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# Dosimetry Systems

Effective and Efficient Dosimetry  
Uniquely Enabled by RPL Technology

## OUR PRODUCTS

- Dose Ace: RPL In-Vivo Dosimetry System for Medical Use
- RPL Dosimetry System for Environmental Monitoring
- RPL Glass Badge Personal Dosimetry System
- TechnoTrak2
- Wide-Range Neutron Pit (WNP) System

Pioneer of RPL Dosimetry

**CHIYODA TECHNOL CORPORATION**



# Chiyoda Technol presents

## Effective and Efficient Dosimetry - Indispensable for Radiation Control in All Fields and for All Occasions

- Innovative top quality radiophotoluminescence (RPL) detectors
- Unparalleled quality RPL Glass Badge dosimeters
- Accuracy far beyond any conventional film, TLD, or OSL dosimeters

We are the only provider of unparalleled top quality Glass Badge and RPL dosimeters

# OUR MISSION

Radiation has two opposite, distinctive, impacts on human beings: harm and benefit. Our mission is to help guarantee the safety of this potentially harmful substance. We have over 60 years' history of developing high quality dosimetry systems and providing dosimetry services for professionals at risk of irradiation. We focus on industries including medicine, pharmaceuticals, biology, engineering, and agriculture. In response to social and environmental needs, we are expanding our service to include daily radiation surveillance for non-professional populations.



The first-generation Glass Badge dosimeter Dosimetry services launched in October, 2000



The current most recent model Services started in December, 2013



Glass furnace



Glass manufacturing



Assembly line

## OUR INNOVATION Glass Badge or RPL Dosimetry

### Principle of Glass Badge or RPL Dosimetry

#### What is radiophotoluminescence (RPL)?

When silver activated phosphate glass is exposed to ionizing radiation, luminescent centers are formed in the glass. When the glass is excited by ultraviolet (UV) rays, it emits orange luminescence. This phenomenon is called radiophotoluminescence or RPL.

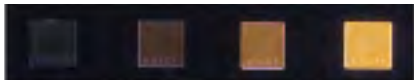
#### Measurement Principle

The luminescent center is stable, with negligible fading. The RPL intensity is proportional to the received dose; therefore, it can be used for dosimetry. In addition, unlike TLD and OSL, the luminescence is not set off with excitation, allowing repeated readouts.

UV OFF



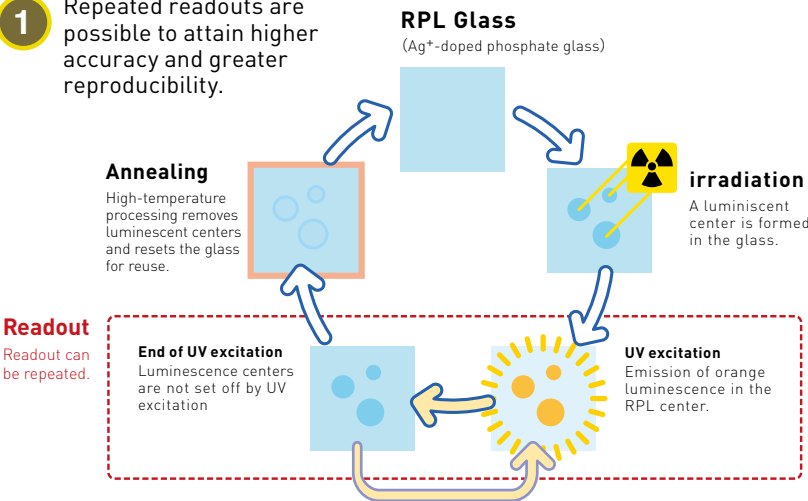
UV ON



0Gy 1Gy 5Gy 20Gy

### Advantages of RPL Glass Badge Dosimeter

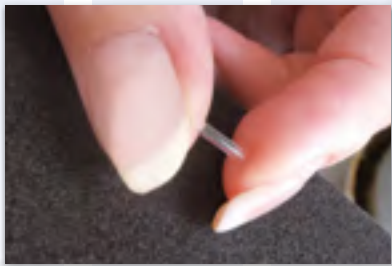
- 1 Repeated readouts are possible to attain higher accuracy and greater reproducibility.



