Noritake

5e

- Excellent technology
- Engineering
- Electronics
- Ecology
- Energy

Heat Technology Revolution

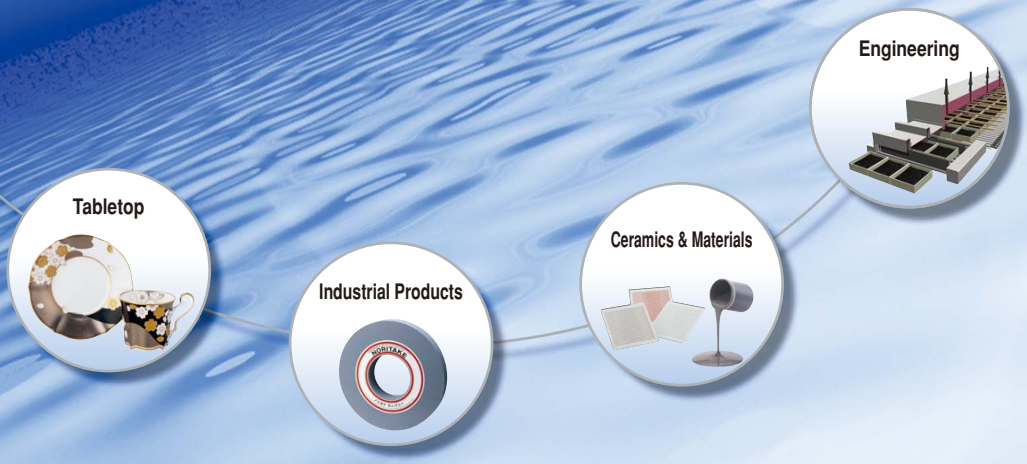
HEAT ENGINEERING

General Catalog

Noritake
since 1904

Noritake technology, focusing on the future

Over a century of our business in the production of tablewares,
Noritake has developed, expanded, and applied its technology
and know-how in various business fields and industries.
We make the technology for the next generation.



1904	Established Nippon Toki Gomei Kaisha (today's NORITAKE CO., LIMITED)
1917	Sanitary Ware Division spun off to become Toyo Toki Co., Ltd. (today's TOTO Ltd.)
1919	The electric insulator division spun off to become NGK Insulators Ltd.
1939	Began full-scale production of industrial grinding wheels
1975	Launched the Noritake Roller Hearth Kiln
1983	Developed Far-infrared ceramic heaters
2003	Acquired shares in Toshiba Ceramic Furnace and established Noritake TCF Co., Ltd.
2010	Development of coating/drying systems for LIB
2014	Launched Ceramic Tube Rotary Kiln

Heat Technology

With the heating technology obtained through the production of porcelain products, we offer the most suitable solution for various heating processes.

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Revolution

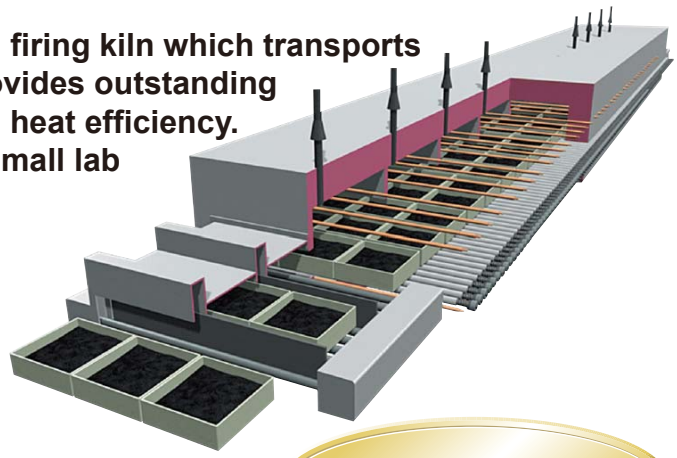
NORITAKE HEAT TECHNOLOGY
Always one step ahead.

Applications

	250°C	500°C	750°C	1000°C	1250°C	1500°C	1750°C	2000°C	2250°C	2500°C
Energy	LiB electrode (130°C) Solvent drying (300°C) EVA film annealing (100°C) MEA for fuel cell (80°C) GDL for fuel cell (360°C)	Electric double layer capacitor (750°C)	Li-ion battery cathode material (1000°C) Solar cell electrode firing (800°C)	Activated carbon (1100°C) Li-ion battery anode material (1300°C) Carbon nanotube (1300°C)	SOFC (1500°C) Si fusion for solar cell (1500°C) High-purity alumina for separator (1600°C)				Li-ion battery anode material (2800°C)	
Electronics	Substrate drying (160°C) FCCL (350°C)	De-binder (600°C)	Electrode firing (800°C) LTCC (850°C)	Varistor (1100°C) Barium titanate (1100°C)	Ferrite (1300°C) PZT (1250°C) MLCC (1250°C)	Alumina substrate (1600°C) HTCC (1650°C)	Nitride based ceramics (1800°C)			
Automotives	Plastics component annealing (120°C) Resin curing (100°C) CFRP (300°C) Cylinder gasket (200°C)		Metal parts	Inorganic pigment (1000°C) Neodymium (1200°C) Sintered alloy (1100°C)	Catalyzer (1500°C) O_2 sensor (1500°C) Spark plug (1600°C)					
Display	LCD (200°C) ITO film (120°C) Optical film (140°C)	Glass anneal (700°C) PDP (550°C)	ITO powder (1000°C)	Phosphor (1300°C)	ITO sintering (1600°C) LED (1500°C)					
Semiconductor	IC tray (170°C) HDD parts (180°C)			Wafer (1200°C)	Process material (1400°C)					
Other	Medical instrument annealing (120°C) Medicines (200°C)		Cosmetics pigment (900°C)	Tile (1200°C)	Porcelain (1300°C) Calcium powder for medical use (1300°C)				Carbon fiber (2500°C)	

Roller Hearth Kiln

Roller Hearth Kiln (RHK) is a continuous firing kiln which transports products using ceramic rollers. RHK provides outstanding temperature uniformity, cleanliness, and heat efficiency. We offer in a wide range of scale; from small lab types to mass-production systems.



Top Market Share

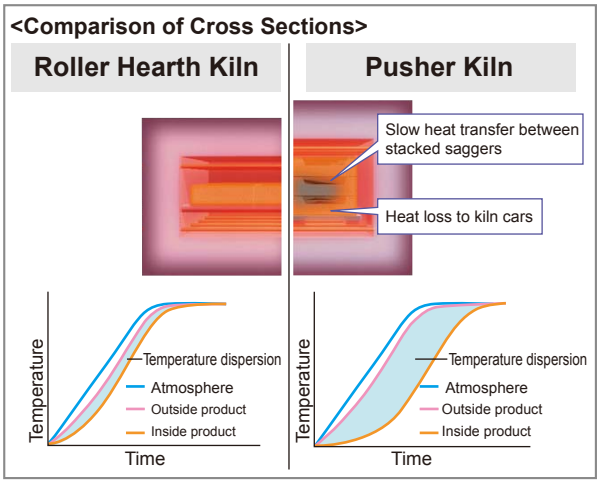
Temperature : Max. 1620°C		
	with Saggers	with Setters (Plates)
Kiln length	Max. 60m	Max. 80m
Usable width	Max. 2m	Max. 4.5m

Fast and Uniform Firing

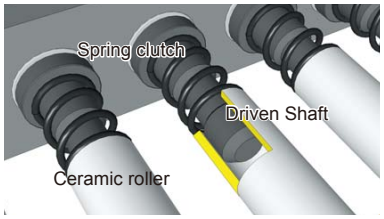
Homogeneous and high-speed firing can be achieved by placing the green materials on the roller conveyor without stacking.

- **The roller conveyor facilitates radiant heating from all directions and reduces the temperature deviation to ±2°C.**
- **Conveyor rollers are driven by Spring Drive. This allows for high speed transfer without meandering.**

<Comparison of Cross Sections>



<Roller drive>



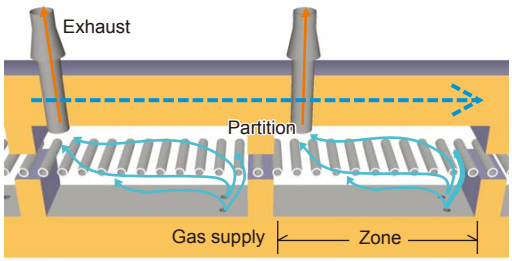
<Example of high speed calcination>

	Alumina Substrate	Thermistor	Lithium Cobalt Oxide	Barium Titanate
Temperature	1600°C	1300°C	1000°C	1200°C
Firing time				
Roller Hearth Kiln	6h	10h	12h	6h
Conventional kiln	36h	24h	24h	18h

Uniform Gas Flow

Partitioned kiln zones with respective ventilation ports provides optimum gas flow for chemical reactions.

<Ventilation Example>



Gas Supply

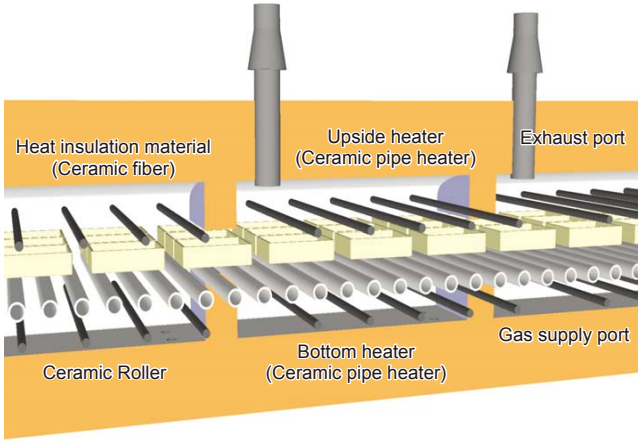
- Optimized flow rate for effective flow around the products.
- Optimized flow volume to achieve the target gas concentration around products.

Exhaust System

- Quickly eliminates the vapor/volatiles generated from the products.
- Effectively divided zones prevent volatiles from spreading through the kiln.

Contamination-Free

Kiln materials can be composed of ceramics which provides contamination-free environment and great resistance to chemical attacks. External handling system/conveyor is also protected with ceramic and plastic materials.



High Gas Tightness

Sealing options are available for efficient firing environment with special gases.

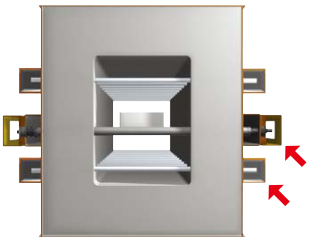
<Airtight Grade Comparison>

Standard type

Oxygen : **200ppm**

Airtight Type

Oxygen : **50ppm**



End portions of rollers and heaters are enclosed to prevent gas leakage.

Super Airtight Type

Oxygen : **10ppm**

Flange seals

High Efficiency / Energy Saving / Space-saving

The combination of uniform heating, high speed calcination and ceramics-only internal materials achieves significantly high production and energy efficiencies.

