



Corporate name: NGK Insulators, Ltd. Date of establishment: May 5, 1919 Paid-in capital: 49.4 billion yen (as of March, 1999)

Nature of business: NGK's main business is the production and sale of electrical insulators, advanced ceramic products, environmental systems, beryllium-copper products, and electronics components. All of NGK's products benefit from the company's extensive production experience, and are designed to reflect the needs of today's society. Backed by top product quality, NGK has achieved a reputation for reliability and is recognized as a leading global manufacturer.

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The Earth's environment, the natural circulation of air and water, depends on the energy from the sun. All living things, from bacteria to humans, coexist in this circulatory cycle. As long as the cycle remains properly balanced, life on earth exists in a stable, sustainable system. Today, however, our environment is at risk. Mankind is consuming too many natural resources, exceeding the Earth's capacity to revive and destroying the irreplaceable environment.

The challenges facing the global environment must be addressed by all humans including future generations. Nations, industries, and citizens worldwide must work together to confront, and solve, today's pressing environmental concerns. For manufacturers in the 21st century the pressure is on. We must learn to operate without increasing the burden on the global environment while also exploring recycling-based technologies that will support a "zero-emissions" society.

At NGK, we are working to meet global standards for excellence by emphasizing three concepts: Strategic Growth, Competitive Performance, and Corporate Citizenship. In terms of the environment, we have already won recognition for our efforts to operate in a responsible manner. One key to NGK's success in this area has been the adoption of a global perspective, which reflects our belief in the need to take on new challenges.

President and Chief Executive Officer

Masaharn Shibat

Philosophy

NGK's positive approach to the environment begins with our corporate philosophy: "NGK products and technologies create new value and contribute to quality of life." In particular, we focus on the "Triple E" areas: Ecology, Energy, and Electronics. Through our work in these areas, we seek to develop solutions to some of the critical challenges facing the next generation.

Action guidelines

In the Design-Review (DR) process, NGK first scientifically evaluates the impact of its production technologies, anti-pollution measures, and waste treatment systems on the environment. Based on our findings, we then take appropriate measures.

Specifically, we:

- 1. Enhance environmental management system;
- 2. Reduce industrial waste by promoting resource conservation and recycling;
- 3. Promote energy conservation, and reduce emissions of CO₂;
- 4. Give preference to purchasing environmentally friendly materials, parts, and products;
- 5. Improve environmental awareness among NGK employees, through educational and informational activities; and
- 6. Begin life cycle assessment (LCA) of products, in an effort to reduce environmental impact.

NGK's core policy concerning the environment

In March 1996, NGK adopted a core policy for environmental performance. We also developed action guidelines governing the implementation of environmentrelated activities. Through these and similar steps, we are making continued company-wide efforts to encourage environmental preservation.

History of NGK's commitment to environmental activities

NGK has taken a far-ranging approach to environmental challenges for almost three decades, ever since an Environmental Preservation Office was established at company headquarters in 1972. In 1996, we introduced a Core Policy for the Environment, which included certain "Action Guidelines." Based on these guidelines, we have worked to develop new business in the "Triple-E" areas to contribute more effectively to global environmental conservation.

1972 (April)

Environmental Committee and Environmental Preservation Office founded within the Company.

Environmental Committee: Responsible for planning and drafting NGK's core policy for the environment

Environmental Preservation Office: Responsible for control and management of NGK's environmental preservation activities Currently designated as "Environmental Management Department"

1992 (June)

Waste Countermeasures Commission established.

Waste Countermeasures Commission: Planning and drafting of NGK's core policies regarding internal waste treatment

1993 (March)

NGK's Voluntary Plan for environmental preservation established. Voluntary Plan: A plan dedicated to global environmental preservation that emphasizes business development in the "Triple E" areas

1994 (December) Chlorofluorocarbons (CFCs) and 1,1,1-trichloroethane abolished.

Chlorofluorocarbons (CFCs) and 1,1,1-trichloroethane use was discontinued prior to the 1995 abolition date cited in the Montreal Protocol.

1995 (February) Internal environmental audit conducted.

A company-wide environmental audit was conducted in preparation for application for ISO14000 series certification.

1996 (March)

NGK's "Core Policy for the Environment" established. The Policy consists of three elements: Philosophy, Action Guidelines, and a Support System.

Targets for the company's First Industrial Waste Reduction Project (reduction of 50% from 1990 levels) are achieved. The Second Industrial Waste Reduction Project (target: reduction of 30% from 1995 levels, by 2000) begins.