- 2 Sensitivity variation in the glass element is minor, ensuring reliability.

Item
Sensitivity variation between RPL glass pieces from different batches: 0.944%±0.036
Sensitivity variation between RPL glass pieces from the same batch: ±1.31%
Reading variation: -2.7% - +2.5%





# Dose Ace

An extremely miniaturized glass detector provides medical quality dose detection. Dose differences between the target and non-target sites are detected correctly even when the sites are in very close proximity.



Reader (FGD-1000SE)

Controller PC

Components

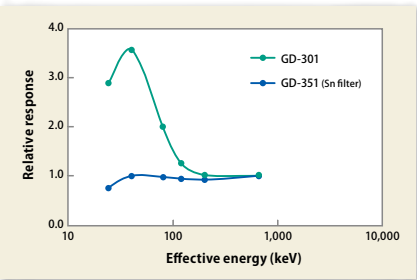
- Glass dosimeter element (detector)
- Reader
- Controller PC

Advantages

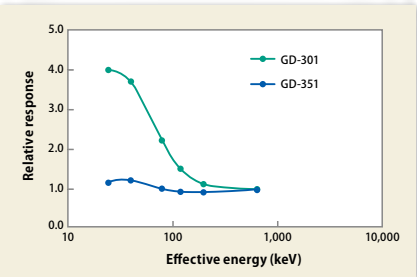
- The high reproducibility of DoseAce has a coefficient of variation of less than 2 percent.
- When the surface of the glass becomes dirty, it can be cleared. you can re-measure the glass element as many times as you want.

- It does not fade under fluorescent light or sun light, so you can handle the glass dosimeter under light and at high temperatures.
- Repeated readouts enhance measurement accuracy.
- Homogeneous composition of PRL glass ensures stable dosimetry.
- Automatic reading system enables immediate readout: up to 20 continuous measurements.

■ Energy dependence to air absorbed dose (free in air)



■ Energy dependence to 1cm dose equivalent (on phantom)



Holder



External view of GLASS Detector: GD-300 SERIES

Real scale



Please refer "Dose Ace" video  
<https://youtu.be/PYLtvX5MZCE>

Optional goods



Water-Proof Holder



Single ID Reader



Annealing Tray Mini (Mini Tray)



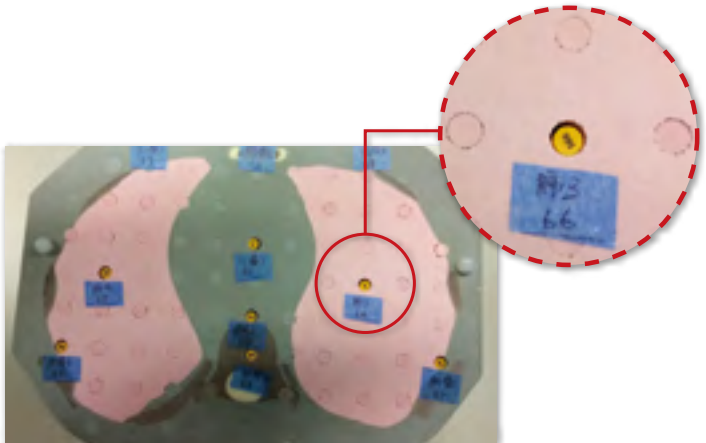
G-Slider

Applications

- Evaluation of phantom dose distribution for radiotherapy and diagnostic imaging
- Small size animal irradiation tests
- Quality assurance of photon (gamma ray and X-ray) irradiation

Users

- Radiology departments
- Phantom simulation institutions
- Animal irradiation laboratories
- Universities
- National Research Institutes



