



# NAKABOHTEC PROFILE



**NAKABOHTEC**





## VALUABLE THINGS FOR THE FUTURE

As a leading company in the field of corrosion prevention, Nakabohtec has been offering products to protect marine structures, infrastructure-supporting pipelines, and similar structures against corrosion since 1951. We aim to continue improving our products on the basis of our long experience and willingness to serve the industry and the environment for the next generations. In addition, by preventing metal corrosion, we intend to contribute to the maintenance of earth environment, such as the protection of resources and conservation of energy. The management principle of our company is “business growth based on anticipating needs, innovation, and contributions to the society.” The catch phrase is “bridge between materials and environment.” Thus, we strive to offer high-quality products that meet or exceed the safety concerns of our clients.



# ALWAYS SERIOUS ABOUT CLIENTS' ISSUES... SOLVING CORROSION PROBLEMS IS NAKABOHTEC'S BUSINESS

Clients' needs are diverse and change over time. To solve the corrosion problems they are facing, we consider their needs and responses.

We tackle corrosion problems associated with the marine environment, salt damage, and on-shore and underground structures; moreover, we develop corrosion prevention methods to meet our clients' needs.

Corrosion prevention is essential for asset management policies based on preventive maintenance rather than supportive care, and we are confident that we meet our clients' expectations.

## For marine constructions

- Object Facilities
  - Port and harbor steel structures (jetties, piers, seawalls)
  - Bridges, submerged caissons, vessels, and others
- Main Products
  - Cathodic protection (galvanic anode systems, impressed current systems)
  - Heavy-duty covering protection (petrolatum tape and covering "PTC" systems, urethane resin and covering systems)



## For pipelines that support infrastructures

- Object Facilities
  - Pipelines (gas, water, agriculture, and others)
  - Underground tanks and others
- Main Products
  - Cathodic protection (galvanic anode systems, impressed current systems)
  - Cathodic protection with solar power
  - Remote monitoring control systems





## For concrete constructions under salt damage



- Object Facilities
  - Bridges (RC structures, PC structures)
  - Port and harbor structures
  - Box culverts and others
- Main Products
  - Cathodic protection (galvanic anode systems, impressed current systems)
  - Remote monitoring control systems

## For plant facilities and gate facilities



- Object Facilities
  - Machinery and facilities (condensers, heat exchangers, and others)
  - Gate facility (dam weir, rivermouth weir, intake weir)
  - Other on-shore facilities
- Main Products
  - Cathodic protection (galvanic anode systems, impressed current systems)
  - Coating protection (zinc anode protection "ZAP" tape, "ZAP" sticker, and others)
  - Marine antibiofouling systems
  - Electrolytic ferrous ion injection systems "NAFES"



## A “TOTAL UNDERTAKING SYSTEM” TO APPLY OUR TECHNOLOGIES AND ACCUMULATED EXPERIENCE

Corrosion and corrosion prevention methods are diverse owing to environmental and service conditions. To respond to the wide range of requirements, we have adopted a unique sales system called "total undertaking system" to fine-tune our services.

1. Total service of investigation, construction countermeasures, and maintenance
2. Establish the construction framework to meet the various job site requirements
3. A lineup of corrosion prevention products applicable to different conditions

Combining the abovementioned factors enables us to have a highly productive and reliable order intake system.

To understand the deterioration of structures, past data and diagnosis are used, and efficient investigation methods are proposed.

### Investigation

We evaluate the deterioration structures on the basis of the investigation results and identify the causal factors. Highly knowledgeable members of our staff analyze and evaluate the data.

### Testing, analysis, and evaluation

To extend the life of structures and facilities, Nakabohtec offers clients many setups that unify investigation, counter measures, and maintenance.

### Monitoring and maintenance

High priority is given to the performance and maintenance of the corrosion protection system. Data are analyzed and assessed and subsequently incorporated in the maintenance works.

### Propose counter measures

Several types of countermeasures are proposed on the basis of the deterioration of structures. Subsequently, an optimal solution is selected considering functionality, workability, cost, performance, and other factors.

### Construction

High-quality counter measures are selected from our rich product lineup that covers various environments and application requirements. Furthermore, at construction sites, safety and environment concerns are addressed.