High speed uniform heating

Uniform atmosphere gas supply

Contamination-free / Chemical reaction resistance

High production efficiency

Roller Hearth Kiln is the best solution for the continuous calcination of advanced products!

Roller Hearth Kiln

Middle-scale facilities are available for making prototype samples to scale up from R&D phase to commercial productions.

3.6m Pilot Roller Hearth Kiln

Air type

Maximum temperature	: 1200°C
Atmosphere	: Air
Sagger size	: 330 x 330 x 100H (mm)
Sagger conveyor	: 1 lane, 1 stack, 7kg/sagger (typical)
Zone	: 300 mm x 12 zones (Heating zone: 1-9)

Atmosphere type

Maximum temperature	: 1200°C
Atmosphere	: Air, N_2, Ar, O_2, $N_2 + H_2$
Sagger size	: 330 x 330 x 100H (mm)
Sagger conveyor	: 1 lane, 1 stack, 7kg/sagger (typical)
Zone	: 300 mm x 12 zones (Heating zone : 1-9, Cooling jacket : 11-12)

7.2m Pilot Roller Hearth Kiln

Air type

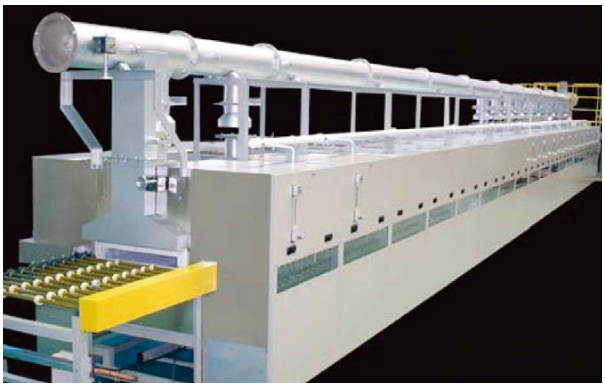
Maximum temperature	: 1400°C
Atmosphere	: Air
Sagger size	: 330 x 330 x 100H (mm)
Sagger conveyor	: 1 lane, 1 stack, 7kg/sagger (typical)
Zone	: 450 mm x 16 zones (Heating zone: 1-13)

Atmosphere type

Maximum temperature	: 1400°C
Atmosphere	: Air, N_2, Ar, O_2, $N_2 + H_2$
Sagger size	: 330 x 330 x 100H (mm)
Sagger conveyor	: 1 lane, 1 stack, 7kg/sagger (typical)
Zone	: 450 mm x 16 zones (Heating zone : 1-13, Cooling jacket : 15-16)

Roller Hearth Kiln offers the options for calcination at highest temperature ranges.

High Temperature Roller Hearth Kiln



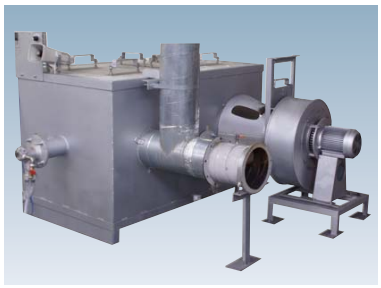
- Conveyor rollers capable of high speed transportation at 1620°C
- Various energy-saving systems/options available.

Maximum temperature	: 1620°C
Atmosphere	: Air
Heat sources	: Electricity, Gas

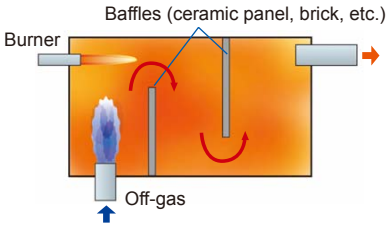
Optional Equipment

Off-gas Combustion System

For the combustion of flue gas from kilns.



- Can be installed on various types of kilns e.g. batch kilns or continuous systems.
- Makes a gas flow inside the kiln to establish the efficient and compact off-gas treatment.



Maximum temperature	: 800°C
Heat source	: Electricity, Gas
Substances to burn	: Tar, binder, etc.

Microwave Kiln for Preheating

Installing a microwave kiln at pre-heating / temperature ramp sections of continuous system e.g. RHK will reduce the ramp-up time.

- Shorter heating time
- Uniform heating
- High efficiency

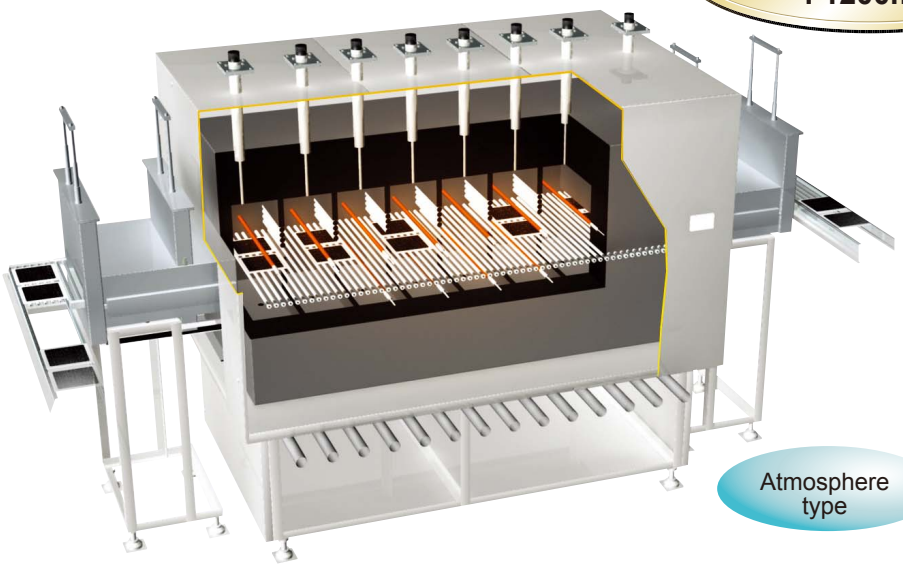
Field test available

Maximum temperature	: 500°C
Atmosphere	: Air, N_2, O_2
Usable dimensions	: 330 x 330 x 100H (mm)

Desk Top Kiln

For the development of prototypes, production of small components, or verification of heating conditions to apply them to larger system.

Shortest kiln length : 1200mm



Atmosphere type

●Compact Design

Designed for smaller products while utilizing the benefits of Roller Hearth Kilns. 1400°C soak profile is possible with this 1200 mm klin.

●Suited for Scale-up

Using this small kiln for R&D or pilot productions will make it quite easy to scale up to larger mass-production system with roller hearth kiln.

●A Solution for Flexible Production

Provides smooth changeover between products and high production efficiency. Ideal for high-mix, low volume production.

●Atmosphere

With its small configuration and good sealing, calcination in highly precise atmosphere conditions is possible.

Air type

■**Basic specification**

	Air type	Atmosphere type
Models	DTK-NA	DTK-SA
Max. temperature	1400°C	
Temperature precision	±2°C	
Zone length	150 mm	
Zones	12	8
Usable dimensions	150W x 50H (mm)	
Kiln length	1200 mm	1800 mm
Roller materials	Mullite / Alumina	
Heater material	SiC	

RHK Simulator

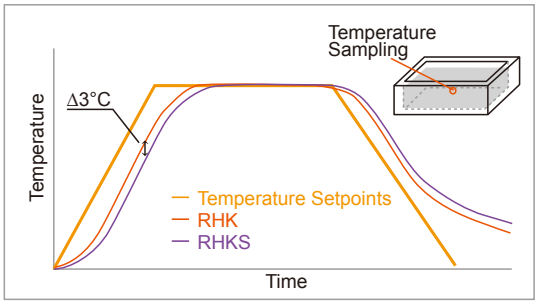
RHK Simulator is a batch kiln which represents the internal structure of Roller Hearth Kiln.

●Easy to Scale-up

You can simulate the settings for continuous kilns i.e. Roller Hearth Kiln with identical parameters on this Simulator. Helps you to design larger, mass-production systems easily by applying such settings.

●Expansion to Continuous Kiln System

Heating parameters established on this simulator can be applied directly to Special-Atmosphere Roller Hearth Kilns for mass production.



●Atmosphere control

Capable of special atmospheres such as nitrogen, oxygen, and so on. Various tests and production conditions can be established.

●Ideal size for laboratories.

●Clean heating

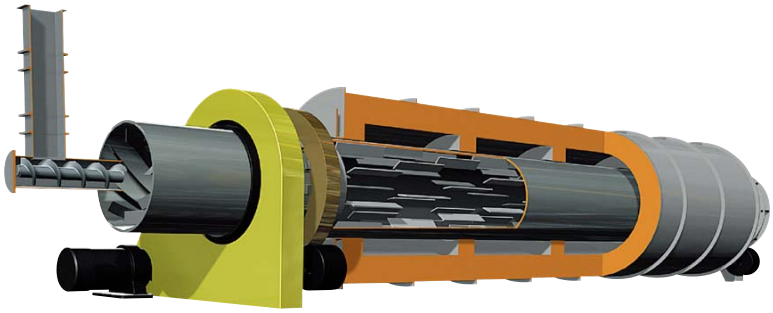
Components inside the chamber can be entirely of ceramics which is ideal for products that are sensitive to metal contamination e.g. battery materials.

■**Basic specification**

	1 sagger type	4 saggers type
Model	RHKS-S1	RHKS-S4
Max. temperature	1400°C	
Atmosphere	Air, N_2, Ar, O_2, N_2 + H_2	
Usable dimensions	330 x 330 x 100H (mm)	660 x 660 x 100H (mm)
Sagger quantity	1	4 (2 x 2)

Rotary Kiln

Continuous kiln for the heat treatment of green materials while agitating in a rotating kiln shell.



High Temperature / Cleanliness

Our special kiln core drum restrains oxidation and abrasion under high temperature conditions.
This maintains a clean atmosphere and prevents product contamination.

Special Atmospheres

Noritake's original sealing system keeps the kiln airtight, which allows the use of special atmosphere gases for heating.

Clean-Processing Rotary Kiln for Mass Productions

Mass-Production Kiln for Clean Calcination of LIB Materials

Perfect for Battery Materials

Shell tube made of special ceramics inhibits the reaction of lithium materials during heat treatment.

Clean Calcination

Chromeless metal shell tubes and ceramic shell tubes achieve a clean thermal treatment without metal contaminations.

High Efficiency

No need of containers e.g. saggers. High efficiency with less cost.

Atmosphere Control

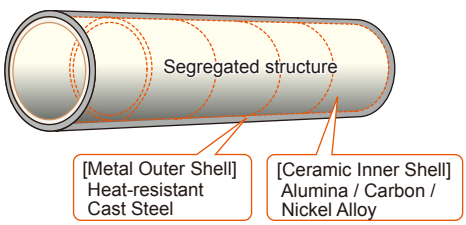
Noritake's original sealing system allows the heat treatment in various atmospheres.

Adhesion Preventing Mechanism

Double-shell structure allows the use of Knockers to prevent powder from adhering inside the shell.

Double-Shell Tube

The double shell structure with segregated ceramic inner tubes enables to make larger shells.