Dose Ace detector in the phantom

Specifications

Glass Dosimeter element (detector)	Model & glass detector dimensions	GD-301	φ1.5×8.5 mm
		GD-302M	φ1.5×12 mm (with ID)
		GD-351	φ1.5×8.5 mm (with filter)
		GD-352M	φ1.5×12 mm (with ID and filter)
Reader	Measuring range	Photon (gamma ray & X-ray) 10 μGy (Sv) to 10 Gy (Sv) [to 100 Gy (Sv) by option] 500 Gy (as a ref.level)	
	Model	FGD-1000SE	
	Display value unit	Gy (Sv)	
	Display value range	1μGy (Sv) to 10 Gy (Sv) [to 500 Gy (Sv) by option]	
	Reproducibility	Coefficient of variation	5% or less (at 100 μGy) 2% or less (at 1 mGy)
	Continuous reading	20 glass detectors	
	Read-out time	6 seconds or less / element	
	Calibration technique	Dose calibration is automatically performed with the standard irradiation glass element and the sensitivity calibration with the internal calibration glass element.	
	Power supply	100, 115, 220 & 240 AC (50/60Hz)	
	Power consumption	Max. 200 W	

Note: Specifications are subject to change without notice for improvement.



Detector

# RPL Environmental Dosimetry System

Our environmental monitoring system features a wide RPL glass surface to support an extensive range of radiation levels of gamma rays, X-rays, and synchrotron radiation.



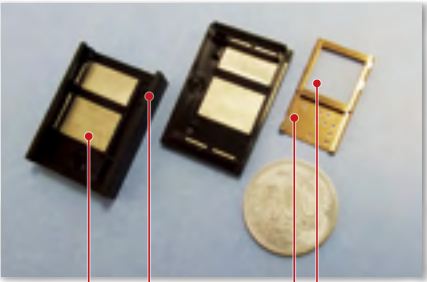
Reader (FGD-202)

Controller PC

Components

- Glass dosimeter element (detector)
- Reader
- Controller PC

Structure of SC-1 Detector

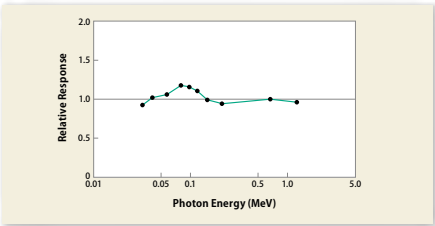


Advantages

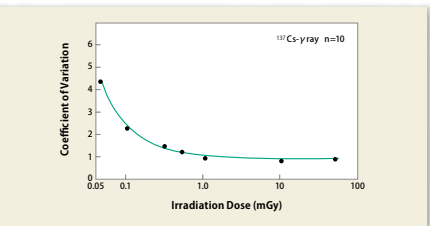
- The wide surface of our RPL glass provides accurate measurements of low to high dose ranges.
- Repeated readouts enhance measurement accuracy.
- Sensitivity variation in the glass element is minor, ensuring reliability.
- Homogeneous composition of PRL glass ensures stable dosimetry.
- RPL glass is resistant to dust and sunlight, providing minimum fading.
- Automated readout process facilitates operation.