## INVESTIGATION

**GRASPING THE CONDITIONS OF DETERIORATION AND DAMAGE OF STRUCTURES AND FACILITIES AND REFERRING TO PAST DIAGNOSTIC DATA AND HISTORY, WE PROPOSE AND CONDUCT OPTIMAL INVESTIGATIONS.**

### Marine Structures

- Corrosion investigation (visual inspection, thickness measurements, water quality investigations, and others)
- Cathodic protection inspection (potential measurements, anode consumption investigation, and others)
- Heavy-duty covering protection investigation (open check, petrolatum residual ratio measurements, and others)
- Others



### Pipelines

- Electrical investigations (electric railways and buried piping)
- Corrosion environment investigations (mainly soil and underground water)
- Others



### Concrete Structures

- Appearance (visual inspection)
- Reinforcing bar corrosion investigation (natural potential, polarization resistance, concrete resistivity, and others)
- Core sampling (neutralization, salt content, compressive strength, and others)
- Reinforcing bar position and covering depth investigation (radar method, chipping investigation, and others)
- Others





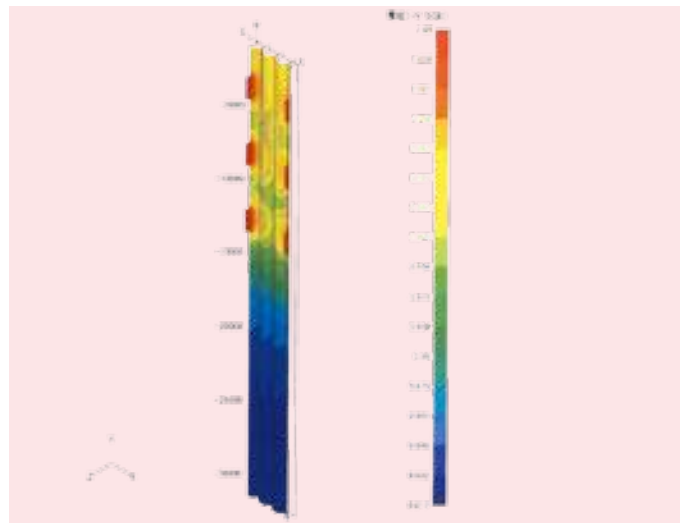


**BY SWIFT ANALYSIS WITH DIAGNOSTIC TECHNIQUES THAT TAKE ADVANTAGE OF STATE-OF-THE-ART EQUIPMENT AND ACCUMULATED EXPERTISE, WE DERIVE THE MOST EFFECTIVE CORROSION PREVENTION COUNTERMEASURES.**

New developments are being constantly introduced in the field of corrosion prevention technology. In addition, corrosion prevention methods are based on rigorous analytical techniques rather than experience and intuition. Nakabohtec uses the finite-element method (FEM) to simulate corrosion and corrosion prevention and high-frequency inductively coupled plasma emission spectroscopy (ICP) to analyze corrosion products.

