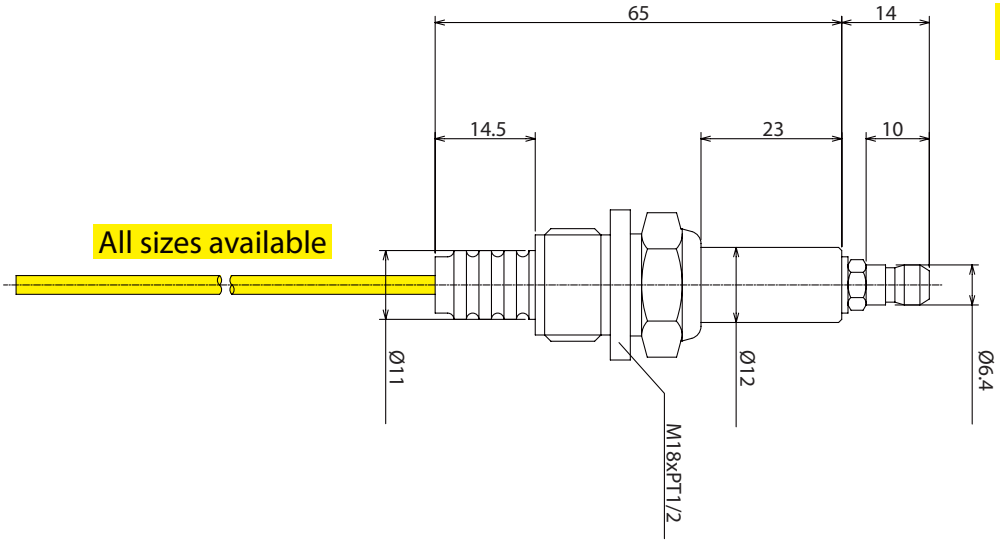


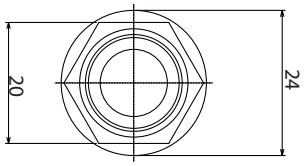
Unit (mm)

M18xPT1/2

M18xPT1/2 Compression nut

All sizes available



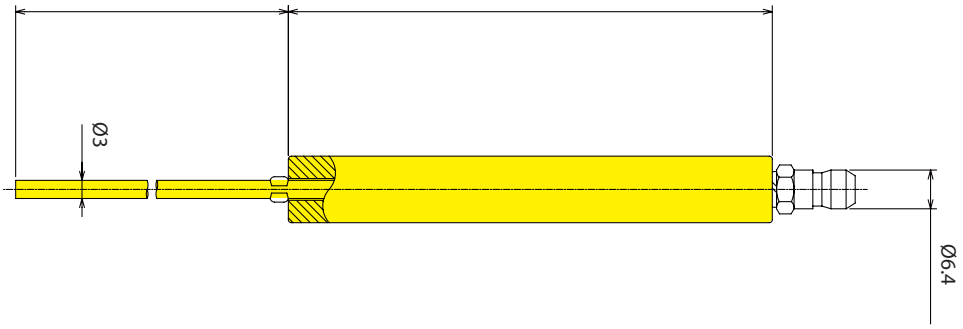


Rod Electrode

Ignition rod

All sizes available

All dimensions available

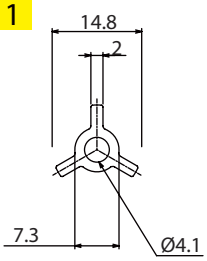


Option parts

Ceramic spacer

Ø4.1 hole

1



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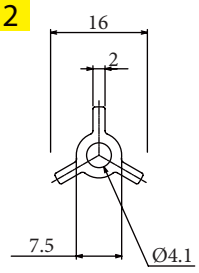

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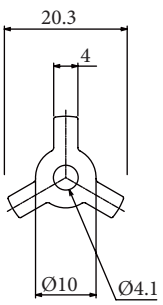

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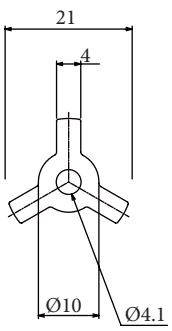

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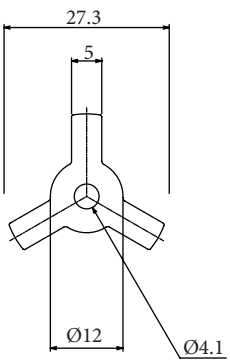
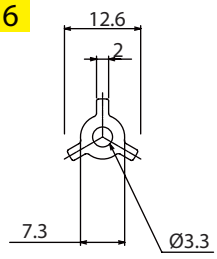


Ø3.3 hole

6



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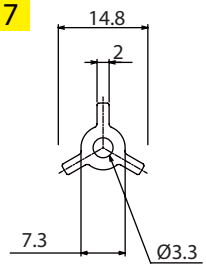

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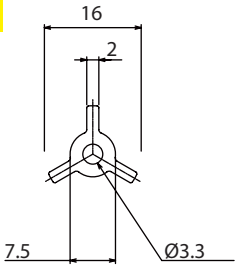

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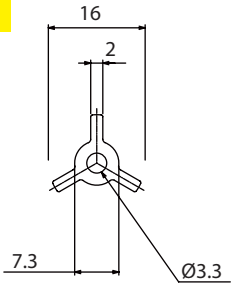

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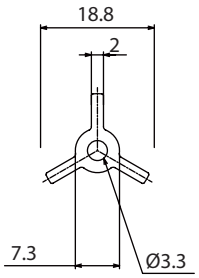
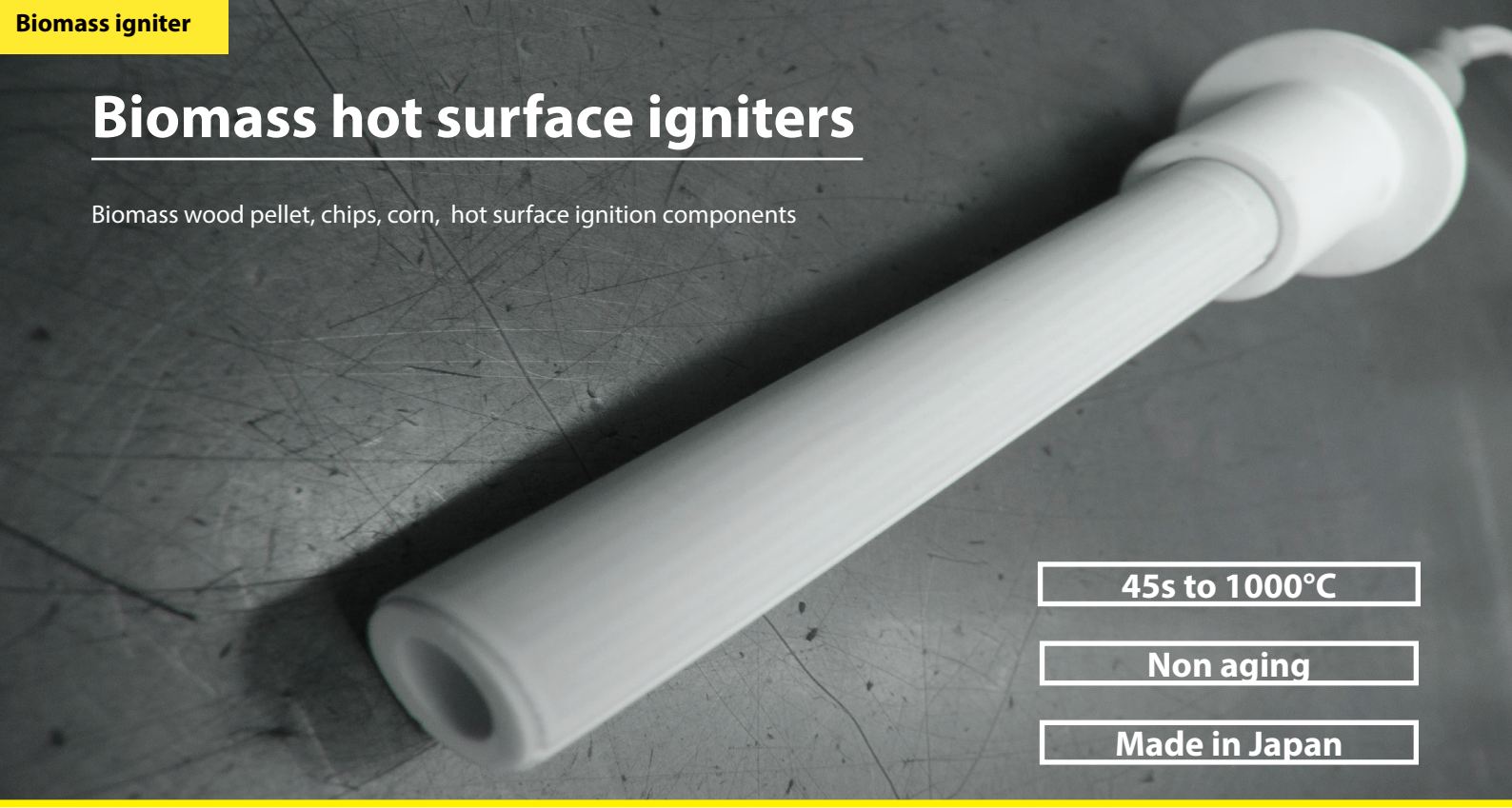