Performance

■ Energy Dependency



■ Sensitivity Variation



Applications

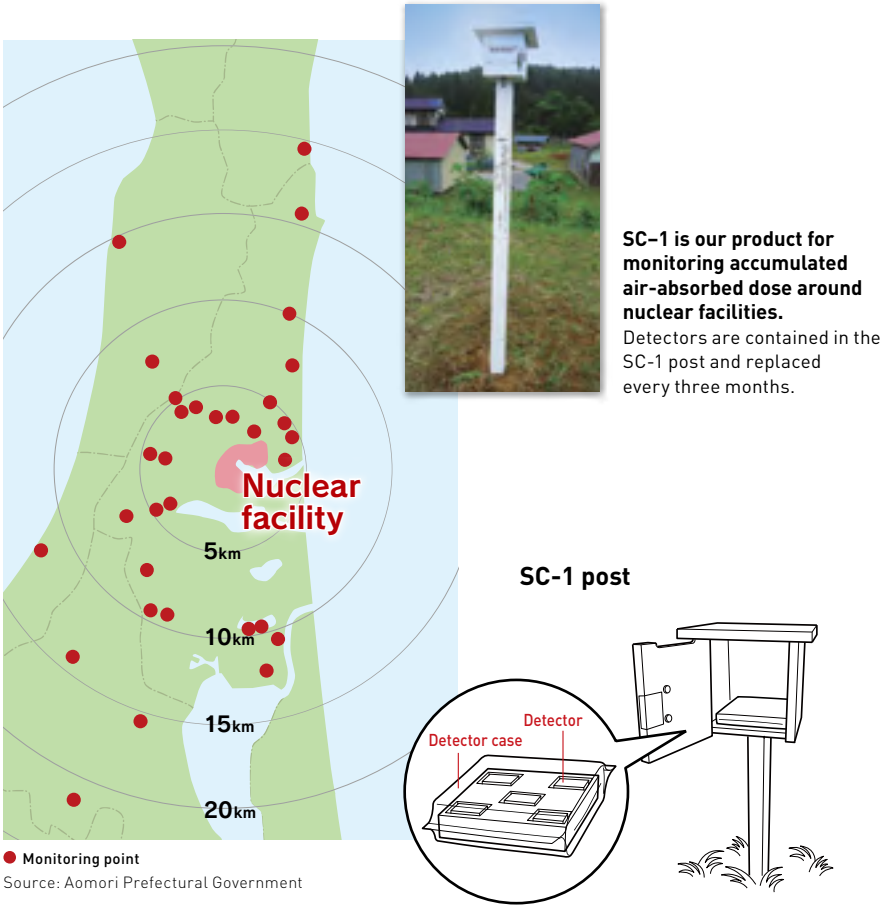
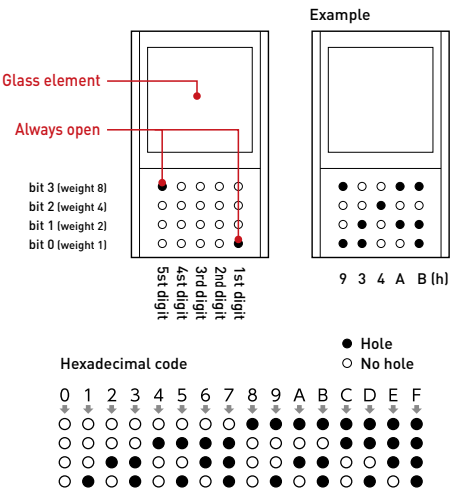
- Gamma-ray monitoring around nuclear power plants.
- Environmental monitoring for healthcare X-ray, radioisotope, or other facilities.
- Air-absorbed dose monitoring on the border of controlled areas

Users

- Nuclear facilities
- Radiology department
- Research institute etc.

Diagram of detector ID control code system

The card number of SC-1 is expressed by a hexadecimal number. A glass card has the hole where the card number was expressed by a binary number. This is called "holecord".



SC-1 is our product for monitoring accumulated air-absorbed dose around nuclear facilities. Detectors are contained in the SC-1 post and replaced every three months.

Specifications

Dosimeter element	Model	SC-1	
	Measuring Range	Photon : 30 keV to 3 MeV 10 μGy to 10 Gy (10 μSv to 10 Sv)	
	Sensitivity Variation	Cv 4.5% or less (Cs-γ 200μGy)	
	Energy Dependency	Within±20 % (32 keV to 1.25 MeV)	
	Dimension	30×40×9 mm	
	Weight	Approx. 15 g	
Reader	Model	FGD-201 / FGD-202 (* with energy estimation system)	
	Indication Range	1 μGy to 10 Gy (1 μSv to 10 Sv)	
	Reading Reproducibility	Cv	5% or less (Cs-γ 0.1 mGy)
			2% or less (Cs-γ 1 mGy)
			1% or less (Cs-γ 10 mGy)
	ID Reading	Automatic	Capsule ID : 8 digits (barcode) Card No. : 20 bits (holecode)
	Readout Time	10 seconds or less / 1 detector	
	Continuous Reading	20 dosimeters	
	Calibration	Dose calibration using standard irradiated glass Automatic correction by internal calibration glass	
	Data Storage Capacity	50,000 data	
	Indicated Items	Dosimeter I D, Element I D, Date and Time, Initial reading, Cumulative (period) value, Parameters, Error messages	
	Dimension (Main Unit)	400(W)×570(D)×415(H) mm	
	Weight (Main Unit)	Approx. 35 kg	