Maximum temperature	: 1100°C
Heat source	: Electricity or Gas
Heating method	: Indirect heating
Operation time	: 30 min to 4 hr (Variable)
Throughput	: 30 to 70 kg/hr
Dimensions	: 8300L x 2200W x 1830H (mm)
Tube size	: I.D. ø500 x 7000 (mm)
Tube materials	: [Outer] Heat-resistant cast steel [Inner] Alumina, carbon, Nickel alloy
Atmosphere	: Air, O_2 (95% or more), N_2, N_2 + H_2 (Oxygen : 50 ppm or less), Ar (Oxygen : 50 ppm or less)

Desktop Rotary Kiln

Ideal for labs and R&D and/or high-mix, low volume productions.

Shell Materials and Maximum Temperatures

Shell tube material	Temperature
Heat-resistant steel	Max. 1000°C
Heat-resistant steel + Alumina	
Heat-resistant steel + Carbon	
Heat-resistant steel + Nickel alloys	
Quartz	
SiC	Max. 1200°C
Alumina	Max. 1300°C

Atmosphere	**: Air, O_2, N_2, $N_2 + H_2$**
Heat source	**: Electricity**
Heating method	**: Indirect heating**

Pilot-size Ceramic Rotary Kiln

Clean Calcination

The ceramic shell tube provides a clean, metal contamination-free calcination.

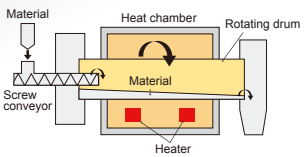
For High Temprature

The ceramic shell enables the calcination at 1000°C or higher.

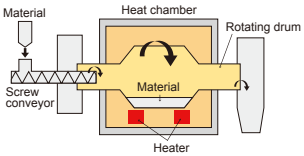
Maximum temperature	**: 1250°C**
Heat source	**: Electricity or Gas**
Heating method	**: Indirect heating**
Operation time	**: 30 min to 180 min (Variable)**
Throughput	**: 2 to 6 kg/hr**
Dimensions	**: 5500L x 800W x 2700H (mm)**
Tube size	**: I.D. ø200 x 2800 (mm)**
Tube materials	**: SUS310S, Heat-resistant cast steel, Inconel 601, SiC, Alumina, Carbon**
Atmosphere	**: Air, O_2 (95% or more), N_2, $N_2 + H_2$ (Oxygen : 50ppm or less), Ar (Oxygen : 50ppm or less)**

Indirect / Direct-Heating Rotary Kiln

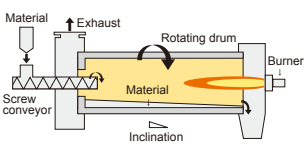
Indirect-heating continuous type



Indirect-heating batch type



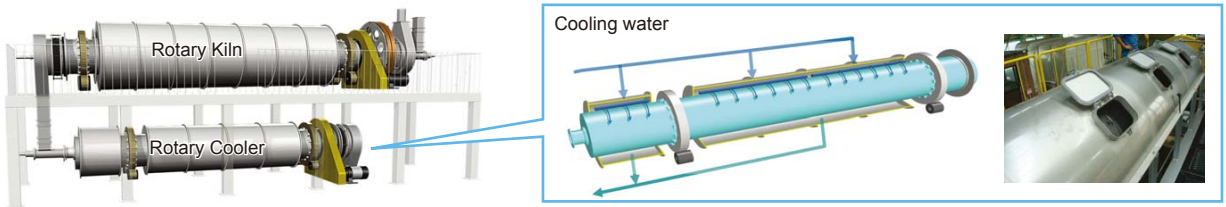
Direct-heating continuous type



Suitable for the mass production of single product.

Maximum temperature	**: 100 to 1150°C**
Atmosphere	**: Air, N_2**
Heat sources	**: Electricity or Gas or Oil**

Optional Equipment : Rotary Cooler



Batch Kiln

We offer various types of Batch Kilns depending on temperature and atmosphere conditions. Available in various sizes, operation methods and heat sources.

Cylindrical Bell Kiln

High Airtight Atmosphere Control

The multiplex seal structure provides superior air-tightness. This also allows for ultra low oxgen concentration with limited supply of gas.

Shorter Air/Gas Purge Time

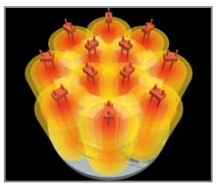
Our original double gas-supply system (direct and penetration) with aid of a vacuum pump reduces the atmosphere-changing time, improving the overall production efficiency.

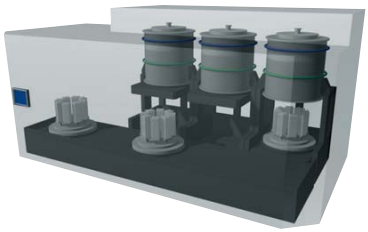
Space Saving

Automatic control system for multiple kilns and their car-handling system improves the production efficiency while reducing the installation space.

Uniform Temperature Distribution

Heaters are installed inside and outside the setter piles, arranged along the circular vessel, to heat the products from three directions.





Maximum temperature	**: 1400°C**
Atmosphere	**: Air, Special atmosphere gas**
Heat source	**: Electricity**
Usable dimensions	**: Model A-AF-500 (4 piles) ø500W x 400H (mm)**
	Model A-AF-850 (8 piles) ø750W x 400H (mm)

Rectangular Elevator Kiln with Cars

Batch Kiln with multiple capabilities and high productivity suitable for medium-scale production of electric components and materials.

Maximum temperature	**: 1400°C**
Atmosphere	**: Air, N_2, N_2 + H_2, O_2**
Heat source	**: Electricity**
Usable dimensions	**: Model A-EV-H/M4P (4 piles) 760W x 760L x 400H (mm)**
	Model A-EV-H/M8P (8 piles) 760W x 1970L x 400H (mm)
	Model A-EV-H/L4P (4 piles) 900W x 900L x 1100H (mm)
	Model A-EV-H/L8P (8 piles) 760W x 1970L x 1100H (mm)

High Temperature Multi-atmosphere Batch Kiln

- Capable of 100% hydrogen and oxygen.
- Compact design, fast heating/cooling.
- Useful for various firing tests and production condition setups.

Model	: A (V)-B-UH16
Maximum temperature	: 1600°C
Atmosphere	: Air, N_2, O_2, H_2, Ar, CO_2
Vacuum range	: <20 Pa
Heat source	: Electricity
Dimension	: 1000W x 1040L x 1655H (mm)
Effective dimension	: 150W x 150L x 100H (mm)
Heating speed	: 60 min to 1600°C

Carbon Batch Kiln

- For the heating of ceramics and new materials

- **Contamination Free**
  Chamber materials with very low impurities promise the heat treatment in high purity atmosphere.

- **Rapid Temperature Control**
  800°C/h temparture rising is possible.
  (2 hours to reach 1600°C)

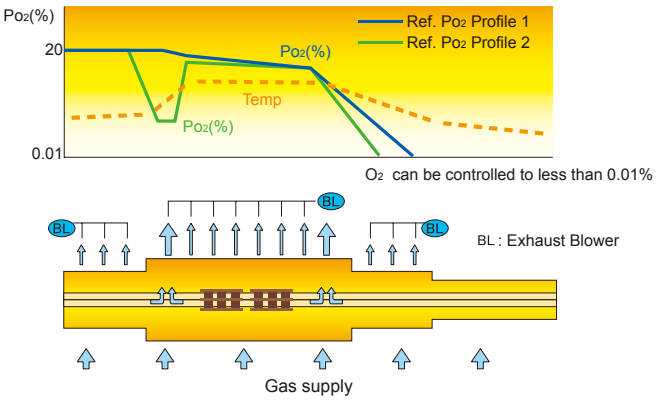
- **Automatic Temperature Control Switching**
  Precise temperature control in a wide range is possible as the measurement uses type R thermocouples for low-temperature zones (<1000°C) and infrared thermometers for higher temperature zones.

Model	: A (V)-B-UH/C
Maximum temperature	: 2400°C
Atmosphere	: N_2, Ar
Usable dimensions	: 300W x 300H x 300L (mm)
Kiln material	: Carbon, Carbon fiber
Heater	: Carbon

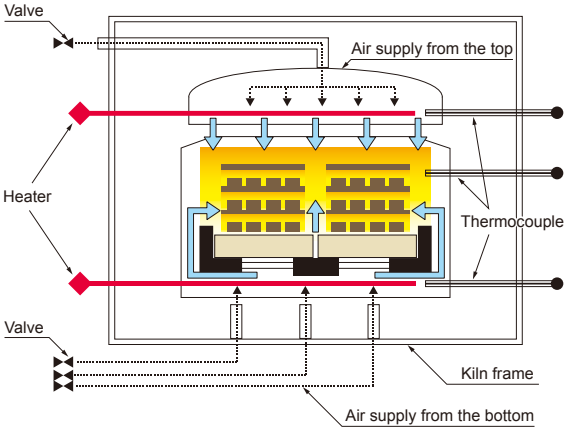
Pusher Kiln

A continuous baking kiln which conveys the products on kiln cars/base plates using hydraulic pushers. Pusher kilns are ideal for mass-production of one product, or productions which require good stability at higher temperatures.

Homogeneous Atmosphere

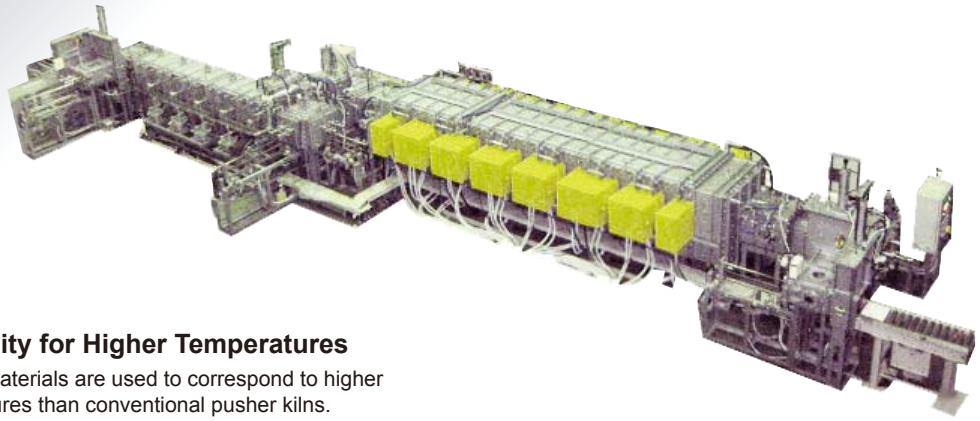


Noritake's original design of the gas supply & exhaust holes allow for high precision atmosphere control.



Gas is supplied from both sides and the center. This enables respective controls of supply volumes, and improves the uniformity of the atmosphere inside kiln.

Carbon Pusher Kiln



Capability for Higher Temperatures

Carbon materials are used to correspond to higher temperatures than conventional pusher kilns.