Unit (mm)

Biomass hot surface igniters

Biomass wood pellet, chips, corn, hot surface ignition components



Introducing the PSx® series ceramic biomass igniters range, an advance in ignition technology for solid fuels.

FKK Corporation specialises in ceramic hot surface igniters and has many years of experience of working closely with customers to develop bespoke solutions for innovative appliances manufacturers. We are a trusted supplier of hot surface ignition products to many industry sectors.

These advanced igniters are simply the best for lighting pellet and biomass burners. They use only a fraction of the energy required by hot air fans and ignition blowers and will light all fuel types. Ideal for wood pellets, corn, maize, coal, coke etc.

With a considerably higher temperature, around twice that of traditional metal sheathed products, ignition times are reduced to as little as 60 seconds. This makes them significantly more economical in use.

All our range can be customized to fit perfectly in your appliance.

Ceramic ignition technology benefits

- A fraction of the energy consumption compared to conventional cartridge or element heater
- Long lasting (non aging)
- Time to ignition 60~90 seconds
- Tested to 100,000 cycles, used for long time in Japanese market (15 years)
- Easy to install and retrofit
- Fits any steel tube with an inner diameter of >18mm
- 1000°C at steady-state temperature
- Cannot overheat even with blower failure
- Available in 120V / 220/240VAC
- Fully electrically insulated with no exposed electric contacts
- UL/CE certified wiring (200 to 500°C heat resistant wire)
- Impervious to oxidation and corrosion
- Dimensions: l = 96mm, d = 16mm (PSx-1)
- Ignite wood chips, split logs, coal briquettes or other biomass, corn etc
- Comply with RoHS, REACH regulation on Hazardous Subsctances

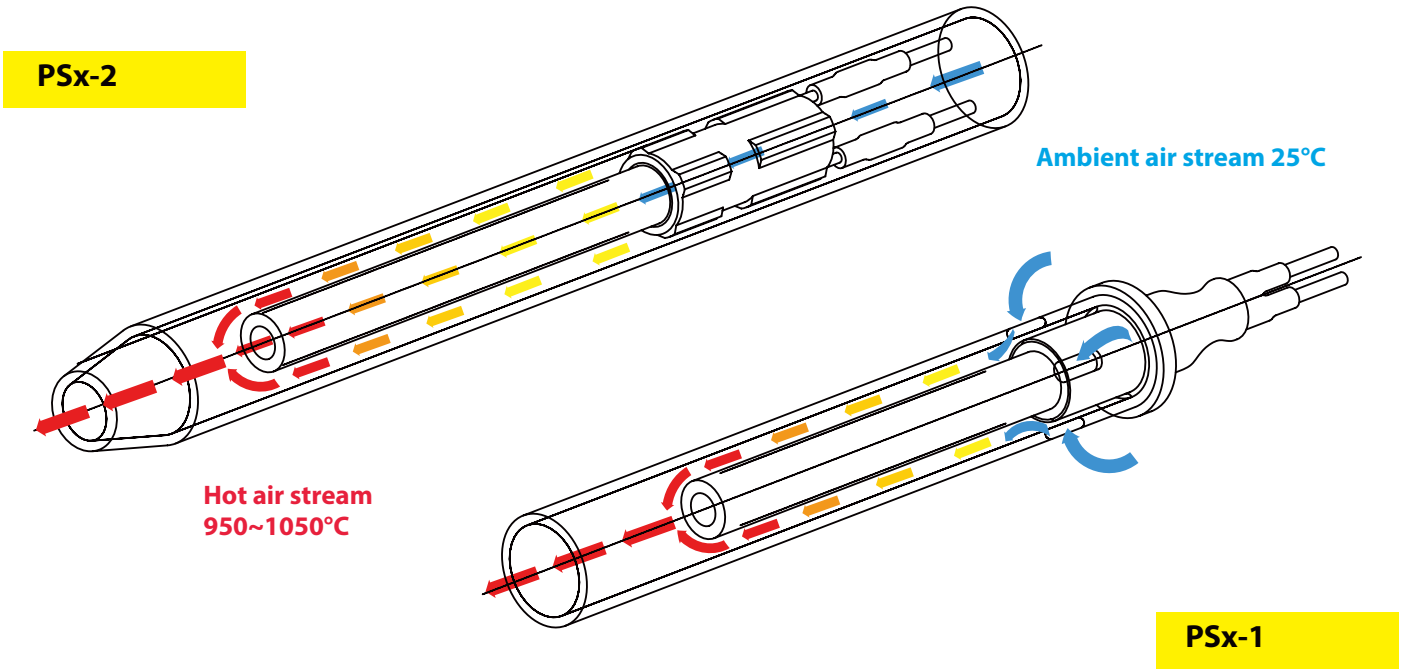
Systems

- Pellet Stove
- Pellet Boiler
- Pellet Burner

A revolutionary way to ignite biomass

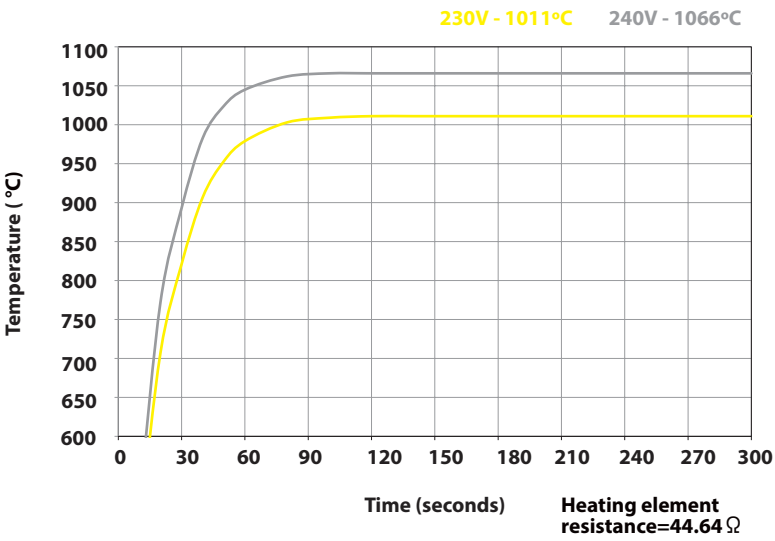
PSx® series igniters revolutionize biomass heating appliances ignition process. FKK develop two type to fit in every appliances:

Blowing air type ceramic igniters have a through hole that let air through the heating element body. With this structure ignition performance can be increase by 1.4 times.