<mark>1996 (Decemb</mark>er)

CO2 Countermeasures Commission established. CO2 Countermeasures Commission: Responsible for planning CO2 reduction measures within NGK

1998 (March) NGK's three production bases simultaneously achieve ISO14001 certification.

1999 (March) Environmental Report issued.

1999 (June) Engineering Business Group achieves ISO14001 certification.



Environmental Management System

As a responsible corporate citizen, NGK must work to preserve the Earth's environment, both by adopting a global perspective toward the environment and by promoting environmental activities. In an effort to lessen the environmental impact of our operations, NGK has voluntarily established a Core Policy for the Environment, under which we pursue a range of conservation-related activities. Among these, we now maintain an internal division dedicated to environmental oversight; in addition, each NGK plant is encouraged to take independent steps to achieve better environmental performance.

Continual improvement

Management review

Environmental policy

Planning • Environmental aspects

Regulations and other requirements
 Purposes and goals
 Environmental management
 program

Implementation and operation

Organization and responsibility
Training, awareness, and competence
Communication
Documents used in the Environmental Management System
Maintenance of documents
Preparations and contingency plans for emergencies



ISO14001 certification

As part of NGK's efforts to address global environmental concerns, the Company has introduced an internal "Environmental Management System." This system is already proving its worth. In 1998, three of our major production bases won recognition for environmental management performance, achieving ISO 14001 certification; in 1999, our engineering business group received ISO 14001 certification as well. Looking forward, NGK plans to eventually obtain ISO certification for all its domestic and overseas subsidiaries and affiliates.

Checking and corrective action • Monitoring and measurement • Incompatibility, adjustment, and protection • Recording • Audit of Environmental NGK has organized an "NGK Environmental Protection Committee," chaired by a director responsible for environmental protection, which oversees "Regional Environmental Committees," chaired by the plant managers. Our "Waste Countermeasures Commission" and "CO₂ Countermeasures Commission," chaired by the environmental protection manager and "Green Products Purchasing Promotion Commission," chaired by the purchasing manager, provide further coverage of key environmental concerns. Our EMS promotion system plans for our Nagoya, Chita and Komaki production bases to become "Environmentally Autonomous Plants." Meanwhile, the Engineering Business Group has begun to supply products designated as having a "lower environmental impact." The Group is also making continued efforts to improve its overall environmental performance.

Organization of the Environmental Protection Committees



ISO14001-Certified Production Bases	Nagoya Chita		Komaki	Engineering Business Group		
Date	March 30, 1998			June 25, 1999		
Inspection Agency	JIC Quality Assurance, Ltd. (JICQA)			Lloyd's Register Quality Assurance, Ltd. (LRQA)		
Registered Scope	R&D and production of HONEYCERAM® exhaust-gas purification units R&D and production of insulators, special meter (including beryllium- copper), and R&D of environmental systems		R&D and production of suspension insulators and translucent alumina parts	Site activities associated with project management, engineering, design, development, procurement and construction management relating to facilities/equipment for the purification of water, the treatment of wastwater, low- and mid-level radioactive waste, and noise control equipment		

NGK's commitment to environmental contribution

Energy conservation

In the ceramics business, the firing process plays an indispensable role in production. This limits the degree to which we at NGK can eliminate CO₂ emissions, a key factor in both global warming and acid rain. However, by placing top priority on energy conservation, NGK has been able to establish targets for CO₂ reduction. These targets, established by a special internal task force, have encouraged us to identify methods of reducing CO₂ output through improved production practices and similar innovations.

Development of new technologies for energy conservation

Refractory bricks, which used to be employed as a material for shuttle kilns, consumed extra energy due to their dense structure and large heat capacity. In the 1970s, NGK introduced insulating refractory bricks, which dramatically lowered heat consumption in shuttle kilns. In the 1980s, NGK introduced the first ceramic-fiberbased insulating materials, which provided further efficiency gains. In the 1990s, our efforts have focused on combustion technologies, including technologies for reducing gas output and recovering heat from hightemperature exhaust gas. In the area of burner control, NGK has developed two key innovations for energy efficiency: on-off combustion and regenerative combustion. The first allows the burner to be operated intermittently, thus reducing combustion intake; the second uses a heat reservoir, installed at the furnace's air outlet, to recover heat. Together, these two innovations reduce fuel consumption by approximately 50% relative to conventional ceramic-fiber-based furnaces. Additionally, the sharply decreased exhaust-gas reduces CO₂ emissions.



Development of NGK's energy-conservation technologies (for shuttle kilns)

Efficient use of a combustion furnace's residual heat

The residual heat in a combustion furnace contains a substantial amount of energy. To utilize such energy efficiently, NGK converts the residual heat for use in the hot-drying process, which is indispensable in ceramics manufacturing.