Contamination-free

Reduces impurities from kiln materials and makes further purification treatment possible.

For Continuous Production at High Temperatures!

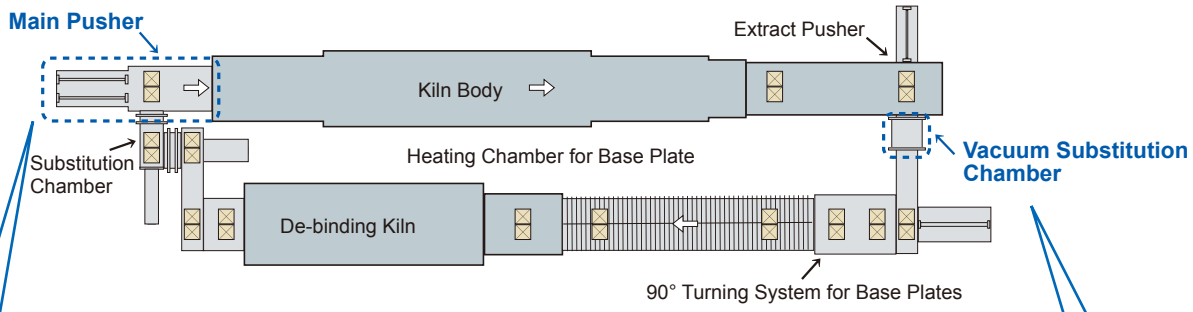
High productivity with continuous production is available with the pusher system.

Model	**: A-CPK**
Maximum temperature	**: 2000°C**
Atmosphere	**: N_2, Ar**
Kiln material	**: Carbon,Carbon fiber**
Heater	**: Carbon**
Kiln dimensions	**: 1800W x 2700H x 6000L (mm)**
Product	**: Ceramics, New material**
Optional equipment	**: Degreasing furnace**

High-temperature Continuous Firing

A wide range of heat treatment is available from 400°C for binder burn-out and higher than 1600°C for sintering.

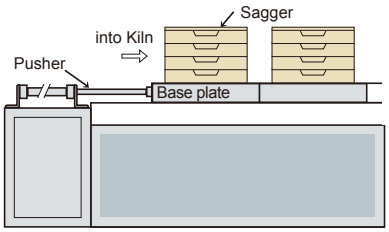
■Layout example



Stable Transportation

●Main Pusher

Manages precise control of transfer speed.
Speed precision : Time difference ±1% (Standard: ±2%)

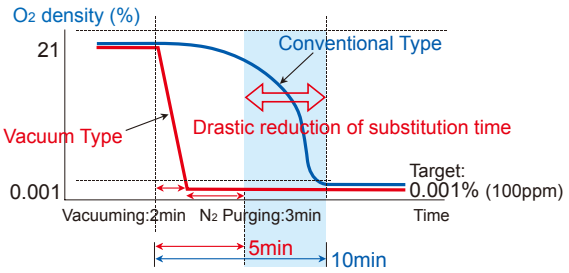


This simple method of pushing with base plates/cars provides excellent stability and reliability.

Reduction in Nitrogen Consumption

●Vacuum Purging System

Exchanges the atmosphere quickly. Optimum for production with short firing cycles. Nitrogen is supplied after the chamber is vacuumed, which reduces the consumption up to 75% (compared to our conventional models).



■ Atmosphere Pusher Kiln

●Uniform Internal Atmosphere

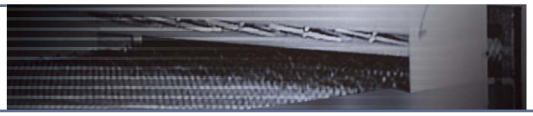
Individual tuning of gas supplies as well as uniform supplies from right/middle/left inlets at the bottom are available.

●Reduction in Nitrogen Consumption

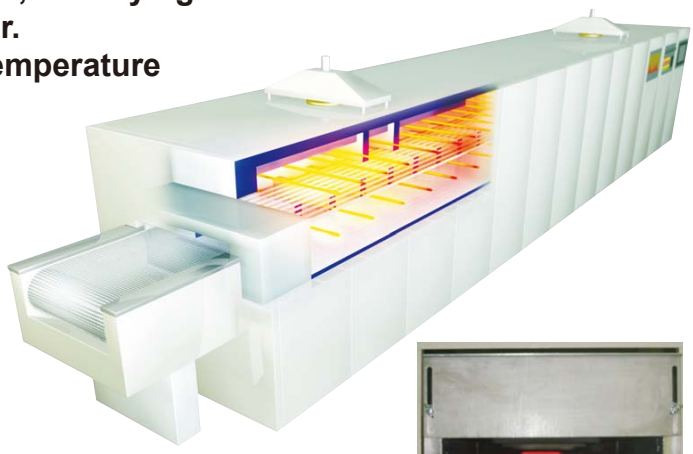
Exchanging gases with vacuum pumps reduces the ventilation time and nitrogen consumption.

Model	**: A-SAP (1 lane) A-SAP (2 lanes)**
Maximum temperature	**: 1650°C**
Atmosphere	**: Air, N_2, N_2 + H_2, H_2, O_2, Ar, CO_2**
Heat source	**: Electricity, Gas**

Mesh Belt Kiln



**Mesh Belt Kiln is a continuous firing kiln, conveying products by a metal mesh-belt conveyer.
It has excellent productivity for lower temperature processes.**



●Clean

Gas flow is controlled from kiln firing zone to burnout zone and binder is exhausted outside of kiln the at an optimum temperature. This allows for maintaining of a clean atmosphere.

●Highly Precise Temperature Distribution

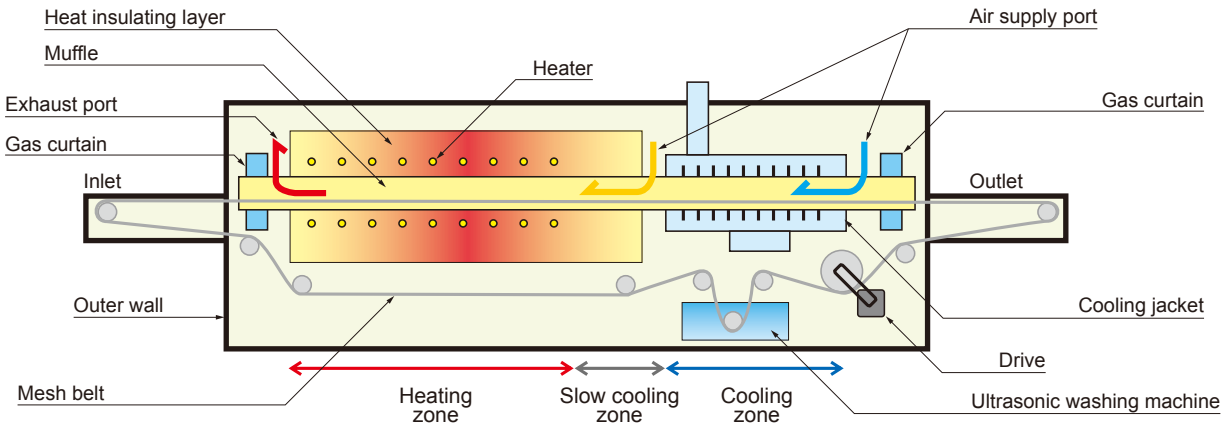
Heater alignment based on past experience and separation control provide precise temperature distribution for any temperature range.

●Energy-Saving

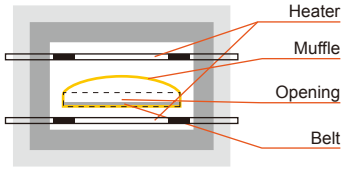
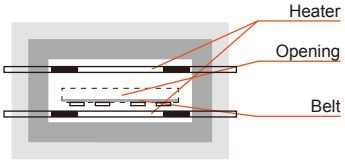
Kiln body, except muffle, is built with molded ceramic fiber and an energy saving structure, it can significantly reduce power consumption.

Operating temperature	**: R.T. - 1000°C**
Temperature precision	**: ±2°C (at 1000°C)**
Oxygen concentration	**: - 10ppm**
Atmosphere	**: Air, N_2, H_2, O_2, Ar**

■Furnace internal structure



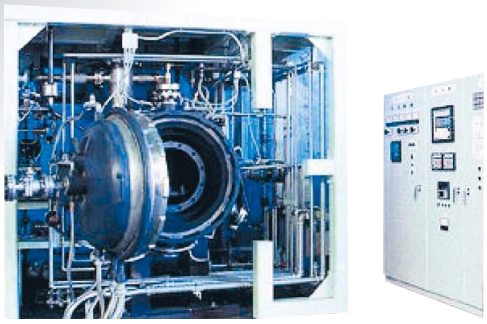
■Muffle type

	Muffle type	Non-Muffle type
Structure		
Heating method	Infrared secondary heating (Metal muffle)	Ceramic tube far-infrared direct heating
Power consumption	Large	Small (Energy-saving type)
Dust	Little	None
Temperature Uniformity	Good	Moderate (Good in Width)
Temperature response	Slow	Good
Temperature control	SSR, SCR	SSR, SCR
Atmosphere	Air, N_2, H_2, O_2, Ar	Air

Kiln for Special Use

We also design special kilns for various customer requirements such as vacuum, pressurization, high temperature firing, and other requirement.

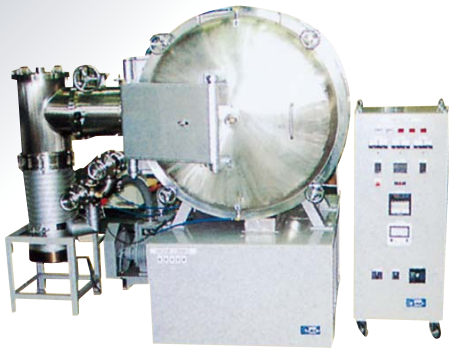
Carbon Kiln



- Stable heating even at high temperature zones
- Compact and space saving

Maximum temperature	: 2800°C
Atmosphere	: N_2, Ar
Heat source	: Electricity

Atmosphere Vacuum Kiln



- Atmosphere and Vacuum firing are available.
- Maximum 1 Pa vacuum level.