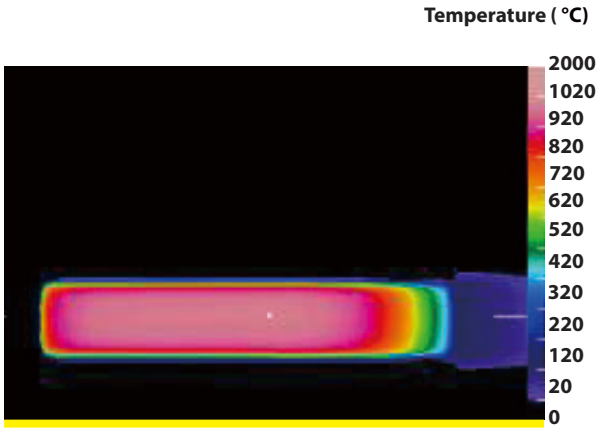


Radiant type ceramic igniters, use radiant heat effect to heat surround air for indirect ignition of pellet.

Rising temperature



Heat distribution



PSx series igniters line up

A simple and efficient solution for pellet ignition

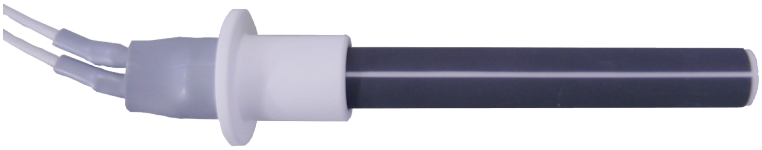
Application

Heaters suitable for ignition of wood pellet, logs, woodchips, coal for stoves, boilers and burners.

Features

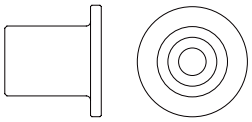
- Designed for over 100,000 ON/OFF cycles.
- Fast ignition time (60~90s to ignite pellet according to burner)
- Wiring available in UL or CE certified version.
- Totally customizable solution, many design available
- 240W and 300W type
- Available in 120V , 230V, 220~240V

Line up



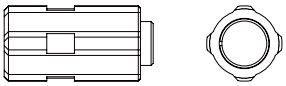
PSx-1

26mm ceramic flange
Surround air radiant type



PSx-2

17mm ceramic flange
Blowing air type

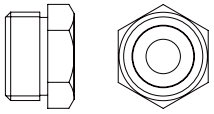


PSx-3 / PSx-4

No flange, perfect retrofit solution
Blowing air or radiant type available

PSx-6 / PSx-7

G3/8" threaded flange fixed on heater
Blowing air or radiant type available



All drawings and data-sheets are available for downlad at : www.fkk-corporation.com/en/download
You can also scan the QR code to go directly on the related page

Line up

Unit (mm)

300W Class - Black coating alumina heaters (B)

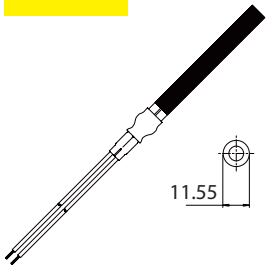
PSx-1-B

300W - 1050°C

PSx-2-B

300W - 1050°C
Blowing air

PSx-3-B



300W - 1050°C

PSx-4-B

300W - 1050°C
Blowing air

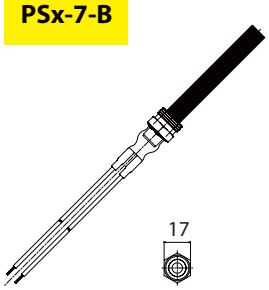
PSx-5-B

300W - 1050°C

PSx-6-B

300W - 1050°C

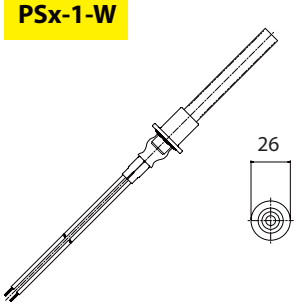
PSx-7-B



300W - 1050°C
Blowing air

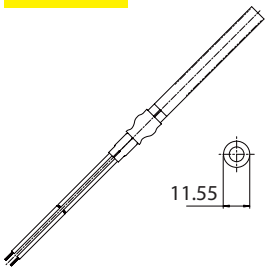
240W Class - White coating alumina heaters (W)

PSx-1-W



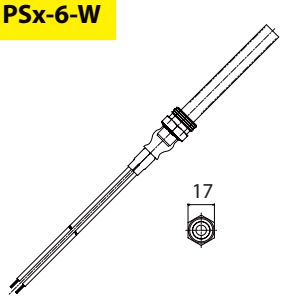
240W - 970°C

PSx-3-W



240W - 970°C

PSx-6-W

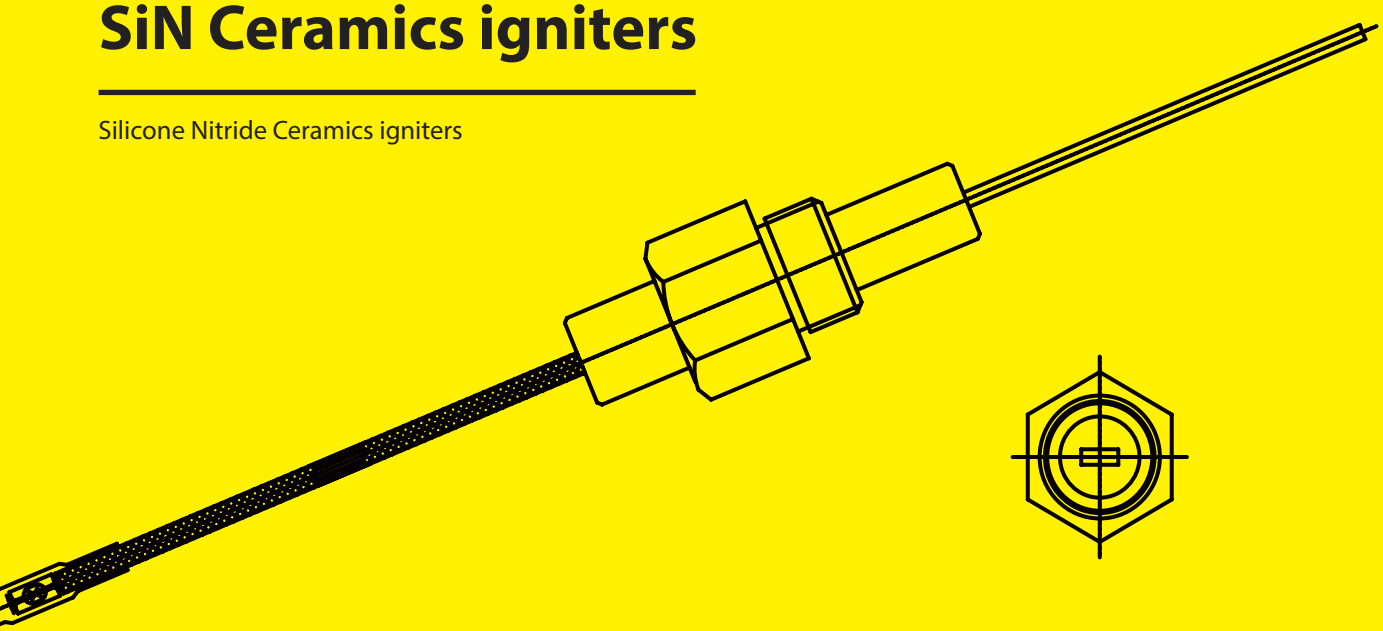


240W - 970°C

Type	Reference	Flange type	Heater length (mm)	Available voltage (V)	Cable length (mm)
300W	PSx-1-240-B	ceramic 26mm	107	120, 220~240V	350mm *All lengths availble upon request
	PSx-2-240-B	ceramic bushing 17.7 mm	113	120, 220~240V	
	PSx-3-240-B	Flange less - Retrofit	107	120, 220~240V	
	PSx-4-240-B	Flange less - Retrofit	107	120, 220~240V	
	PSx-5-240-B	G1/2" flange 23mm	107	120, 220~240V	
	PSx-6-240-B	G3/8" flange 17mm	107	120, 220~240V	
	PSx-7-240-B	G3/8" flange 17mm	107	120, 220~240V	
240W	PSx-1-120-W	ceramic 26mm	107	120, 230V	
	PSx-3-120-W	Flange less - Retrofit	107	120, 230V	
	PSx-6-120-W	G3/8" flange 17mm	107	120, 230V	