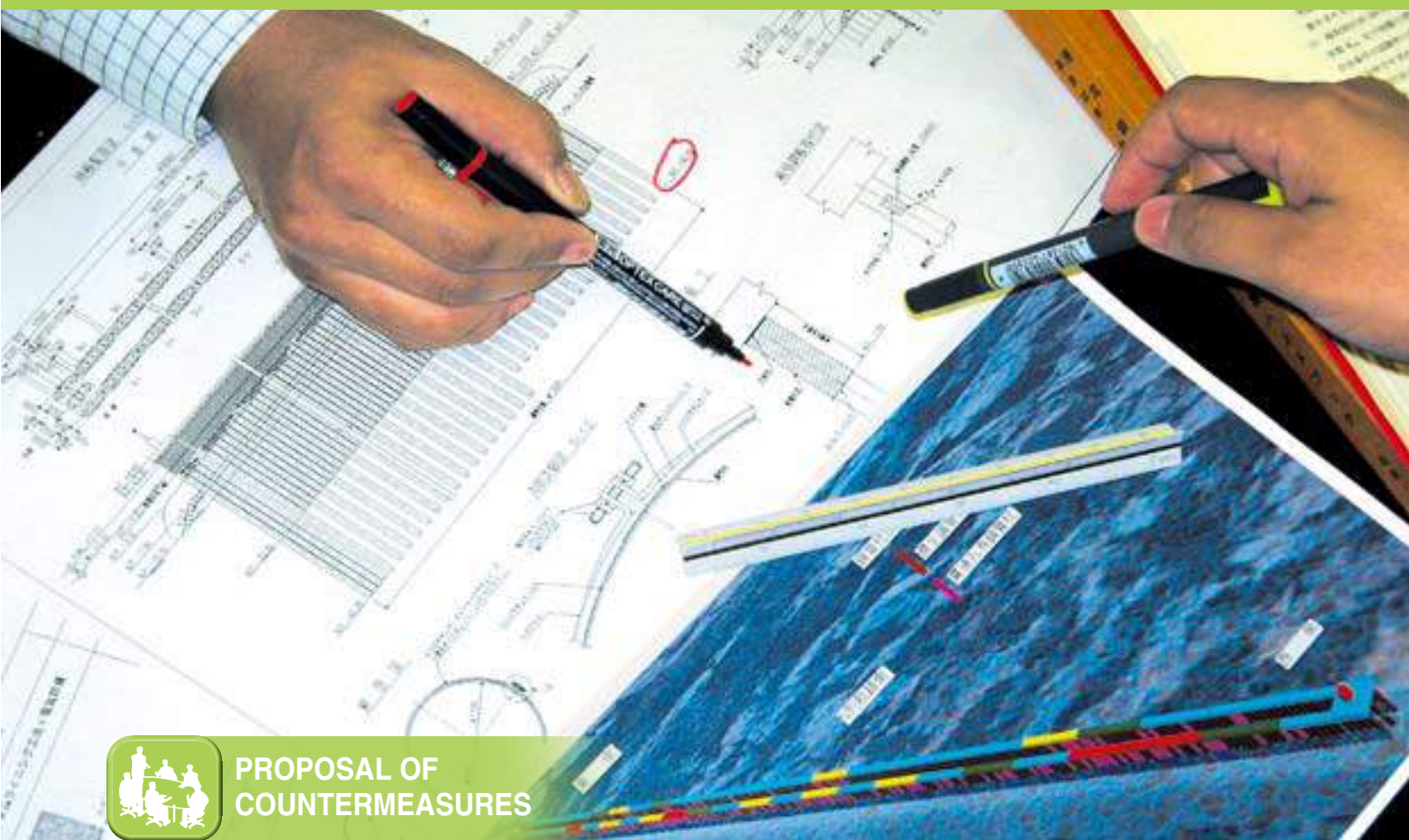


Electrical potential analysis using FEM



Example of output from FEM analysis





## **BASED ON DIAGNOSTIC RESULTS, WE PLAN AND PROPOSE PRECISE CORROSION PREVENTION COUNTERMEASURES, WHICH SUIT COST PERFORMANCE AND ENVIRONMENT.**

We start by understanding the clients' needs to find the right solution to the corrosion problem at hand. We simulate the corrosion conditions and solutions, evaluate the cost, and propose the optimal method. Our sales, technical, and research staff work together to address the clients' needs.



Proposal of countermeasures by presentation



Scene of planning



## APPLICATION OF COUNTERMEASURES

**FOR THE CHILDREN IN THE FUTURE, WE PROTECT SUCCESSIVELY  
CONSTRUCTED PROPERTIES, MAINTAINING THEIR VALUE.  
“PREVENT AND TRANSMIT” IS OUR MOTTO.**

### For marine constructions

Marine structures are exposed to intense corrosion, making corrosion prevention critical. The aluminum alloy anode “ALAP” and “PTC” system developed by Nakabohtec has been applied and tested for many years to extend the life of marine structures.



The application of “PTC” system to steel sheet piles



“ALAP” applied to steel pipe piles



## For pipelines that support infrastructure

Gas, water, and oil are critical to industry and everyday life. Pipelines that deliver them may develop holes owing to stray current or macrocell corrosion. Thus, pipeline corrosion will not only affect the supply of gas, water, and oil but also lead to major accidents depending on the content.

Our cathodic protection system for underground facilities is a reliable technology that has been in operation for more than 50 years.



Pipeline corrosion protection with magnesium alloy anodes



Cathodic protection using solar power

## For plant and gate facilities

Condensers and heat exchangers in power or chemical plants, dams, weirs, and floodgates are critical to our country's infrastructure. However, they are exposed to corrosion in seawater, fresh water, and soil and are in risk of heavy corrosion owing to the combination of different metals.