Note: Specifications are subject to change without notice for improvement.





# Personal Dosimetry System

Institut de Radioprotection de Sûreté Nucléaire (IRSN) is providing Dose Monitoring Service in Europe using our products. Our accumulated Know-how is available through the French Institute. Chiyoda Technol also helps you to consult your needs and provides Individual Dosimetry System. Please contact us.

Chiyoda collaborates with the French Institut de Radioprotection et de Sûreté Nucléaire (IRSN) to globally proliferate our RPL technology.

Site  
e.g. Hospital and / or department name

Distribution unit code

User's name

Colour code showing period of wear

Period of wear

ID number of the badge

Real scale



RPL Dosimeter is the flagship among our products, resulting from our long years' research and experience.

Chiyoda Technol has been engaging in Individual dose monitoring business since 1954. At present, we operate the service with a total number of 4 million units in Japan.

## Technical Benefits

- Proven European-scale performance recognized by the major European laboratories that choose the institute's dosimeter (see intercomparison results)
- Recording threshold: 0.05 mSv
- Less than one percent of fading over a period of 12 months

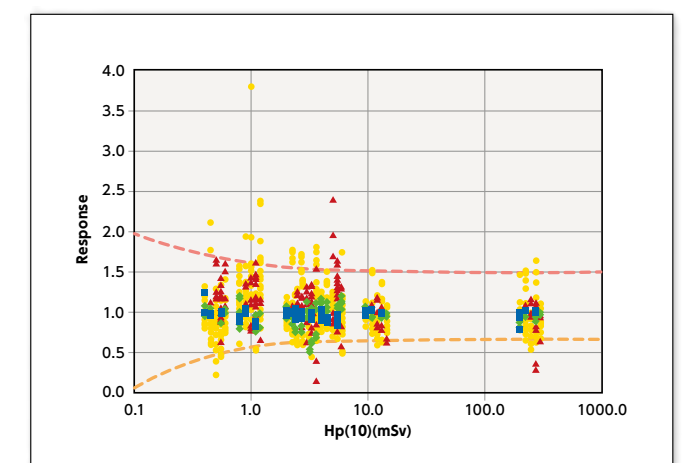
## Specifications

	Detected energy range (A)	Dose range (B)
Photon (X,y)	From 16 keV to 6.6 MeV	From 0.05 mSv to 10 Sv
Beta	From 100 keV to 3 MeV	From 0.05 mSv to 10 Sv

(A) These values are not operating limits but correspond to the minimum and maximum energies available in the reference facilities that conducted the tests.  
(B) In laboratory conditions, the detection limit is a few  $\mu$ Sv only.

## EURADOS INTERCOMPARISON 2010

RPL (in blue) is one of the rare technologies to pass all the tests with non-compliance. Ref: EURADOS Report 2015-1