Maximum temperature	: 1700°C
Vacuum range	: 1 Pa
Atmosphere	: Vacuum, Ar, N_2
Heat source	: Electricity

Pressure Kiln

- Max pressure 0.96 MPa
- Compact and space saving

Maximum temperature	: 1600°C
Atmosphere	: Air, N_2
Heat source	: Electricity

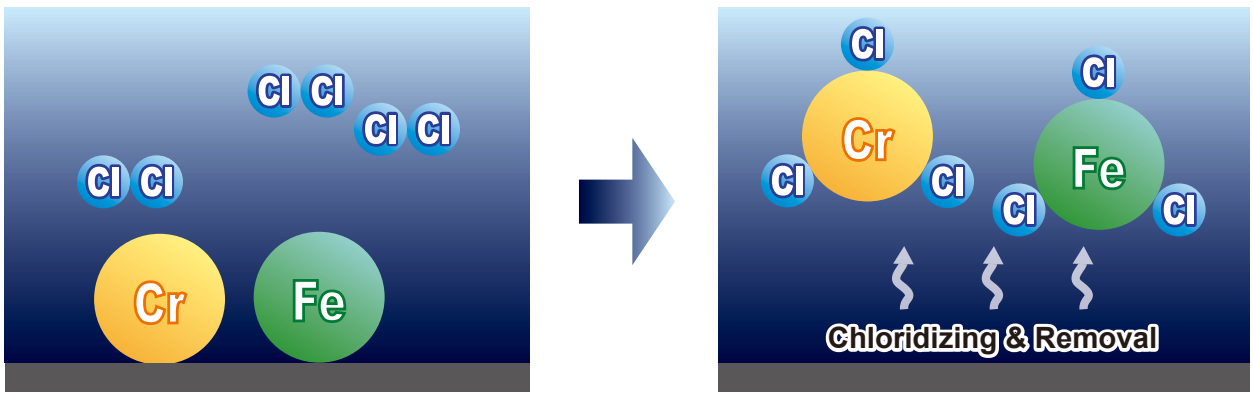
Batch Kiln with Chlorine Atmosphere

Capable of corrosive gases e.g. chlorine. Our newly-developed technology protects the structure from corrosions.
Withstands high vacuum and high temperature (max. 1,450°C). Effectively removes metal impurities from ceramic powders e.g. carbon, silica, SiC.

- Removes impurities effectively by the chemical reactions with chlorine gas.
- Fully automated and easy to use; All you have to do is to place the item and push a button.
- Vaporized impurities will be discharged out of furnace by our original system.
- Maintenance-friendly chamber.
- Hydrogen, nitrogen and argon gases are also usable as well as chlorine.
  (Interlocks are provided for the safe use of those gases.)

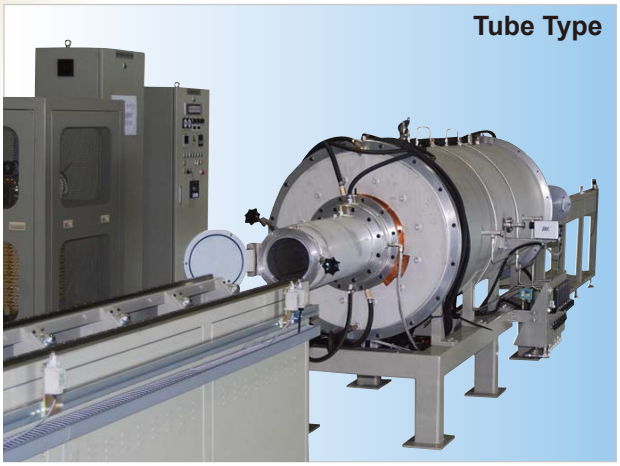
	Model: 470	Model: 800
Dimensions	3900W x 3900L x 2500Hmm	5000W x 5000L x 2200Hmm
Effective dimension	470W x 470L x 600Hmm	800W x 800L x 700Hmm
Maximum temperature	1450°C	
Vacuum level	<10 Pa	
Heat source	Carbon heater	

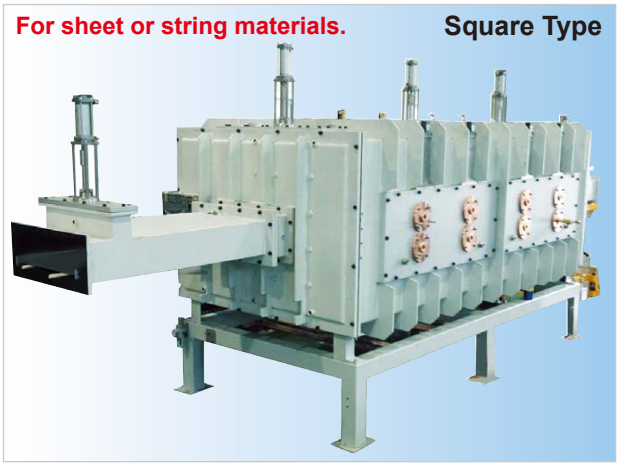
■Removal of Metal by Chlorine (Example)



Long Tammann Furnace

Capable of continuous heating at ultra-high temperature (2800°C)





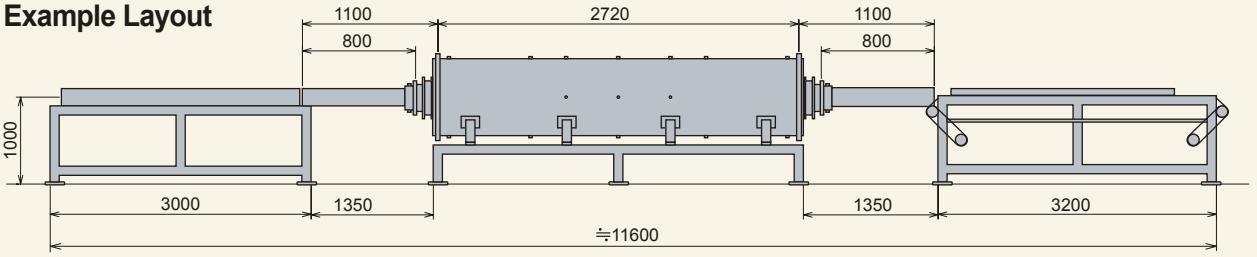
- Continuous high-temperature heating at < 2,800°C in Ar or N_2
- High productivity & energy saving. Heat-up/cooling processes not required unlike Batch Furnaces.
- Precise temperature uniformity with new heating technology. Enhances the product quality.
- The square type can be zone-divided to provide stepped heating, which offers optimum thermal profiles for your products.

Applications

- Sintering of SiC products (roller, heater, tube etc.)
- Sintering of C/C composite, Graphitizing of carbon fiber
- Various heat treatment such as graphitizing or carbonization
- Heat treatment of SOFC
- Graphitizing and carbonization of graphite sheets

Operating temperature	: Max. 2800°C Min. 100°C
Atmosphere	: Ar, N_2
Conveyor	: Pusher, Roll to Roll (sheet or film)
Discharge	: Roller conveyor
Furnace length	: 2000 - 8000mm (customizable)
Usable Width	: [Tube] - ø300 mm [Square type] <1100mm
Utility	: Electricity, gas, coolant water, exhaust line

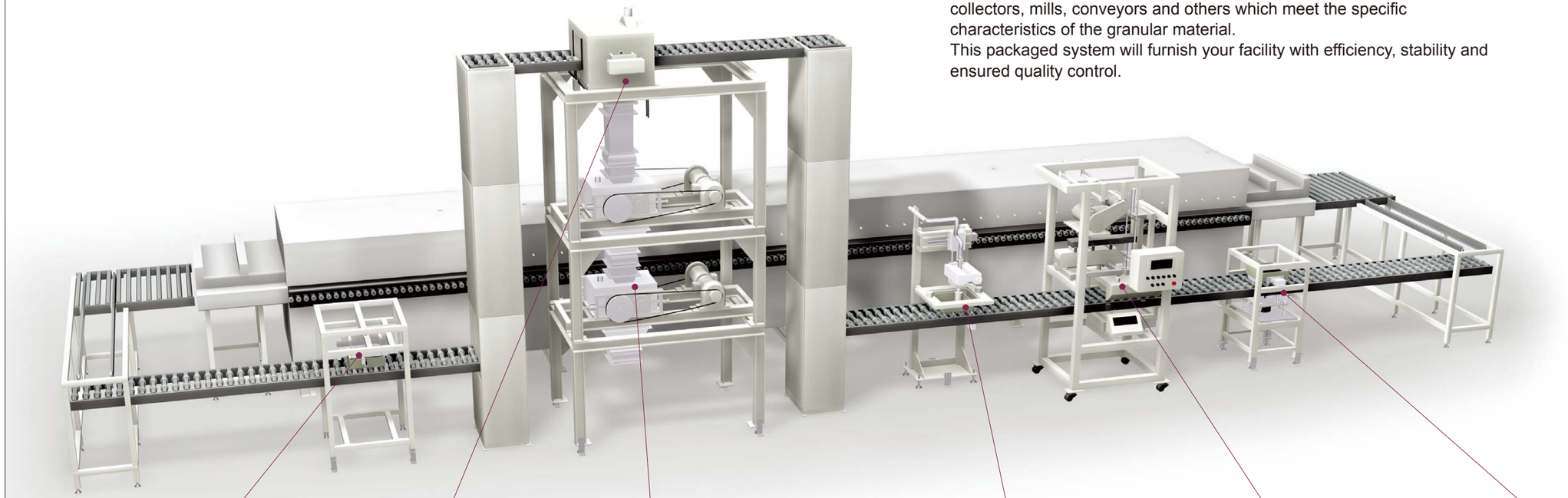
Example Layout



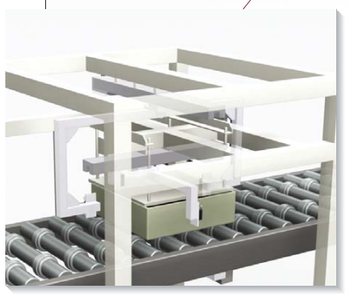
Automation

Powder Handling System

Noritake also provides customized material-handling systems for the firing of powder/granule products.
We offer contaminant-free equipments and systems such as feeders, collectors, mills, conveyors and others which meet the specific characteristics of the granular material.
This packaged system will furnish your facility with efficiency, stability and ensured quality control.

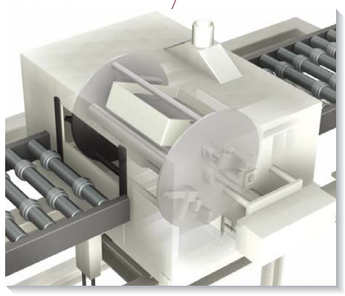


- Feeder
- Powder Leveling (Vibration/Sway)
- Kiln
- Sagger Inspection
- Powder Collector
- Crusher/Mill
- Sagger Cleaner



Sagger Inspection

Containers are inspected by sensors to find cracks and prevent future troubles.

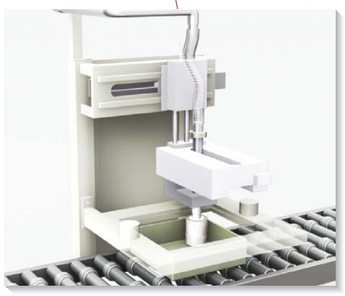


Powder Collector

The powder recovery machine overturns a sagger in a sealed enclosure to collect the powder material.

Crusher/Mill

Caked powders are crushed into proper particle sizes using roll crushers, jaw crushers, etc.

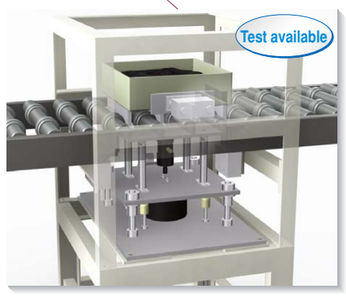


Sagger Cleaner

Powders remaining inside the container will be vacuum-cleaned with a brush nozzle.