Based on our corrosion prevention technology and rich product lineup, we provide optimal construction methods applicable to many complex corrosion cases.



Magnesium alloy anodes installed on a weir facility



Movable tank-type ferrous ion injection system (movable tank-type "NAFES")

## For concrete structures under salt damage

Concrete structures, particularly bridges, must be durable and reliable.

However, concrete structures deteriorate owing to salt-induced corrosion of reinforcing bars.

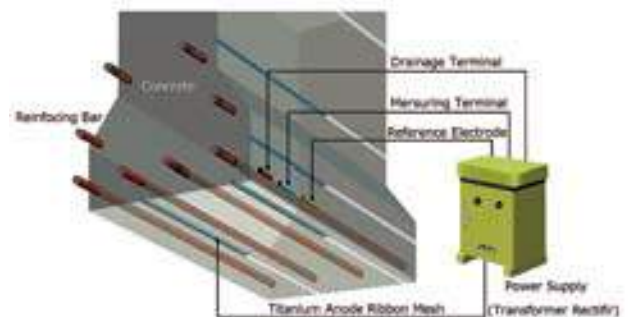
Salt may come from the atmosphere or antifreezing agents.

Our cathodic protection technology is widely adopted as an effective means against salt damage.



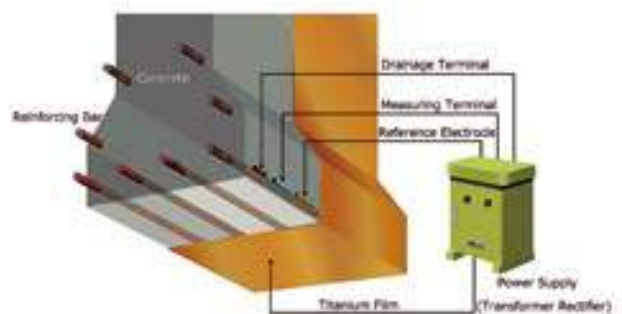
### ■ Titanium anode ribbon mesh system

Ribbon-shaped titanium electrodes coated with metal oxides are installed in grooves formed in concrete, and current is fed by a DC power unit to the reinforcing bars via the electrodes.



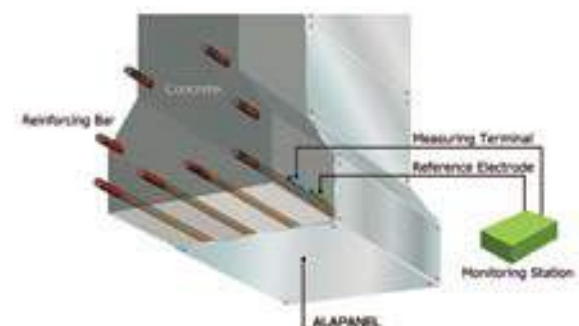
### ■ Thermal sprayed titanium anode system

High-purity titanium is coated on the concrete surface by an arc thermal spray to form a highly durable electrode film, and current is fed by a DC power unit to the reinforcing bars via the electrode film.



### ■ Aluminum panel anode system "ALAPANEL"

Panel-shaped aluminum alloy anodes are fitted on the concrete surface to supply current from the anodes surface to the reinforcing bars. This system is unique as it does not require electric power.







## MAINTENANCE (Monitoring)

### WE CONSTRUCT THE OPTIMAL LIFE-CYCLE MANAGEMENT BY PERFORMING REGULAR MAINTENANCE.

Monitoring at regular intervals is critical to the long-term use of corrosion prevention systems. Data are collected and stored and then used in the planning stages of protection works. The Nakabohtec maintenance system has gained trust for its ease of use and high precision.



Monitoring the current at the anodes



Monitoring with "Pockereco"



## NAKABOHTEC ACTIVELY PARTICIPATES IN OVERSEAS PROJECTS

Our reliable technology is based on years of experience and effective communication with worldwide users. We work with our overseas business partners and develop state-of-the-art technologies for new foreign markets.