--- Upper Limit  
--- Lower Limit

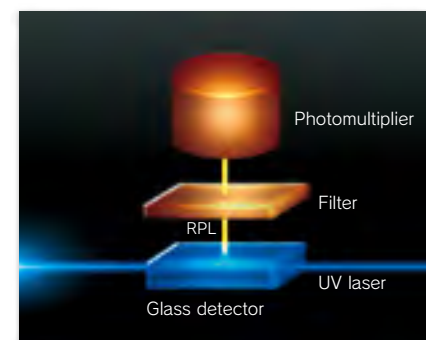
● TLD  
▲ Film  
◆ OSL  
■ Other



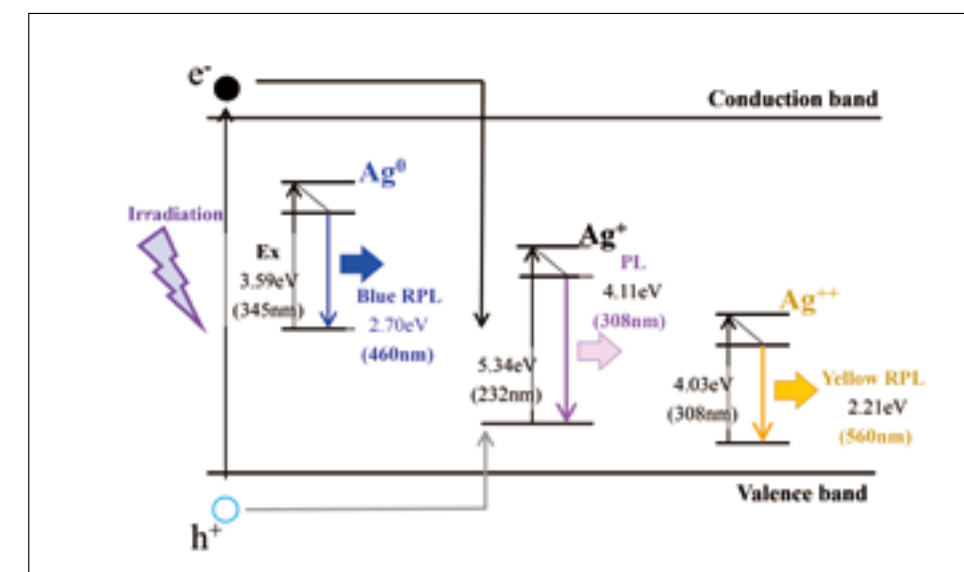
Reader (FGD-660)

## Automatic Reader FGD-660

RPL is the only dosimeter with non-destructive reading center that is able to routinely take 50 measurement points per dosimeter which can be read repeatedly without fading. We associated it with RPL Dosimetry Reader (FGD-660), the read-out system for glass detector, using solid-state (UV) laser that is capable to drive continuous pulses to the ultra violet excitation source.



## RPL emission model of Ag<sup>+</sup>-doped phosphate glass.



The composition of luminescence of silver doped glass has been clarified by recent research. Please refer to: Y. Miyamoto et al. Radiophotoluminescence from silver-doped phosphate glass, Radiation Measurement 46: 1480-1483, 2011



# TechnoTrak2

The TechnoTrak series are made from poly allyl diglycol carbonate (PADC). Our dosimetry service by using TechnoTrak1 (TT1) with pre-soaking\*<sup>1)</sup> technique complies with ISO21909-1 requirements. TechnoTrak2 (TT2) provides the same performance with TT1, but without the need of pre-soaking. Furthermore, TT2's performance is the best without pre-soaking process.\*<sup>2)</sup>

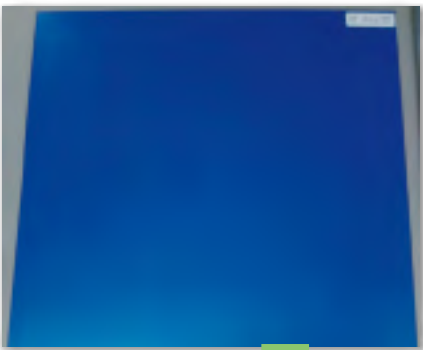
\*<sup>1)</sup> Ohguchi, H., Oda, K., Yamauchi, T., Nakamura, T. and Maki, D. New pre-soaking technique for PADC and application to wide-range personal neutron dosimeter. Radiat. Meas. 43, S500-S503 (2008).