Feeder

New powder is poured into containers using vibration feeder, screw feeder or other methods that are suitable for the properties of the powder.



Powder Leveling Machine (Vibration/Sway)

The surface of piled-up powder is flattened quickly at Leveling Station after it was poured into a container.

Refractory

Total Support

With our experiences and knowledge as a kiln/oven supplier, we can offer the most suitable kiln furniture for your facility.

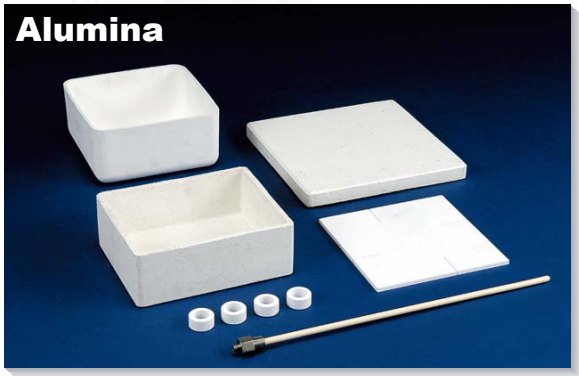
Wide Variation

Various materials, sizes, shapes and options are available for your needs.

Cordierite-Mullite

Resistant to thermal shock, suitable for high ramp/cooling rates. High purity or high porosity types available, capable of special shapes.

Alumina

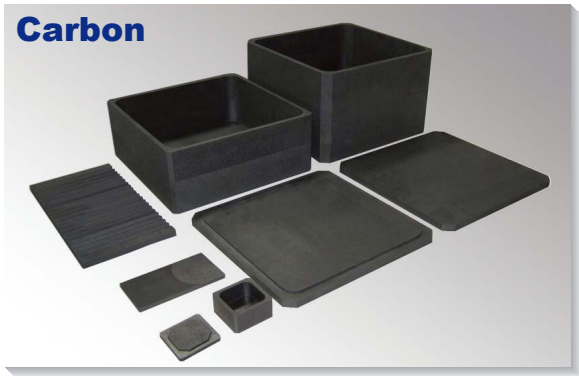


Great thermal resistance, suitable for applications at higher temperatures. Its excellent flexural strength is ideal for stacking. Available with flexible line-up to be used under various conditions.

Magnesia-Zirconia

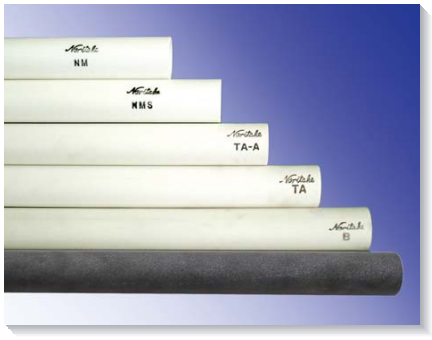
Best thermal resistance. Excellent resistance to the chemical reactions with alkaline materials guarantees long service life.

Carbon



Extremely conductive therefore suitable for quick heat-up/cooling of product, shape can be flexibly customized as it is made by cutting instead of mold.

Ceramic Roller/Tube



Noritake ceramic roller provides excellent dimensional precision, sufficient strength in high temperature range, and excellent corrosion resistance. Being used in a wide range of applications such as conveyor rollers in roller hearth kiln, shell tubes in rotary kilns, heat-resistant tubes, gas sampling tubes, gas supply tubes, and acid resistant components.

Roller	Alumina Content (%)	Recommended Temperature (°C)
B	55	- 1200°C
TA	60	1100 - 1300°C
TA-A	65	1150 - 1350°C
TA-N	69	1200 - 1400°C
NM	72	1300 - 1500°C
NM-S	75	1400 - 1650°C
TA-S	99	- 1400°C
KE	87	- 1650°C
SiC	-	- 1400°C

Properties

		Porosity (%)	Bulk Density (g/cm³)	Flexural Strength (MPa)	Thermal Expansion*1 (%)	Thermal Conductivity (W/mK)	Chemical Components (%)			Max. Working Temperature*2 (°C)
							Al_2O_3	SiO_2	MgO	
Cordierite-Mullite										
KR-4A	Sagger, Plate	29	2.1	9	0.30	0.9	57.3	32.6	8.3	1200°C
ANC	Sagger, Plate	35	1.9	13	0.23	1.2	53.9	37.0	5.6	1200°C
MT-70	Plate	30	2.1	6	0.32	0.9	60.0	35.0	3.0	1200°C
Mullite										
NR-H	Sagger, Plate	24	2.3	11	0.36	1.8	65.0	35.0	-	1200°C
P1	Plate	71	1.1	10	0.77	0.6	84.0	16	-	1200°C
Alumina										
MY-99X	Sagger, Plate	<0.1	3.9	300	0.80	31	99.7	-	-	1600°C
MM-8	Sagger, Plate	20	3.2	25	0.83	2.9	99.8	-	-	1600°C
MM-3	Plate	25	2.8	20	0.58	2.6	91.1	8.8	-	1500°C
Spinel-Cordierite										
MK-3AM	Sagger, Plate	35	2.0	8	0.29	1.4	57.4	19.2	19.8	1200°C
MK-7-3	Sagger, Plate	25	2.6	6	0.75	1.5	69.9	4.5	24.8	1200°C
Magnesia										
MY-PS	Sagger, Plate	<0.1	3.2	100	1.30	15	0.4	0.4	98.5	1600°C
MY-M99	Sagger, Plate	17	3.0	13	1.30	3.9	0.2	0.3	98.8	1600°C
Zirconia										
TZ-Y	Plate	<0.1	5.6	200	1.00	3.0	$ZrO_2+Y_2O_3$ =99.8%			1750°C
MY-Z42	Sagger, Plate	20	4.5	15	0.58	0.8	ZrO_2+CaO =99.0%			1750°C
Silicon Carbide										
HE-902	Plate	<0.1	3.1	450	0.44	180	SiC=98.0%			1450°C
KM-8	Sagger, Plate	23	2.4	79	0.43	154	SiC=99.0%			1350°C
Carbon										
MY-C1	Sagger, Plate	15	1.7	14	0.3	150	C=99.0%			-

*1) Thermal expansion: Linear coefficient for heating from room temperature to 1,000°C.
*2) Maximum working temperature depends on the processing objects and conditions.
(Other specifications not listed above are also available.)

Kiln Heater

SiC Heater

Working temperature : 400 - 1400°C

Non-metal element consisting primarily of silicon carbide.

- Keeps clean environment inside the kiln.
- Simple to use and easy to maintain.
- Suitable for various unique atmospheres.

Coated Type

Special coating e.g. CVD, alumina, or glass is applied to protect the heater from rapid degradation in severe atmospheres.

Homogeneity Type

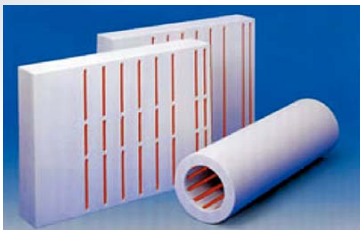
The center section of the heating element does not heat up. Therefore, uniform heating in the horizontal direction is possible. This type is effective for wide continuous kilns.

Protection Tube

Protects the heater from chemical attacks due to acidic or alkaline off-gases generated from heated products. Available with alumina, mullite, SiC, etc.

Insulated Metal Heater

Working temperature : <1000°C

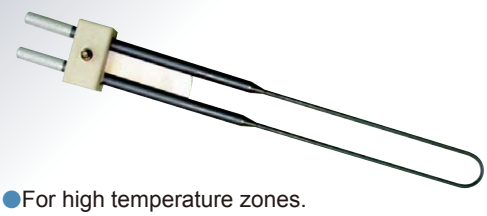


A heater module consisting of thermal insulation and metal heating element.

- For smaller structure and efficient heating.
- A surface covered with heating elements provides uniform heating.

$MoSi_2$ Heater

Working temperature : 1000 - 1800°C



Molybdenum disilicide-based heater for high temperature.

- For high temperature zones.
- The shape can be customized to meet your requirements.

- High purity material is used for this heater.
  It will extend the life time of glass protection film which is formed at the surface of heating element.
  It is high efficiency against creep property features and has a high mechanical tolerance.

Thermocouple

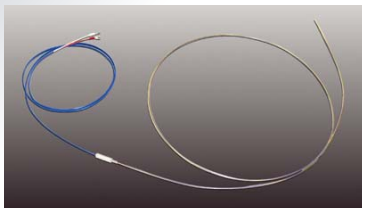
Thermocouple with Protecting Tube

The ceramic protective tube prevents atmosphere gas from damaging the thermocouple and its accuracy. Tube material will be selected to meet your heating conditions.

Thermocouple with Protective Jacket

A light and flexible thermocouple whose conductors are protected with electric-insulation jackets e.g. plastics, glass, ceramics. Ideal for real-time temperature measurement of products while conveying through a kiln.

Sheath Thermocouple



Thermocouple protected by metal sheath such as SUS provides flexibility for mounting in narrow spaces.

Wide Variation

We offer the most suitable products for customers' demand.

Type	Materials		Working temperature (°C)
	Positive Wire	Negative Wire	-200 0 200 400 600 800 1000 1200 1400 1600 1800
K	Chromel	Alumel	0 - 1000°C
J	Iron	Constantan	0 - 400°C
R	Platinum rhodium	Platinum	400 - 1400°C
B	Platinum rhodium	Platinum rhodium	800 - 1600°C
PR40-20	Platinum rhodium	Platinum rhodium	1000 - 1700°C

Note) The working temperatures are of JIS (Japan Industrial Standard) recommended.

After-sales Service

Temperature calibration

Thermocouples require periodical calibration as they deteriorate with time. Noritake therefore provides temperature calibration programs according to the operating conditions to ensure the users' quality controls.

Wire recast

Products using precious metals such as platinum can be very expensive.
Noritake recasts and recycles used wire.

Partial repair

Depending on the circumstances, protection tubes and terminals may be damaged earlier than thermocouple.
Noritake can make partial repairs and suggestions on improvement methods.

Far-infrared Heating System

Far Infrared Conveyer Furnace

Excellent high-speed/uniform heating by the combination of far-infrared and hot-air. With the belt type continuous conveyance, automatization is available by combining customer's equipment.

Operating temperature	: R.T. <230°C (Product temperature standard)
Temperature precision	: ±5°C (at 230°C) (Product temperature standard)
Atmosphere	: Air, N_2 (Optional)
Heat source	: Electricity
Clean level	: Class 10000 * Capable of class 1000 depending on conveying system
Heating method	: Far infrared heater + Hot air

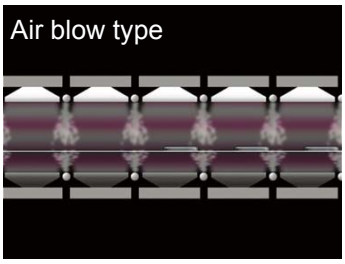
High-speed/high-precision heating

The hybrid of far-infrared heating and hot-air can uniformly heat at high speed.