SiN Ceramics igniters

Silicone Nitride Ceramics igniters



FKK Corporation producing OEM custom order ceramic silicon nitride igniters for gas and oil energy-efficient equipments. FKK Corporation is now one of the world's leading producers of ceramic igniters for compact boilers and tankless water heater as well as Fuel Cell SOFC/PEFC appliances, covering Asia and America .

Features

Long Rated life
While standards igniters only last 2 or 3 years, FKK ceramics igniters are made to last at least 90000 hours (nearly 10 years) according to Japanese standard and made to be very resistant in all conditions (high humidity, freezing temperatures, strong vibrations, etc.). We are the unique maker in the world to be able to design SiN igniters with average life greater than 90,000 hours in continuous operation at nearly 1400°C.

High temprature, high constraint
FKK ceramics igniters can reach 1400°C. However, due to perfect sealing process, lead wire junction temperature do not exceed 150°C.You can miniturize your system, make it safer and prolonged the rated life of other components.

Faster
Rising temperature is faster: up to 1000°C in 8 seconds.

High efficiency
High-watt density discharge allow high thermic efficiency.

Superior properties
Highly resistant to mechanical strength, high temperature strength and thermal shock. Excellent electrical insulation, dielectric strength and thermal shock resistance.

Material

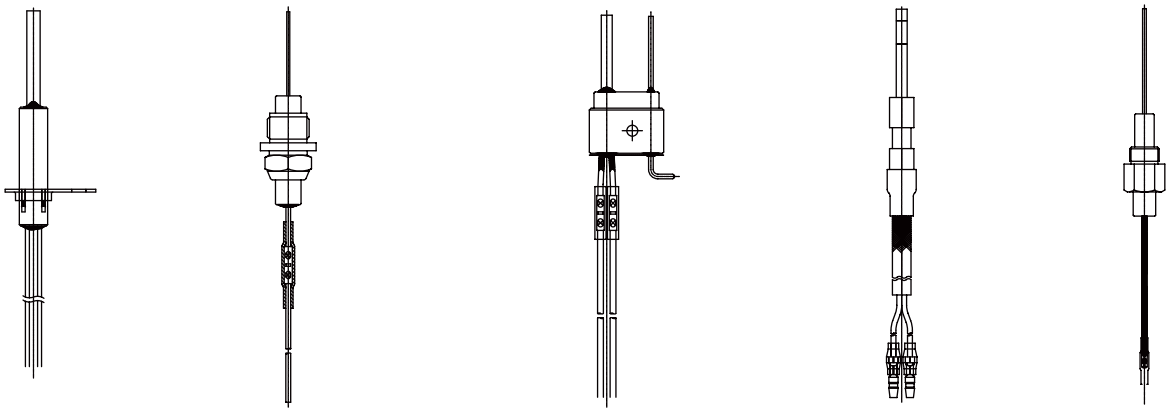
- Silicone Nitride Si_3N_4

Range of temperature

- 1200~1400 °C

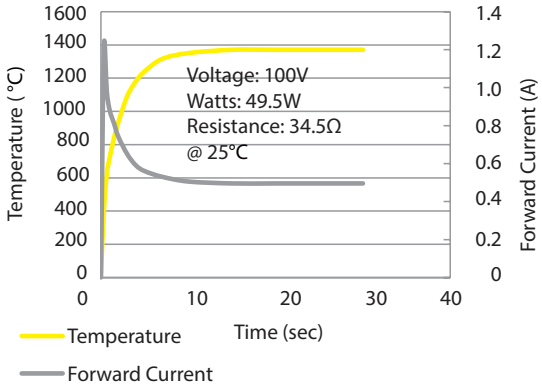
Application

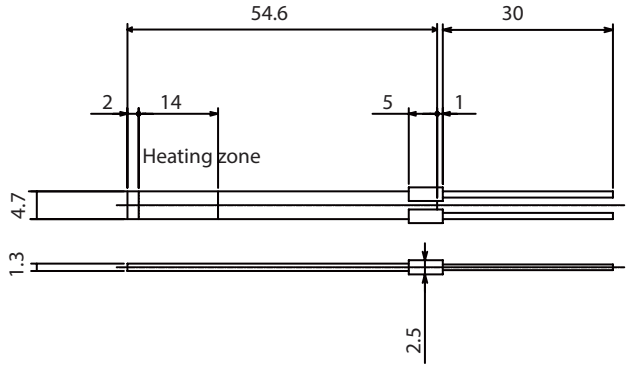
- Furnace, burner
- Gas, oil water heater, boiler or other heating equipment
- SOFC, PEFC, Fuel Cell MCHP burner components



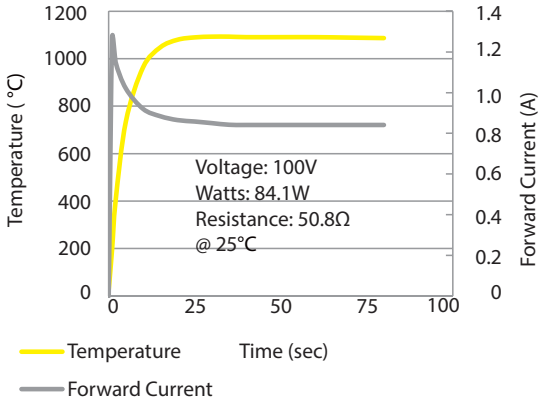
Unit (mm)