\*<sup>2)</sup> Assenmacher, F., Boschung, M., Hohmann, E. and Mayer, S. Comparison of different PADC materials and etching conditions for fast neutron dosimetry. Radiat. Prot. Dosim. 170(1-4), 162-167 (2016).

Easy preparation.  
TT2 has high surface quality and stays constant, so that pretreatment such as pre-etching is not required.



TT2 is delivered with original aluminium bag in order to maintain quality.



TT2 with protect filter



Customized cutting available

Unique ID codes can be printed upon your request.



Example of 2D ID code



Example of binary ID code

In our radiation monitoring center

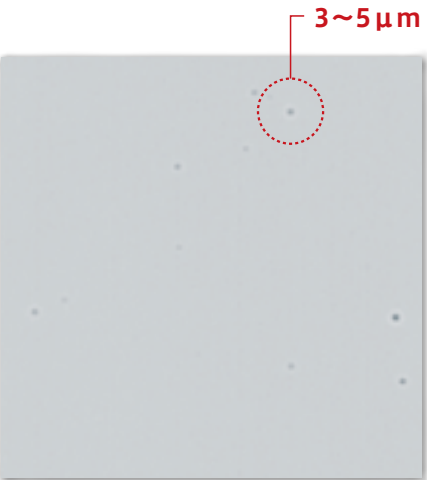
Our dosimeter "Glass Badge" is composed with polyethylene radiator and boron nitride converter. Our dosimetry service with unique processing and measurement methods meets with ISO21909-1 requirements.



TechnoTrak1 in our RPL dosimeter (Glass Badge)

The performance of TechnoTrak2, Solid State Nuclear Trak Detector

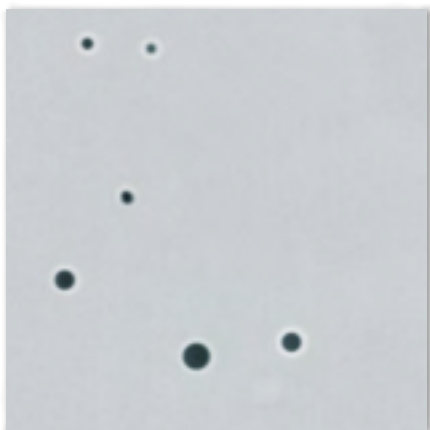
TT2 is developed to be used as a Solid-State Track Detector. This device detects an accumulated neutron dose. The TT2 provides highly sensitive detections of neutron with low back ground noise.



144 keV



250 keV



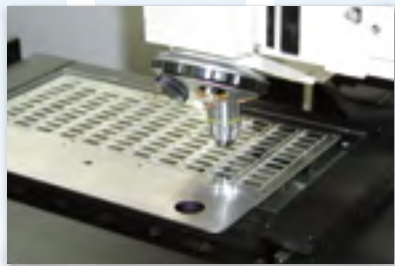
<sup>252</sup>Cf

Etching condition: 30 wt% KOH, 90°C, 2.5h

## Specifications

TechnoTrak2	Sheet size	280 x 280 mm / sheet
	Thickness	0.8 mm, 1.25 mm
	Detector size	Customize cutting available
	ID engraving	digital numbers and various type of ID code is available