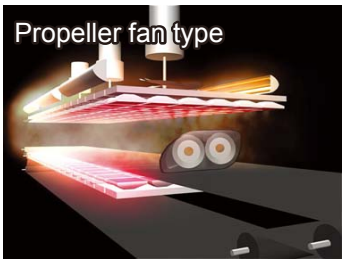
Energy-saving

With radiant heating, there is minimal heat loss and the combination of a energy-saving heater therefore, running cost is reduced.

Hot-air introduction system can be selected according to product shape and temperature conditions.



For standard furnace



For creating high precision temperature distribution

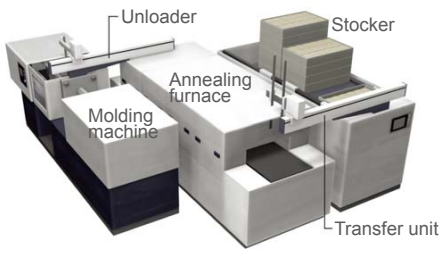
Clean heating

This furnace uses Noritake far-infrared heater and a teflon-coated mesh belt which reduces the amount of dust formation.

Automation

With the belt type continuous conveyance, automatization is achieved through integration customer's equipment.

Example of continuous system



Applications

- Plastic molded goods annealing
- Epoxy/Phenol resin heat hardening
- Drying/Hardening printed substrate
- Drying paint
- Drying moisture etc.

Far-infrared Clean Conveyer Furnace

Operating temperature	: R.T. - 400°C
Temperature precision	: ± 5°C
Atmosphere	: Air, N_2
Heat source	: Electricity
Clean level	: Class 100
Heating method	: Far infrared heater + Hot air

High-speed/High-precision Heating

By using both far-infrared heating and hot-air assist uniformly heat at high speed.

Clean Atmosphere Heating

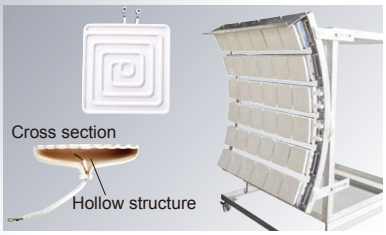
Special processing on the surface of a heater maintains the inside of a furnace at pure atmosphere.

Capability for Multi-Stack Systems:
Can be used for mass-production by stacking 2 - 3 tiers of furnaces and adding auxiliary elevators.

Applications

- LCD, PDP, OLED, FED glass substrate:
  Moisture drying after cleaning, various paste drying
- Drying/firing of printed ceramic substrates

Far-infrared Heater



Electric Plate Heater <PLC>

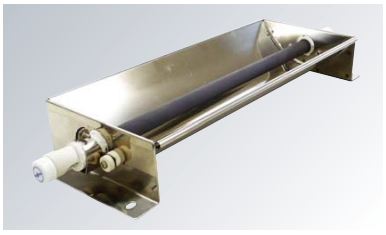
The hollow structure inhibits the heater's back side form heat-up / radiation and reduces power consumption.

Surface temperature	: Max. 650°C
Sizes	: 120 x 120 mm
Capacity	: 100 - 800W

Electric Plate Heater <PLR>

Best suited for heating wide area uniformly.

Surface temperature	: Max. 400°C
Sizes	: 400 x 300 mm, 300 x 200 mm
Capacity	: 500 - 2000W



Electric Pipe Heater <SCH>

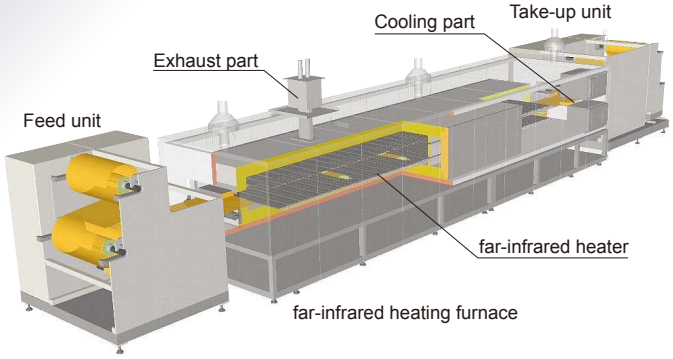
Low cost & Lightweight. Most suitable for simple continuous furnace.

Surface temperature	: Max. 550°C
Size	: 425 - 1575 mm
Capacity	: 400 - 2000W
Other	: Optional reflective board

Far-infrared Heating System

Roll to Roll Far-infrared Heating Furnace

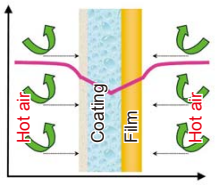
Infiltration of far-infrared ray reduces treating time significantly by heating the inside and outside of film simultaneously.



NORITAKE provides the optimum Roll to Roll conveyance system to meet the property of each different film.

■Cross section model of heat transferring (early stages of heating)

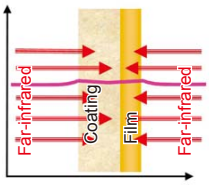
Hot-air heating method



Coating surface hardens first.

→ Internal solvent does not fall out.
→ Foaming and migration

Far-infrared heating method



Entire coating is dried efficiently and uniformly.

→ Shortening of processing time
→ Improvement in physical properties of a product

Roll to Roll Special Atmosphere Furnace

Operating temperature	**: R.T. - 400°C**
Temperature precision	**: ±5°C**
Atmosphere	**: Air, N_2 (Option)**
Clean level	**: Class 1000**
Film width	**: 600 - 1200 mm**
Conveyance tension	**: 10 - 100N**

Uniform Heating

Our unique heaters were developed exclusively for this equipment and the structure of its furnace can stabilize far-infrared heaters as well as atmosphere temperature, which enable precise temperature profiles.

Measures for curls and wrinkles during conveyance

Equipment design solves the problems such as curls and wrinkles of products caused by heat.

Maintenance improvement for heating space

The top of the furnace opens wide for easy feeding of film prior to operation and periodical maintenance.

Applications

- 2-Phase FCCL polyimide drying - heat cure processes
- Polyimide water drying process
- Annealing process for various transparent heat-resistant film

Roll to Roll Furnace for High Temperature

By integrating the thermal treatment and Roll-to-Roll conveyance technologies of Noritake, we can offer a tailored high temperature R2R furnace that fulfills all of your requirements.

Operating temperature	: - 1400°C
Temperature precision	: ±10°C
Atmosphere	: N_2, Ar
Film width	: 600 - 1000mm
Conveyance tension	: 30 - 150N

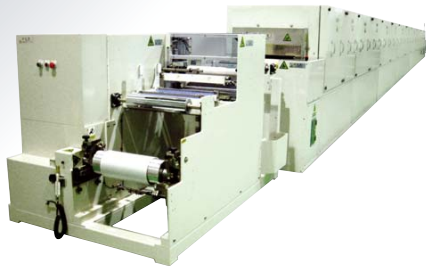
High Efficiency / Energy Saving / Space-saving

The combination of uniform heating, high speed calcination and ceramics-only internal materials achieves high production and energy efficiencies.

Applications

- Hear treatment of CNT materials
- Hear treatment of fiber materials
- Hear treatment of metal foils

Roll to Roll Far-inferred Film Anneal Furnace for Optical Film



Operating temperature	: R.T. - 240°C
Temperature precision	: ±3°C
Atmosphere	: Air, N_2 (Option)
Clean level	: Class 1000
Film width	: 500 - 1700 mm
Conveyance tension	: None (inside Heating Furnace)

Uniform Heating

Heater zone arrangement of far infrared heaters for wide-width film provides a high-accuracy temperature profile.

Roll to Roll conveyance system for Optical film

We propose conveyance system to reduce load during heating and not to cause distortion and damage caused by conveyance on products.

Applications

- ITO film crystallization anneal process
- Anneal process for various types of function membrane film
- Individual annealing treatment process for Optical film (PI, PEN, PET, PMMA etc.)

[Test equipment:
Roll to Roll far-infrared heating furnace for films]

Production-level test furnace is available at our facility.
(Capable of 600 mm-width product, overall length 10 m, furnace 5 m)

Vacuum Heating System

Automated Drying System with Material Handling Conveyor

Labor Saving
Processes without human operators prevent contamination of materials and dry room.

Safety Improvement
Reduces safety risks by replacing operators in heavy-lifting/transporting tasks.

Processes Integration
Establishes automated transfer line with preceding and subsequent processes.

Optional :
Communication with distributed control system, Product traceability with barcode system

For LIB, Capacitors, Electrodes, Cells

Vacuum Drying Oven

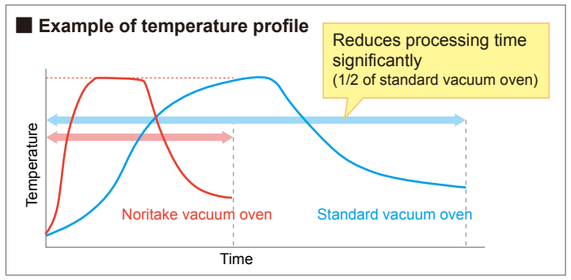
Shorter Processing Time
The use of heat transfer mediums (nitrogen, CDA, argon) for heat-up and cool-down along with our original convection system reduces the total processing time.

Uniform Heating
Homogeneous heating between the inside and outside of materials improves the product quality.

Establishing Optimum Recipes
Flexible control system for developing temperature settings.

For drying of LIB, LIC, Electrodes, Cells, Separators

Example of temperature profile



Operating temperature	**: R.T. - 250°C**
Temperature precision	**: ±5°C**
Atmosphere	**: Vacuum N_2, CDA, Ar**
Vacuum level	**: 10 Pa (7.5×10^{-2} Torr)**
Heat source	**: Electricity**

* Optional : Doors on both side, barcode management

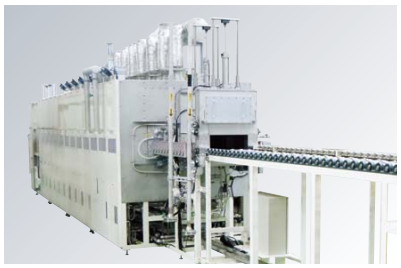
Test Equipment

We offer various test kilns to meet customer requirements.
Please feel free to ask us about in-house firing and sample manufacturing.