(For more information, refer to the Production Process Chart on page 8.)

CO2 output reduced through a change in fuel

By changing the fuel used in its combustion furnace, from oil to gas, NGK's Chita Plant was able to reduce its CO₂ emissions drastically; even better, SOx emissions were eliminated entirely. NGK's AC and Komaki plants are now working to change fuel types as well.

Change of CO₂ emissions (Basic Unit) (kg-c/100 million yen)

(vear)

Resource conservation and recycling

NGK is promoting efficient use of resources and reduced industrial-waste output. We have achieved complete recycling by reusing all production-related wastes, such as scraps from the forming process. Furthermore, industrial-wastes are collected from our clients and are recycled in an effort to cut our emissions output to zero.

8

Complete recycling on production line achieved — Insulators and HONEYCERAM® Plant —

Scraps and defective units generated during the forming process are returned to the mixing area, then entirely reused. (1)

If already fired, defective units (ceramic fragments) are recycled into refractory raw materials, such as bricks and aggregate, for use in sound-absorbing or sound-diffusing boards. (2)



Initiative to collect and reuse scrap — Beryllium-copper Plant —

Beryllium-copper strips are typically processed for use in compact electronic parts and similar goods. Due to the precise nature of the production process, large amounts of scrap are generated during the embossing phase. NGK collects this embossingrelated scrap from our customers and reuses it.



Training and education for employees

We at NGK believe that individual action is essential in environmental matters. Each of us has a role to play in learning more about environmental issues, in particular, how we can help preserve the global environment.

NGK's campaign for the environment relies on several elements, including project teams, Quality System(QS) activities, internal newsletters, and company information videos.

Separation & collection of office refuse

NGK production bases in Nagoya, Chita, and Komaki have all been equipped with "RISAPOST" recycling stations, so that employees can separate their trash into appropriate recycling containers. Since October 1998, all three workplaces have achieved 100% recycling of paper waste. Even thermal paper and wrapping paper are recycled and used to create a special toilet tissue (made entirely from recycled material) for use within the company.



The NGK headquarters building receives a "Commendation for Superior Garbage Reduction" from the Nagoya Citizens' Assembly on Garbage Reduction.

Green purchasing

The Engineering Business Group and other Groups are conducting active development of products that help to reduce environmental impact (please see page 11). We give business preference to companies that have or are pursuing "ISO" certification and promote the purchasing of green products. At NGK, we use "Eco Mark" products such as 70% whiteness paper from 100% recycled materials and ball-point pens made from recycled plastics.

The "Paperless Office" campaign

NGK has sharply reduced paper usage by emphasizing the use of "paperless" office technology. Official notices and documents that used to be circulated in hardcopy form, for example, are now distributed over an intranet system. For meetings, employees are encouraged to use projectors instead of distributing paper handouts. When printed material must be distributed internally, employees are encouraged to save paper by printing the documents on used paper.

Improving environmental awareness

Individual awareness plays a key role in our efforts to address environmental problems. With this in mind, NGK offers the following educational initiatives for employees:

A program to help engineers gain a better understanding of environmental regulations, so that they can support the Company's environmental efforts and responsibilities to society

An Environmental Management System (EMS) program covering the main points of NGK's environmental policy. As part of the program, "Environment Cards" listing individual departmental and employee goals are distributed to all attendees. Modification of QS activities to include two new topics: industrial waste treatment and the need for energy conservation

Special emphasis on environmental issues in company newsletters and videos





Reducing environmental impact

Another of NGK's goals is to reduce the environmental load of all our products and facilities to as close to zero as possible. To do this, we implement fundamental solutions starting from the design process. Products and facilities are approved only after extensive simulations that assess the production process as well as related applications. Through such careful planning, NGK seeks to minimize environmental impact while also enhancing the quality of its products.

Rapid removal of CFCs and Trichloroethane

NGK stopped using 1,1,1-trichloroethane and other ozone-depleting chlorofluorocarbons (CFCs) in 1994, prior to the Montreal Protocol, replacing them with environmentally friendly substances such as water-based detergents. All our replacement materials are completely ozone-safe.



Working to reduce the environmental impact

In an effort to develop new products and manufacturing technologies imposing less of a burden on the environment, NGK introduced a new concept in 1998: Design-Review (or DR). The DR concept calls for a "design-review" stage at every step in the product development process, in which teams from the Design, Development, Production, and Sales areas all meet to discuss potential concerns. Among the topics discussed are measures to reduce pollution and industrial-waste output.