YEAR	LOCATION	OWNER	PROJECT NAME
1992	Iran	National Iranian Oil Company	Arak Refinery Project, ICCP
1992	Malaysia	Petronas Penapisan (Melaka) Sdn. Bhd.	Design & Engineering Consultant for Melaka Refinery Phase-1, ICCP
1994	Thailand	Star Petroleum Refining Co., Ltd.	Star Petroleum Refinery PJ, ICCP for tank bottom
1995	Qatar	Qatar Liquefied Gas Co., Ltd.	Qatargas Upstream Development onshore receivings, storage & loading facilities, ICCP
1996	Indonesia	Pertamina	Balikpapan Refinery 1 Upgrading, ICCP for U/G pipe
1996	Kuwait	Petrochemical Industries Company	KPP 1,000,000 Polypropylene, SACP for U/G pipe
1996	Thailand	Rayong Olefins Co., Ltd.	ROC Olefins Plant, ICCP & SACP for tank bottom & U/G pipe
1997	Qatar	Ras Laffan Liquefied Natural Gas Co., Ltd.	Ras La?an Onshore Facilities Project, ICCP & SACP for tank bottom & U/G pipe
1996~98	Kuwait	Kuwait National Petroleum Company	MAF Project, ICCP & SACP for tank bottom & U/G pipe
1998	Malaysia	Aromatics Malaysia Sdn. Bhd.	KR-2 Project, ICCP & SACP for tank bottom & U/G pipe
1998	Malaysia	Shell Refining Co. (F.o.m) Bhd.	Port Dickson LRCC Project, ICCP & SACP for tank bottom & U/G pipe
1998	Malaysia	Titan Petrochemicals (M) Sdn. Bhd.	Titan 2 LDPE PJ, ICCP & SACP for tank bottom & U/G pipe
1996~98	Singapore	Sumitomo Chemical Singapore Pte. Ltd.	SMAG PJ, ICCP for U/G pipe
1998	Thailand	Rayong Olefins Co., Ltd.	ROC PJ, ICCP for tank bottom & U/G pipe





YEAR	LOCATION	OWNER	PROJECT NAME
1998	Qatar	Ras Laffan Liquefied Natural Gas Co., Ltd.	Ras Laffan Onshore Facilities Project, ICCP for tank bottom & U/G pipe
1999	Jordan	Zai Water Treatment	Water Treatment Plant PJ, ICCP for U/G pipe
2001	India	Petronet LNG Ltd.	Dahej LNG Terminal, ICCP for tank bottom & rebar in concrete pile
2002~04	Vietnam	Electricity of Vietnam	Phu My II 1-4 Combined Cycle Power Project
2003	Qatar	Ras Laffan Liquefied Natural Gas Co., Ltd.	Ras Laffan Onshore Expansion Project
2004	Russia	Exxon Neftegaz Limited	Sakhalin II Project
2005	Qatar	Qatar Gas Co., Ltd.	QG2 Onshore PJ-LNG storage facilities (EPC of LNG storage tank)
2005	Republic of Turkey	Ministry of Transportation (DHL)	Marmaray Project Contract BC-1
2006	Qatar	Ras Laffan Liquefied Natural Gas Co., Ltd.	Ras Laffan Onshore Expansion Project train 5-7
2007	Papua New Guinea	PNG Taiheiy Cement Limited	Corrosion protection of 10,000 tons jetty
2007	Madagascar	Port d'Ehoala S. A.	Integrated Growth Poles Project, Port of Ehoala Project
2008	Saudi Arabia	Rabigh Refining and Petrochemical Co. (SCEC & Saudi Aramco)	The Rabigh PC-1 Project
2008	Algeria	Sonatrach	GP1.Z Phase III Project

# SEEKING TECHNOLOGIES THAT CONTRIBUTE TO THE NEXT GENERATION...

## TC unit system



To shorten the construction period, reduce environmental impact, and minimize costs, we have developed a new linear anode system with an improved method for setting the anodes.

While conventional linear anode systems require grooves to be etched onto concrete surfaces in which the anodes are placed, the proposed system installs anodes on the concrete surface without the use of grooves, thereby almost totally eliminating the dust and noise associated with grooves.

In addition, because the structure body surface remains uncovered, any change in conditions other than deterioration by salt damage can be easily detected visually.

Moreover, because anodes are placed inside FRP trays, durability and anode performance have improved.

## Urethane resin and covering system



Various types of heavy-duty covering protection methods have been applied to existing structures. Such methods depend on resins and face environmental or workability issues, such as water pollution or expensive surface preparation.