■ Roller Hearth Kiln

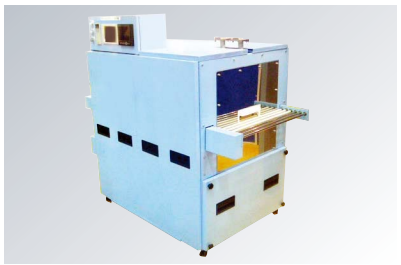
Atmospher RHK

Maximum temperature	: 1400°C
Atmosphere	: Air, N_2, N_2 + H_2, Ar, O_2
Effective dimension	: 330W x 100H (mm)



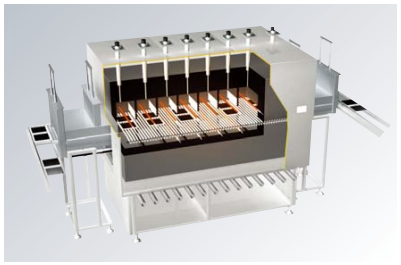
High Temperature Atmosphere Roller Hearth Kiln

Maximum temperature	: 1500°C *1400°C for N_2 or N_2 + H_2 atmosphere
Atmosphere	: Air, N_2, N_2 + H_2, Ar, O_2
Effective dimension	: 300W x 100H (mm)



Desk Top Kiln

Maximum temperature	: 1400°C
Atmosphere	: Air
Effective dimension	: 150W x 25H (mm)



Atmosphere Desk Top Kiln

Maximum temperature	: 1400°C
Atmosphere	: Air, N_2, N_2 + H_2, Ar, O_2
Effective dimension	: 520W x 70H (mm)

RHK Simulator

Maximum temperature	: 1400°C
Atmosphere	: Air, N_2, Ar, O_2, CO_2
Effective dimension	: 330L x 330W x 100H (mm)

Batch Kiln

Elevator Type Atmosphere Batch Kiln

Maximum temperature	: 1400°C
Atmosphere	: Air, N_2, N_2 + H_2, O_2
Effective dimension	: ø750 x 400H (mm)

Batch Kiln for De-binder

Maximum temperature	: 600°C
Atmosphere	: Air, N_2
Effective dimension	: 450W x 450L x 450H (mm)

Multi Atmosphere Batch Kiln

Maximum temperature	: 1600°C
Atmosphere	: Air, N_2, H_2, O_2
Effective dimension	: 150W x 150L x 100H (mm)

Carbon Heater High Temperature Batch Kiln

Maximum temperature	: 2900°C
Atmosphere	: N_2 (- 2400°C), Ar
Effective dimension	: ø100 x 120H (mm)

Rotary Kiln

Desk Top Rotary Kiln

Maximum temperature	: 1300°C
Atmosphere	: Air, O_2, N_2, N_2 + H_2
Tube size	: ø108 x 1100L (mm)

Ceramic Reactor Core Rotary Kiln

Maximum temperature	: 1250°C
Atmosphere	: Air, N_2, N_2 + H_2
Tube size	: ø240 x 2800L (mm)
Tube materials	: Alumina, Carbon, Quartz, SiC

Atmosphere Continuous Rotary Kiln

Maximum temperature	: 1000°C
Atmosphere	: Air, N_2, N_2 + H_2
Tube size	: ø300 x 4100L (mm)

Indirect Continuous Rotary Kiln

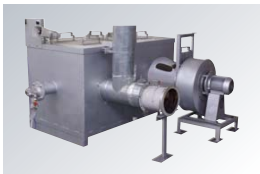
Maximum temperature	: 1050°C
Atmosphere	: Air
Tube size	: ø300 x 1500L (mm)

Test Equipment

Optional Equipment

Microwave Kiln for Preheating

Maximum temperature	: 500°C
Atmosphere	: Air, O_2, N_2
Effective dimension	: 330W x 330D x 100H (mm)



Exhaust Gas Kiln

Maximum temperature	: 800°C

- For the heat treatment of off-gas from kiln.

Recuperator

Exhaust intake temperature	: 300°C - 1000°C
Pre-heated discharge temperature	: - 700°C
Pre-heated substances	: Air, COG, Mix, N_2

- Heat exchanger to recover the hot waste gas from industrial kilns and improve the thermal efficiency.

Fully Automatic Powder Processing System

Auger Feeder

- Less dust and high speed

Rotary Feeder

- Stable feeding of low-fluidity powder

Vibration Feeder

- Low abrasion and high feeding accuracy

Powder Levelling Machine (Vibration/Sway)

- Makes the powder height uniform after supplied into container.

Test Equipment

Drying Furnace

Conveyer type far-infrared heating furnace

Temperature	: Max. 240°C
Heating furnace length	: 2150 mm
Belt effective width	: 450 mm
Feature	: Air blow system combined with hot-air

Batch type far-infrared heating furnace

Temperature	: Max. 360°C
Effective dimension	: 450W x 450D x 200H (mm)
Feature	: Side blow system combined with hot-air

Conveyer type far-infrared heating furnace for N_2

Temperature	: Max. 400°C
Heating furnace length	: 1860 mm
Belt effective width	: 450 mm
Feature	: For Nitrogen, Roll to Roll test is possible.

R to R type far-infrared heating furnace for N_2

Temperature	: Max. 400°C
Heating furnace length	: 4650 mm
Effective width	: 600 mm
Feature	: For Nitrogen, Tension control 10 - 100N

Dry Room available

Batch type vacuum drying furnace

Temperature	: Max. 150°C
Chamber effective	: 950W x 750D x 950H (mm)
Vacuum level	: 1 Pa
Feature	: Uniform heating, Cooling system (shortening of processing time)

Dry Room available

* Dew point in Dry Room: -30°C

Multi-atmosphere Drying Furnace

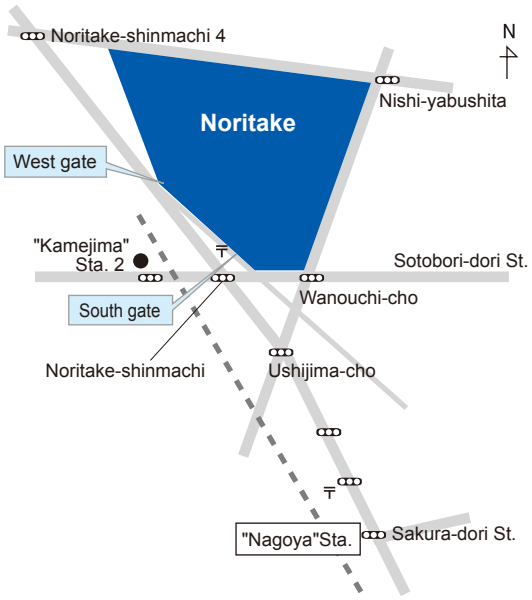
Temperature	: Max. 600°C
Heating furnace length	: 2630 mm
Effective width	: 800 mm
Feature	: Capable of heating by quick-heating heater and in wet atmosphere

Locations

Nagoya

Head Office

3-1-36, Noritake-shinmachi, Nishi-ku, Nagoya, Aichi 451-8501 Japan
- 15 min. walk from Nagoya Station
- 5 min. walk from the No. 2 exit of Kamejima Station
  (Subway Higashiyama line)



Tokyo

Tokyo Office

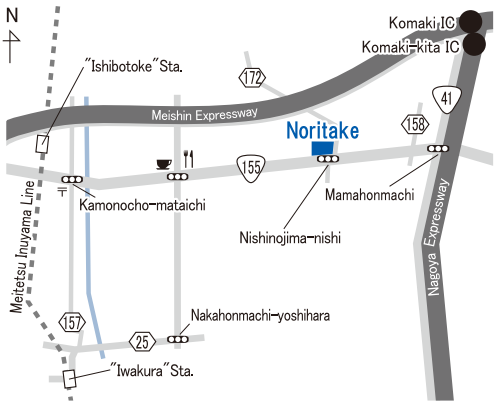
1-13-8, Toranomon, Minato-ku, Tokyo 105-8502 Japan
- 3 min. walk from the No.4 or 1 exit of Toramonon Station
  (Subway Ginza line)

Komaki

Heat Technology Test Center

Komaki Factory

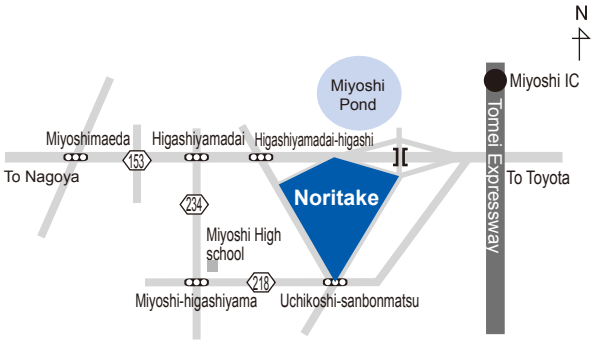
1780 Oaza-mitsubuchi, Komaki, Aichi 485-0075 Japan
- 15 min. by car from Iwakura Station (Meitetsu Inuyama Line)
- 10 min. by car from Meishin Expressway Komaki Interchange
- 10 min. by car from Nagoya Expressway Komaki-kita Interchange



Miyoshi

Miyoshi Office

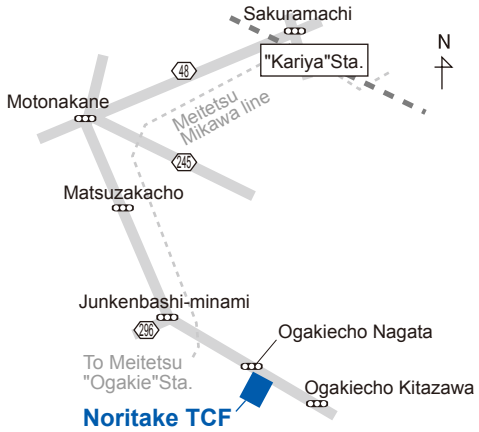
300 Higashiyama, Miyoshi-cho, Miyoshi, Aichi 470-0293 Japan
- 12 min. by car from Miyoshi Interchange



Kariya

Noritake TCF Co., Ltd. (Head office)

7-7 Shimofuji, Ogakie-cho, Kariya, Aichi 448-0813, Japan
- 10 min. by car from Kariya Station (JR Tokaido main Line)

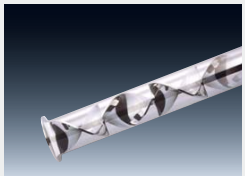


Engineering Group

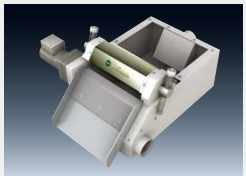
Various other machines and devices are also available with us along with the heat-treatment products.

Fluid Technology (Chemical equipment, Filtration system)

Static mixer and mixing / heating / cooling / reaction systems using the mixer, and filtration system such as filtration equipment, magnet separator, etc.



Static Mixer



Magnet Separator

Machine Technology

Cutting solutions such as sawing machine (Thin Cut Master).

Carbide Tipped Circular Sawing Machine

NORITAKE CO., LIMITED

ENGINEERING GROUP Heat Technology Dept.

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⚠ Safety Precautions

- Consult our agencies or head office to confirm appropriate usage (selection) according to your planned use purposes.
- The specification and appearance are subject to change without advance notice for improvement reasons.
- This catalog lists the standard specification. The shape, dimensions, and materials of the machines may be changed depending on the requested specification by customers.
- The charts and equations used in this catalog are adopted as a reference, and they by no means represent guaranteed figures.
- The color and shape of the machines in the photos in this catalog may differ from those of the real machines. This catalog carries only the photos of selected machines from each series, not all machines.
- For more details, please contact our agencies or head office.

17/08/1000/AT