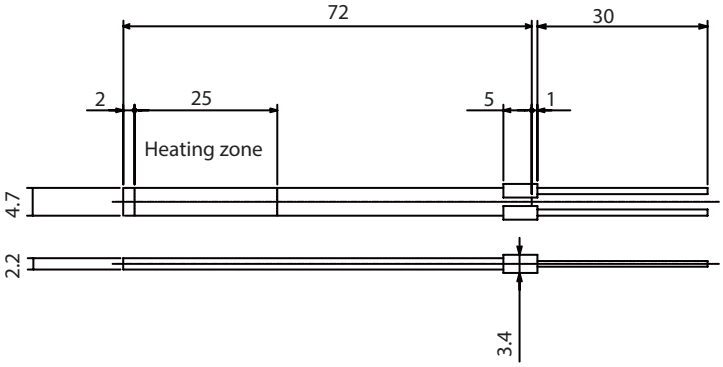
Si_3N_4 Igniter 54.6L



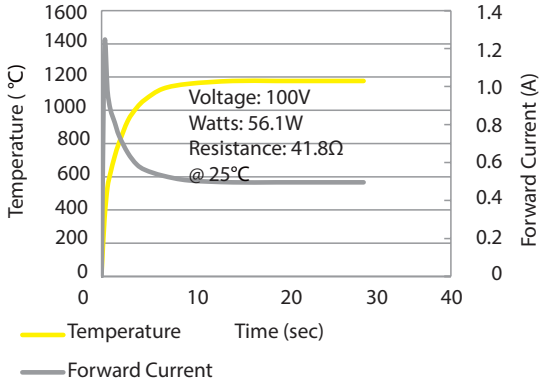


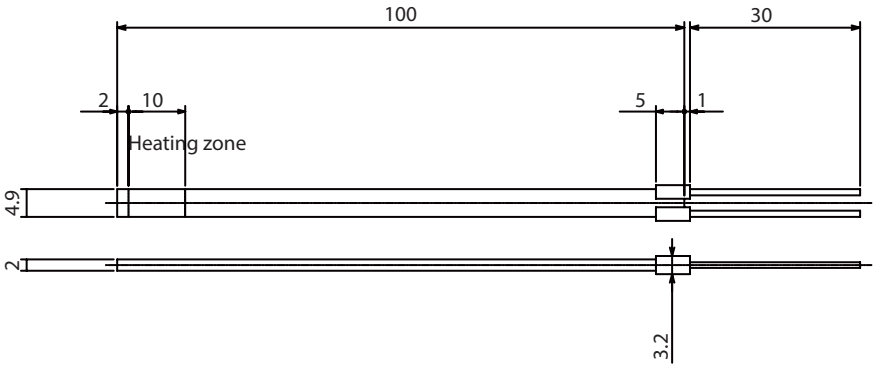
Si_3N_4 Igniter 72L

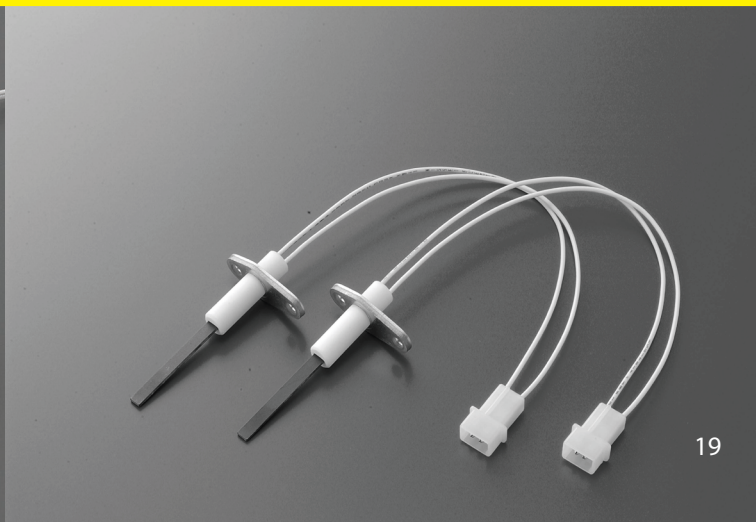


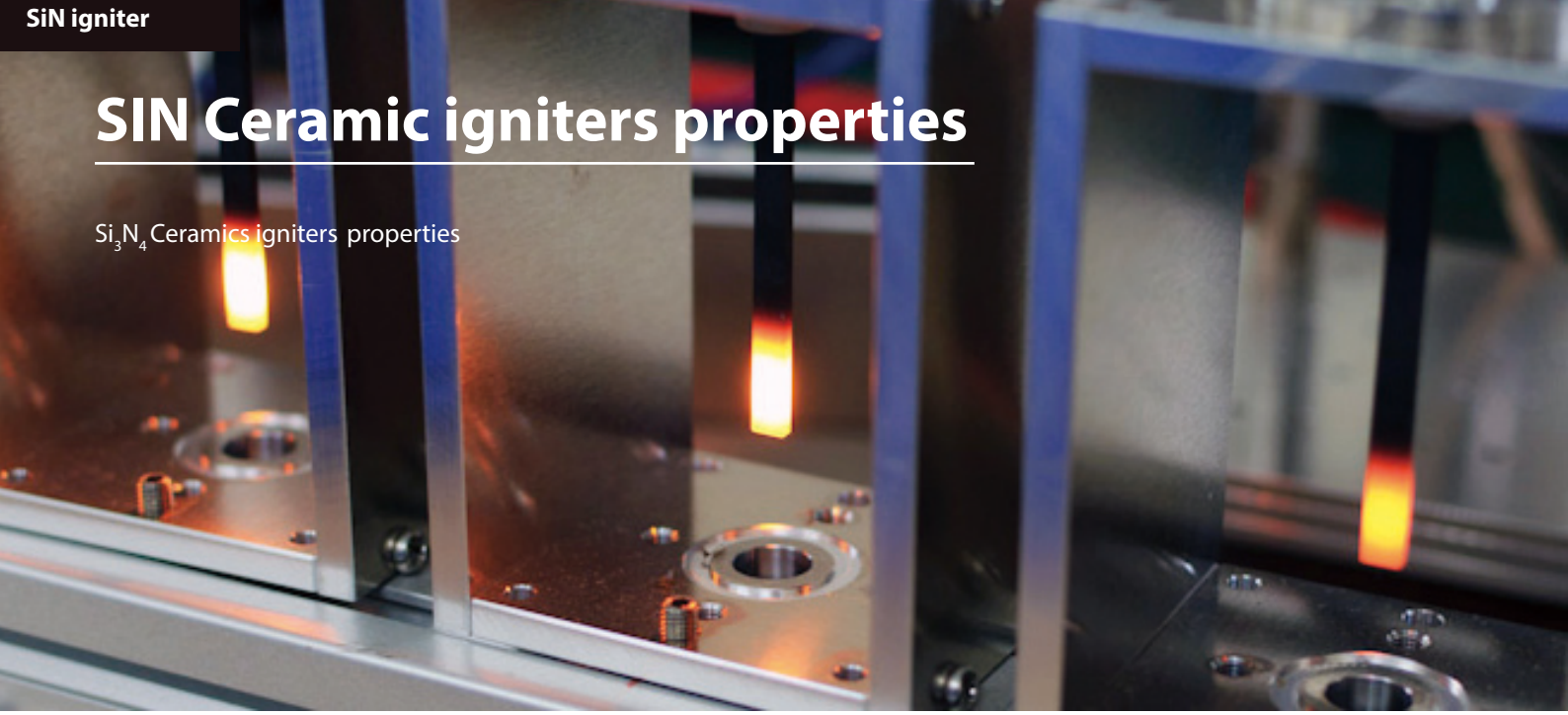


Si_3N_4 Igniter 100L









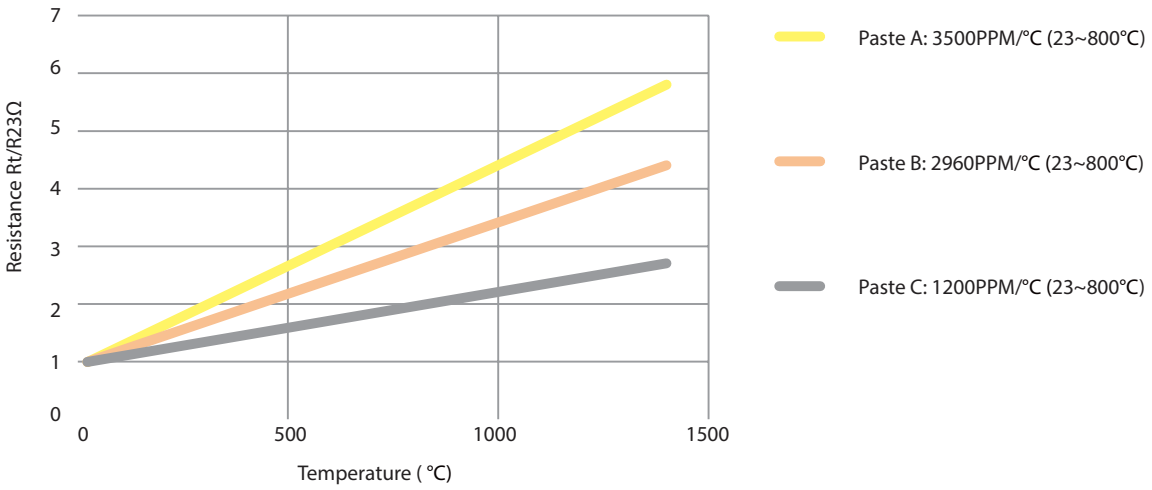
SIN Ceramic igniters properties

Si_3N_4 Ceramics igniters properties

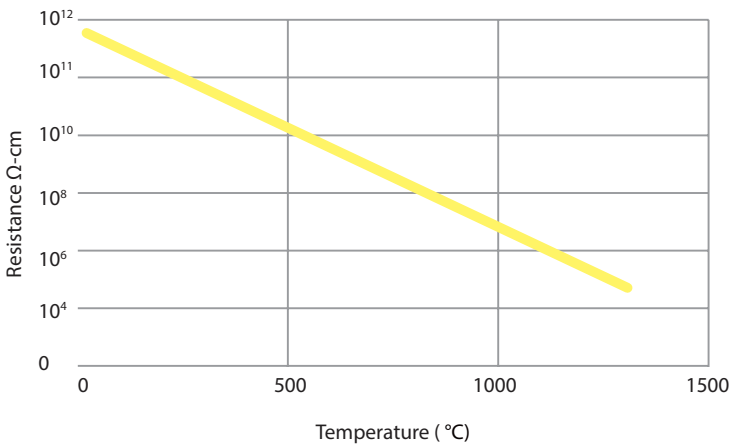
Mechanical and Thermal Properties

Items	Unit	SiN Igniter	
		SN220	SN362
Maximum temperature	℃	1300	1400
Typical temperature	℃	1200	1300
Thermal conducticity	w/mk	25	31
Linear expansion coefficient	/℃(40-800℃)	$3.2x10^{-6}$	$3.7x10^{-6}$
Vickers hardness (500g load)	GPa	14.7	17.1
Bending strength	MPa	590	900
High-temperature strength (Flexural strength at 800℃)	MPa	600	900
Thermal shock resistance	℃	600	900

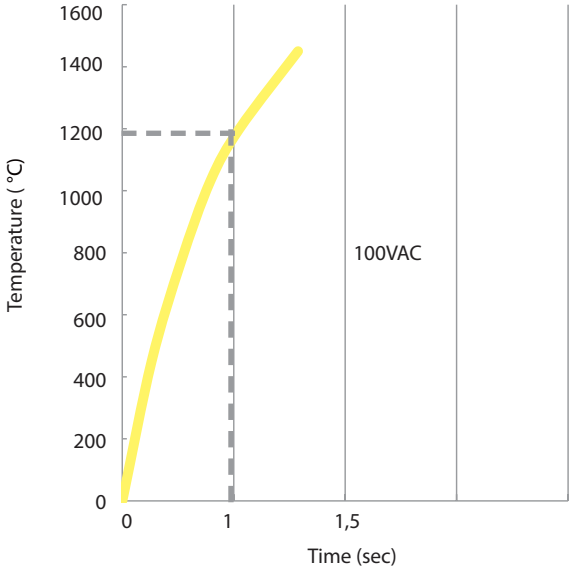
Temperature coefficient of resistance



Resistance

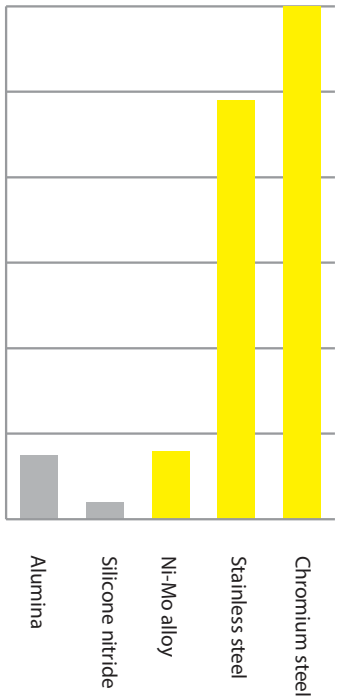


High speed type