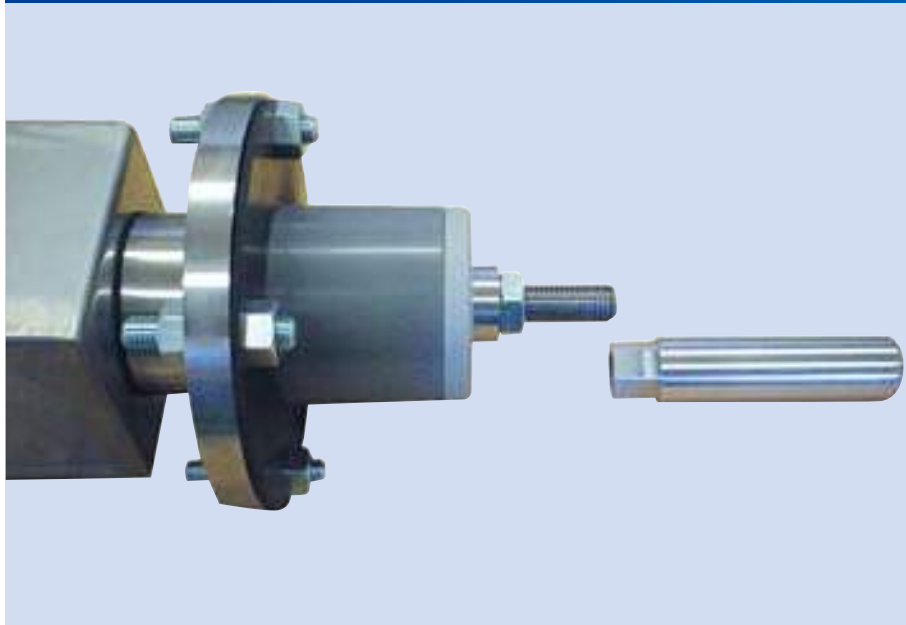
This system that we developed is a super long-term durability coating protection method that uses an insoluble urethane resin as a corrosion prevention layer and a FRP cover as a protection layer.

The method offers environment-friendly long-term corrosion prevention and requires simple even manual surface preparation.



# NAKABOHTEC KEEPS TAKING ON CHALLENGES

## Flange-type platinized titanium electrode



The Pollutant Release and Transfer Register (PRTR) law was revised in 2003. The law reduced the allowed maximum transaction volume of substances from 5 t/year to 1 t/year and required businesses to report the transfer/use/disposal status. Conventionally, lead alloys were used as anodes in the cathodic protection of plant facilities. However, they are one of the subject substances in the PRTR law. The flange-type platinized titanium anode is a new product developed to meet the current environmental requirements. This product satisfies environmental concerns and reduces the life-cycle cost because of the recycling and reuse of the electrode parts.

## “Pockereco” (Portable pocket recorder)



Conventionally, cathodic protection devices for monitoring used analog processors. “Pockereco” was developed to increase the data processing speed and to obtain high-quality results. The operation/process NAPLSIII software was simultaneously developed. The software enables the personnel in the field to transmit electronic data to the office and quickly respond to clients.

**Nakabohtec wishes to conserve the environment  
for the children in the future. Thus,  
we set specific targets and work on conservation activities.**

————— **Nakabohtec Corrosion Protecting Co., Ltd. Basic Environmental Policy** —————

**Principle**

Nakabohtec embraces the slogan, “bridge between materials and environment,” and contributes to the life extension of social capital, such as civil structures, underground structures, machines, and equipment, through cathodic protection, coating protection, and others. While being engaged in such activities, we are fully aware of the environmental impact of our activities. Thus, we at Nakabohtec are strongly committed and engaged in environment conservation.

**Policy**

1. Nakabohtec strives to reduce the environmental load, stop, and prevent pollution in all its business activities.
2. Nakabohtec abides by laws, rules, regulations, acts, and agreements and sets and implements its own targets.
3. Nakabohtec promotes the development and application of environment-friendly technologies and products.
4. Nakabohtec forms organizations and frameworks to promote environmental conservation activities.
5. Nakabohtec informs all employees about the basic environmental policies, makes educational campaigns, and teaches the importance of environmental conservation to raise their awareness level.









**NAKABOHTEC CORROSION PROTECTING CO., LTD.**