Environmentally friendly products

NGK is committed to a future of global ecological harmony, in which an abundant society can coexist with nature. Toward this end, we seek to manufacture products that promote environmental protection and energy conservation.

ELECTRONICS

ECOLOGY

ENERGY

NAS_® Batter

This is a new energy storage system. Made from high-quality Beta alumina ceramics, the NAS Battery utilizes electric energy efficiently and protects natural resources and the environment.

Combustion System/Kiln Furniture

NGK's combustion systems have enabled us to make dramatic advances in the incineration technologies we offer. This environmentally friendly system requires less fuel than conventional systems and features reduced CO₂ output. Like other products in the Kiln Furniture range, it was designed with an emphasis on energy efficiency.

Ceramic Membrane Filtration Systems

NGK now offers new water filters for households and commercial users. Both employ advanced ceramic-membrane filtration, which removes viruses and colloids efficiently. The commercial filter is also relatively compact.

Automobile Exhaust Gas Purification (HONEYCERAM®)

We have already shipped more than 400 million of our HONEYCERAM emissionscontrol units for automobiles. We are currently developing an ultra-thin HONEYCERAM unit, which will reduce ventilation resistance and provide improved performance in the crucial seconds just after engine start-up.



Diesel Particulate Filter

With slight modifications, HONEYCERAM units can remove diesel particulates from dieselengine exhaust. HONEYCERAM, like other ceramic filters, enables the particulates to be reburned, thus improving engine efficiency. This technology is already employed widely in forklifts and municipal buses.



Recycle Plazc

NGK is constructing "Recycle Plaza", home to vast amounts of recycled materials. All trash and wastes are separated on the premises, so overall recycling rates are high. In addition, a library and various meeting rooms are available and provide added support for public activities focused on recycling. This new "Public-Participating Recycling Plaza" not only can be used for both garbage separation and recycling, but also plays an educational role as well.

Wastewater Treatment System

NGK has designed new wastewater treatment systems that allow large volumes of sludge to be incinerated, leaving only pollution-free byproducts. One of our more recent advances is a circulating fluidized system, which is both compact and energy-efficient.



luidized Bed MSW Incineration System

This sludge treatment process allows urban trash to be converted into gas, which is then used to burn additional trash. The treatment process also reduces dioxin output.

Permeable Interlocking Block Manufacturing System

This system converts incinerated sludge, produced in the process of sewage treatment, into colorful, highly permeable blocks. These blocks represent an innovative solution to the problems posed by incinerated sludge, as they can be used to cope with drainage problems caused by excess rainfall.



Cullet Sound-Absorbers

Cullet is a recycled material made from used glass, such as bottles, which is fired, then mixed with cement. It makes an efficient sound absorber and is currently used in Tokyo along the elevated areas of the Mita line. Cullet has received an "Eco Mark" from the Japan Environmental Association.



NGK's performance vs. current pollution control standards

Nagoya Plant

Address: 2-56, Suda-cho, Mizuho, Nagoya Product: Ceramic honeycomb substrate for automotive catalytic converters (HONEYCERAM®)



D		Standard	Actual value			
Division	irem		1996	1997	1998	
	Sulfur produced in combustion (%)	0.1*	0.10	0.10	0.03	
Exhaust gas	NOx (ppm)	180	110	95	72	
	Soot and dust (g/Nm ³) 0.15	0.002	0.002	0.002	
	рН	5.7~8.7	6.2~7.6	6.8~7.6	6.6~7.8	
	SS (mg/l) 600	2~25	5~39	5~32	
Waste- water	BOD (mg/l) 600	1~10	1~21	1~32	
	Oil (mg/l) 5	0.5~2.2	0.5~4.5	0.5 ~ 1.3	
	Other metallic salts(mg/l) Sewage water law	N.D. or Tr.	N.D. or Tr.	N.D. or Tr.	
Ambient	Day (dB) 70	52~70	54~69	53~69	
noise	Night (dB) 60	51~61	49~60	53~62	
Pumpeo undergi	l round water (m³/day	330	170	180	152	

1...Measurement variation due to influence of background noise

Relevant laws and agreements

Exhaust gas : Regulations of Aichi prefecture (* Pollution control law of Nagoya city) Wastewater : Sewage water law Ambient noise : Regulations of Nagoya city Pumped underground water : Regulations of Aichi prefecture

Chita Plant

Address: 1, Maegata-cho, Handa, Aichi Products: insulators, equipment for electrical transmission and distribution, ceramics products for the chemical industry, sewage treatment systems, beryllium-copper strips, ceramics components for semiconductor manufacturing