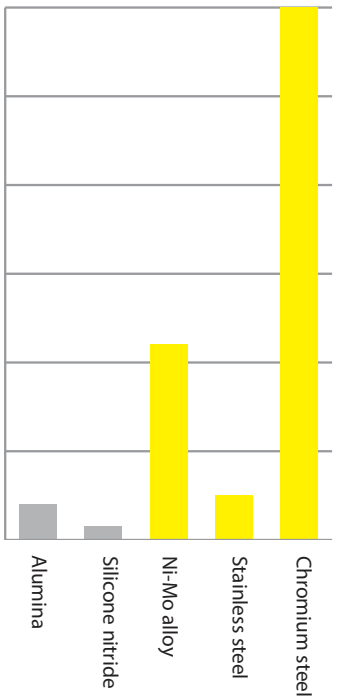


Chemical characteristics (nitric acid resistance)

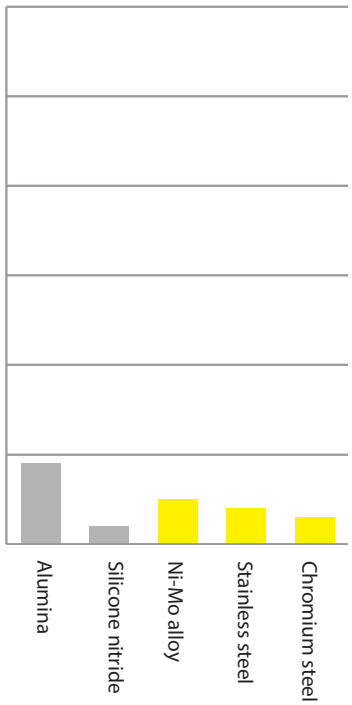
Corrosion Loss - 60% H_2SO_4



Corrosion Loss - 60% HNO_3



Corrosion Loss - 60% NaOH



SNx series igniters line up

Silicone Nitride Ceramics igniters standard products

Application

Gas burner, water heater, experimental application

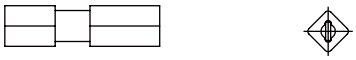
Features

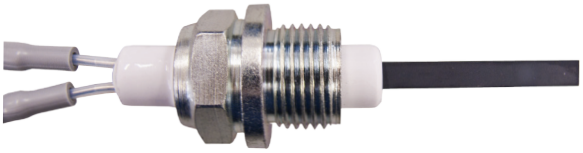
- High temperatue1200~1400℃
- 1000℃ in 1 second
- High resistance to thermal shock (600~900℃)
- Designed for over 90000h of powering
- 100V,120V , 220V current available
- Totally customizable solution, many design available

Line up

SNx-1

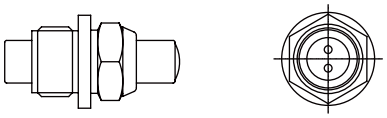
D.8mm X L40mm Ceramic flange
1200℃ type





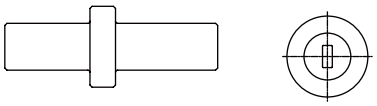
SNx-2

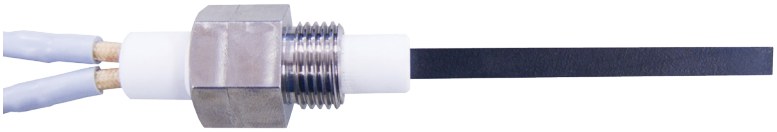
M18 Compression nut flange
1200℃ type



SNx-4

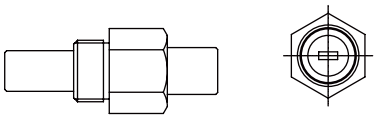
D.19mm X L50mm Ceramic flange
1300℃ type

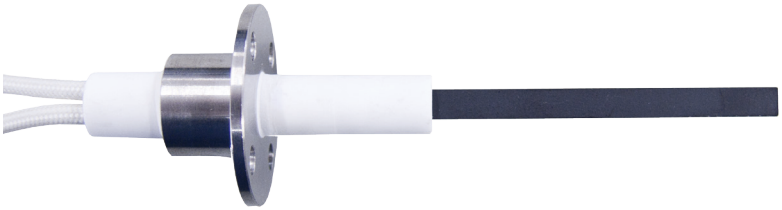




SNx-5

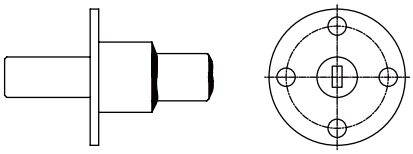
M16 Compression nut flange
1300℃ type





SNx-6

32mm Round metal flange
1300℃ type



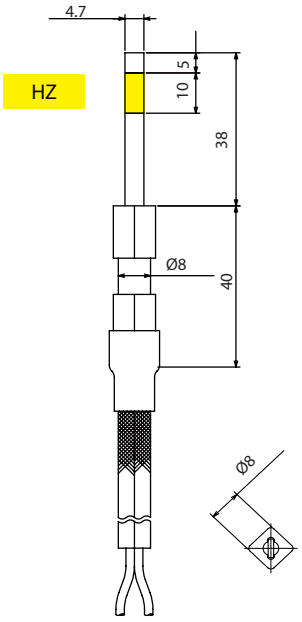
Line up

Unit (mm)