	3	ltem		Standard	Actual value			
	Division				1996	1997	1998	
	Exhaust gas	Sulfur produced in combustion (%)		0.5	Shifted to LNG	Shifted to LNG	Shifted to LNG	
		NOx (ppm)		150	81	93	110	
		Soot and dust (g/Nm ³)		0.2	0.07	0.08	0.055	
		Ве	Total for p	output ant (g/day)	10	0.497 ~ 0.505	0.475 ~0.660	0.477 ~0.571
			Outpu in the r	t concentration residential area (µg/Nm³)	0.01	0.00004 ~ 0.00013	0.00004 ~ 0.00008	0.00003 ~0.00008
	Waste- water	pН			5.8~8.6	6.9~7.3	6.6~7.3	6.8~7.2
		SS		(mg/l)	30	1~6	2~8	2~6
		COD (mg/ 2)		20	3~5	2~3	2~5	
		Oil		(mg/l)	2	0.5 ~ 1.3	0.5~0.6	< 0.5
		Сор	oper	(mg/l)	1	0.01~0.04	0.01 ~ 0.03	0.01 ~ 0.03
1.11		Zinc (mg/l)		1	0.05~0.08	0.03 ~ 0.10	0.05 ~ 0.09	
141210		Soluble iron(mg/l)		0.5	0.1 ~ 0.5	0.1~0.5	0.1~0.4	
11.1	Ambient noise	Day (dB)		65	43~64	44~64	44 ~ 63	
11111		Night (dB)		65	39~61	42~65	42 ~ 62	
	Vibration	Day	,	(dB)	70	< 45	< 45	< 45
		Nig	ht	(dB)	70	< 45	< 45	< 45

Relevant laws and agreements

Exhaust gas : Pollution control agreement with Handa city Wastewater : Pollution control agreement with Handa city Ambient noise : Pollution control agreement with Handa city Vibration : Pollution control agreement with Handa city

Komaki Plant

Address:1155, Tagami, Futaebori, Komaki, Aichi Products : suspension insulators for electrical transmission, equipment for electrical transformation and distribution, glass substrates, translucent alumina ceramics (HICERAM®)



D	Test days	CI	Actual value			
Division	Item	Standard	1996	1997	1998	
	Sulfur produced in combustion (%	0.6	0.09	0.09	0.09	
Exhaust gas	NOx (ppm)	170	97	100	100	
	Soot and dust (g/Nm ³	0.2	0.01	0.02	0.01	
	рН	5.8~8.0	5.9~7.6	6.4~7.8	6.3~7.8	
	SS (mg/l) 80	1~9	1~7	N.D. ~ 7	
	BOD (mg/l) 17	1~4	1~4	N.D. ~ 4	
Waste- water	Oil (mg/l) 2	0.1~0.7	0.1~0.6	N.D. ~ 0.7	
	Zinc (mg/l) 3	0.1~0.2	0.1 ~ 0.3	N.D. ~ 0.5	
	Dichloromethane(mg/l) 0.2*	N.D.	N.D.	N.D.	
	Other metallic salts(mg/l) Water pollution control law*	N.D. or Tr.	N.D. or Tr.	N.D. or Tr.	
Ambient	Day (dB) 65	49~64 ²	51~65 ²	53 ~ 63 ²	
noise	Night (dB) 55	47~62 ²	45 ~ 62 2	48 ~ 62 ²	
Pumpeo] round water (m³/day	4023	3281	3150	3145	

2...Measured from the nearby road (including background noise)

Relevant laws and agreements

Exhaust gas : Pollution control agreement with Komaki city Wastewater : Pollution control agreement with Komaki city (* Water pollution control law) Ambient noise : Regulation of Aichi prefecture

Pumped underground water : Regulation of Aichi prefecture

SS: Suspended Solid COD: Chemical Oxygen Demand BOD: Biochemical Oxygen Demand N.D.: Not Detected Tr.: Trace

We are making every effort to recycle resources and protect the environment.



This report contains tree-free paper made from agricultural waste (specifically bagasse, which is obtained from the strained lees of sugarcane). Global warming is caused by excess levels of CO2. Use of tree-free pulp helps to reduce the rate of logging activity, and thus to preserve trees, which absorb CO2. In addition, tree-free paper can be produced without using any of the high-temperature, high-pressure processes required by wood-based papers, making it an even more environmentally sound alternative.



This report was printed using soy ink, which contains none of the petroleum solvents found in conventional ink. The use of soy ink not only helps to conserve limited petroleum resources, but also reduces emissions of the volatile organic compounds (VOCs) generated during printing. Soy ink also facilitates biodegradation and depigmentation of waste because of its vegetable properties, and is thus particularly suited for use with recycled paper.





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