HZ = Heating zone

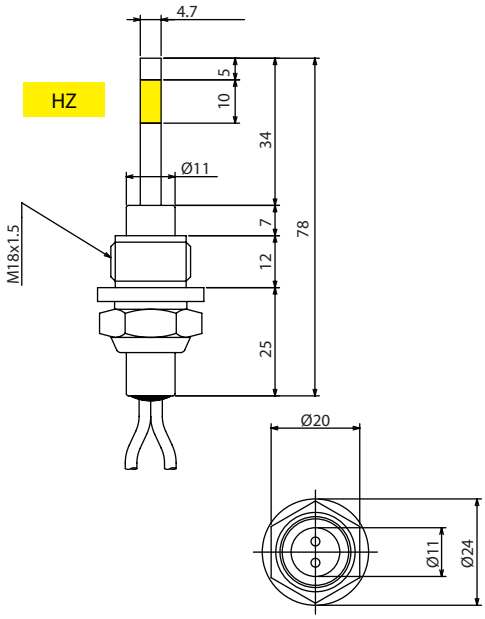
1200℃ type

SNx-1



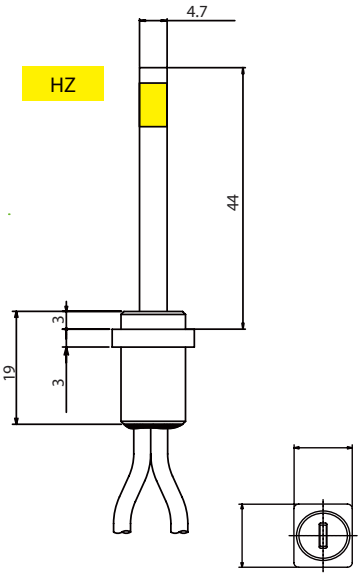
32~45W - 1300℃

SNx-2



32~45W - 1300℃

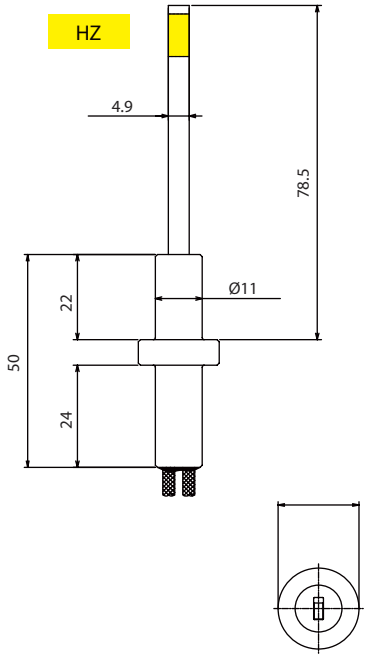
SNx-3



44~63W - 1300℃

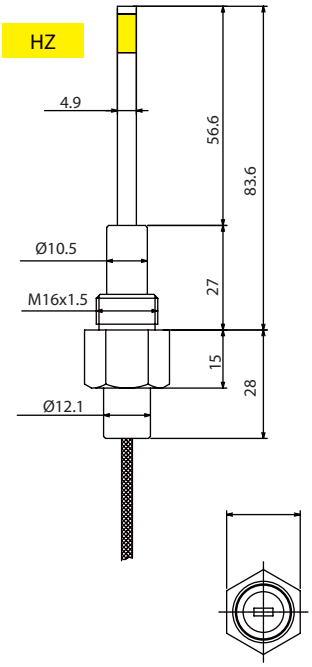
1300℃ type

SNx-4



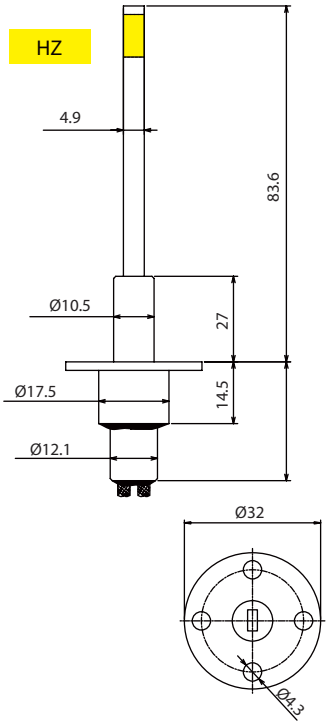
47~65W - 1300℃

SNx-5



47~65W - 1300℃

SNx-6

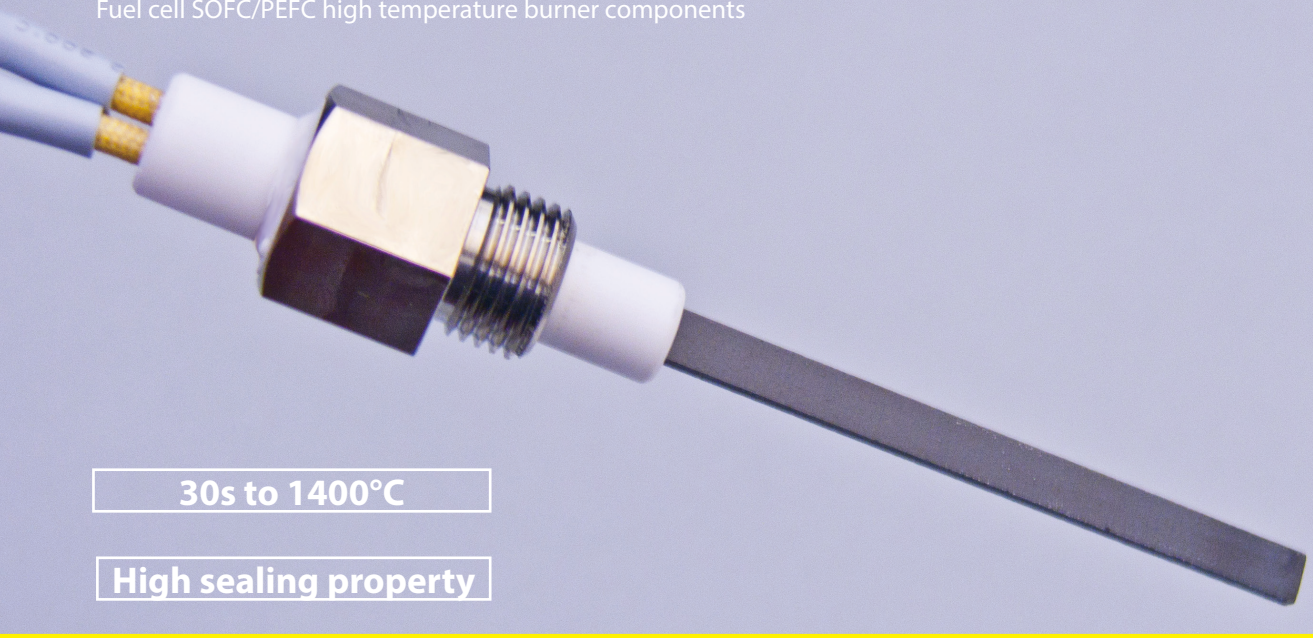


47~65W - 1300℃

Type	Reference	Flange type	Heater length (mm)	Available voltage (V)	Cable length (mm)
32~45W 1200℃	SNx-1	Ceramic 8 x 40mm	38	100, 120	350mm *All lengths availble upon request
	SNx-2	M18 flange 24mm	34	100, 120	
	SNx-3	Ceramic 14 x 19mm	41	100, 120	
47~65W 1300℃	SNx-4	Ceramic 19 x 50mm	56.5	100, 120	
	SNx-5	M16 flange 19mm	56.6	100, 120	
	SNx-6	Metal flange 32mm	56.6	100, 120	

Fuel Cell Burner Igniter

Fuel cell SOFC/PEFC high temperature burner components



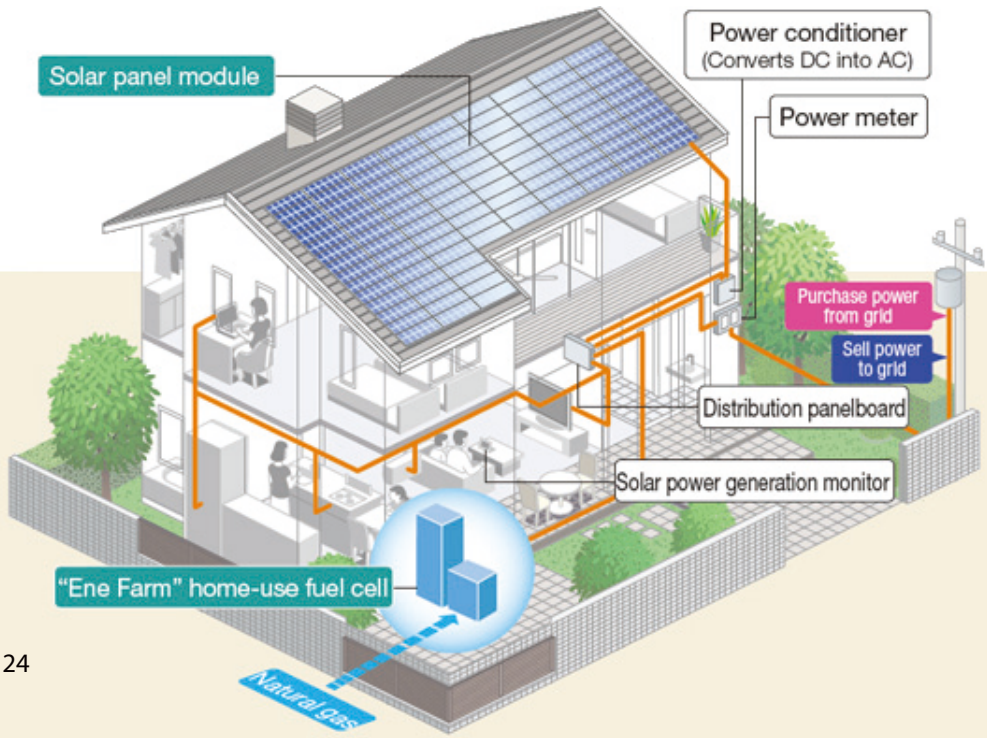
30s to 1400°C

High sealing property

FKK provide all the Japanese Fuel cell appliances manufactures as well well as abroad MCHP SOFC systems maker with advanced ceramics igniters allowing long rated life (up to 90000 hours), high reliability, high temperature (up to 1300°C) and good sealing properties (lead wire temperature junction below 150-200°C). With high temperature performance you save energy on start-up burner gas pre heating operation, off-gas burner exhaust gas combustion as well as air preheating.

Worldwide customer make the choice of FKK for several reasons

- High reliability and quality: over 90000 hours (nearly 10 years) of rated life, Japanese quality
- Very high temperature: 1350°C, 1000°C in less than 6s
- High pressure resistance and very low temperature at lead wire junction (below 100-200°C)
- 30-60 Ohms resistance
- Power rating: 45-75 Watt
- Competitive cost: by providing major fuel cell makers, we achieved high cost/quality performance
- Major accounts within MCHP system integrator: Panasonic, Osaka gas,Tokyo gas, Eneos, Toshiba



Systems

- Micro CHP : SOFC / PEFC (high temperature)
- Back up power
- Stirling engine

Application

- Igniter for gas pre-heating
- Igniter for start-up burner
- Igniter for off-gas burner
- Igniter for cathode air preheater
- Igniter for SOFC/PEFC reformer high temperature burner

References

- Osaka gas Ene- Farm
- Panasonic Ene-Farm
- Toshiba Fuel cell
- Toyota fuel cell
- Tokyo gas fuel cell
- JX Eneos fuel cell

Advanced Ceramic

FKK can design and provide fine ceramics components.

Engineered material,fine ceramics or technical ceramics support the development of cutting-edge technology.

With more than 60 years as major Japanese ignition electrode maker experience, FKK Corporation engineers developed a strong expertise in designing, manufacturing various technical ceramics products and components.

Material					Al_2O_3	Al_2O_3	Al_2O_3	Mullite	Porcelain	MgO-SiO_2	Zircon Cordierite
Alumina content				%	95	92	90	50~60	-	-	-
Apparent density (specific gravity)				kg/cm^3	3.7	3.6	3.6	2.6	2.5	2.7	2.8
Water absorption				%	0	0	0	0	-	0	0
Mechanical property	Bending strength			N/mm^2	275	280	270	170	69	180	140
	Compressive strength			N/mm^2	-	2150	2000	1470	411	-	580
Thermal property	Coefficient of thermal expansion	RT~200 °C		$\times10^{-6}/k$	-	-	-	5.6	-	-	-
		RT~400°C			-	7.2	7.4	-	-	-	-
		RT~500°C			7.7	-	7.6	-	-	8	-
		RT~700°C			-	7.4	7.8	-	5	-	2.8
		RT~800°C			-	-	-	-	-	-	-
	Thermal conductivity 20°C			W/(m/K)	16.7	16.7	16.7	3.5	1.16	2	2.9
Electrical characteristics	Volume resistivity			kV/mm	>15	>13	12	10	<10	11	-
	Dielectric strength		20°C	Ω/cm	$>10^{14}$	$>10^{14}$	$>10^{14}$	-	10^{12}	$>10^{14}$	10^{12}
			100°C		$>10^{13}$	-	$>10^{13}$	10^{12}	10^{10}	-	-
			200°C		$>10^{12}$	$>10^{12}$	$>10^{12}$	10^{9}	10^{7}	10^{12}	10^{9}
			300°C		$>10^{10}$	-	$>10^{10}$	10^{8}	10^{6}	10^{10}	-
			400°C		-	-	-	10^{7}	10^{5}	10^{9}	-
	Permittivity (1MHz)			-	9.3	9	8.5	-	5.5	7	5
Key Features					Injection molding complex shape possible	Powder molding press simple geometry effective mass production	Extrusion slip casting length-wise possible	Variety injection molded extrusion powder molding		Low thermal conductivity large insulated	Low thermal expansion

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