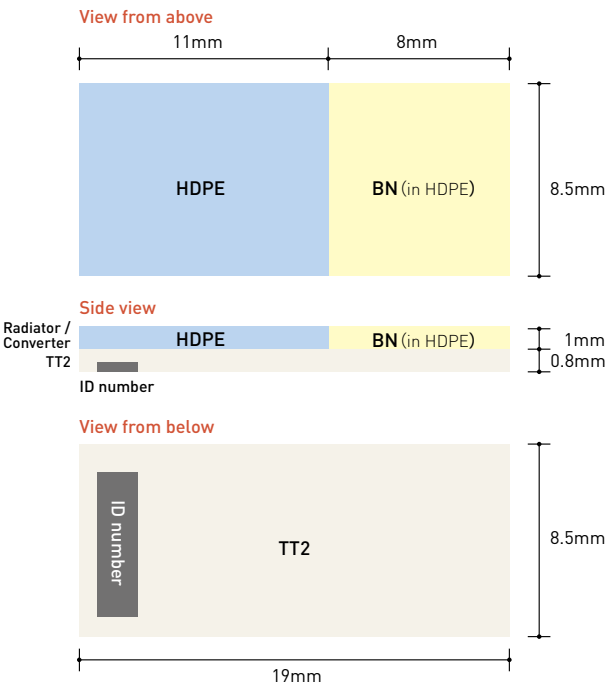




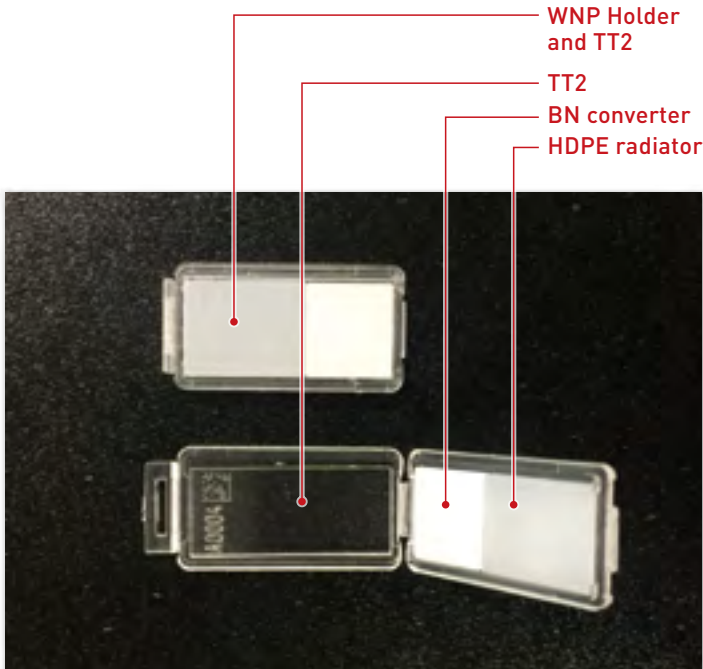
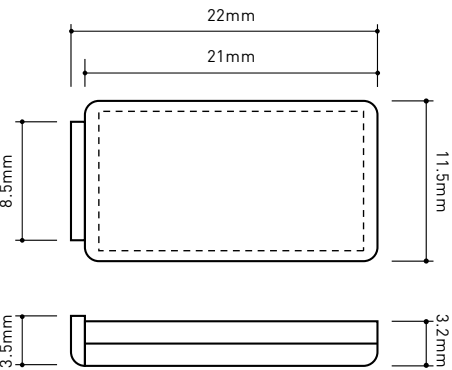
# Wide-range Neutron Pit (WNP) System

Wide-range Neutron Pit (WNP) is our original neutron dosimeter system. The dosimeter consists of TechnoTrak2 (TT2) detector and WNP holder. Two kinds of filters, radiator and converter are built into WNP holder, and enable to measure wide-range energy of neutron, namely fast to thermal neutrons. High Density Poly Ethylene (HDPE) and Boron Nitride (BN) are used for the radiator and converter, respectively. In addition, we suggest the efficient etching method and high accuracy microscope reader. The WNP System was developed based on CTC dosimetry service which meets ISO 21909-1.

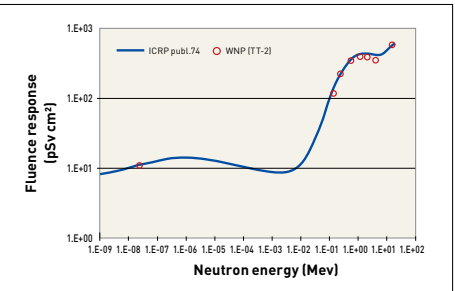
## Structure of WNP holder



## Size of WNP holder



## Excellent energy characteristic



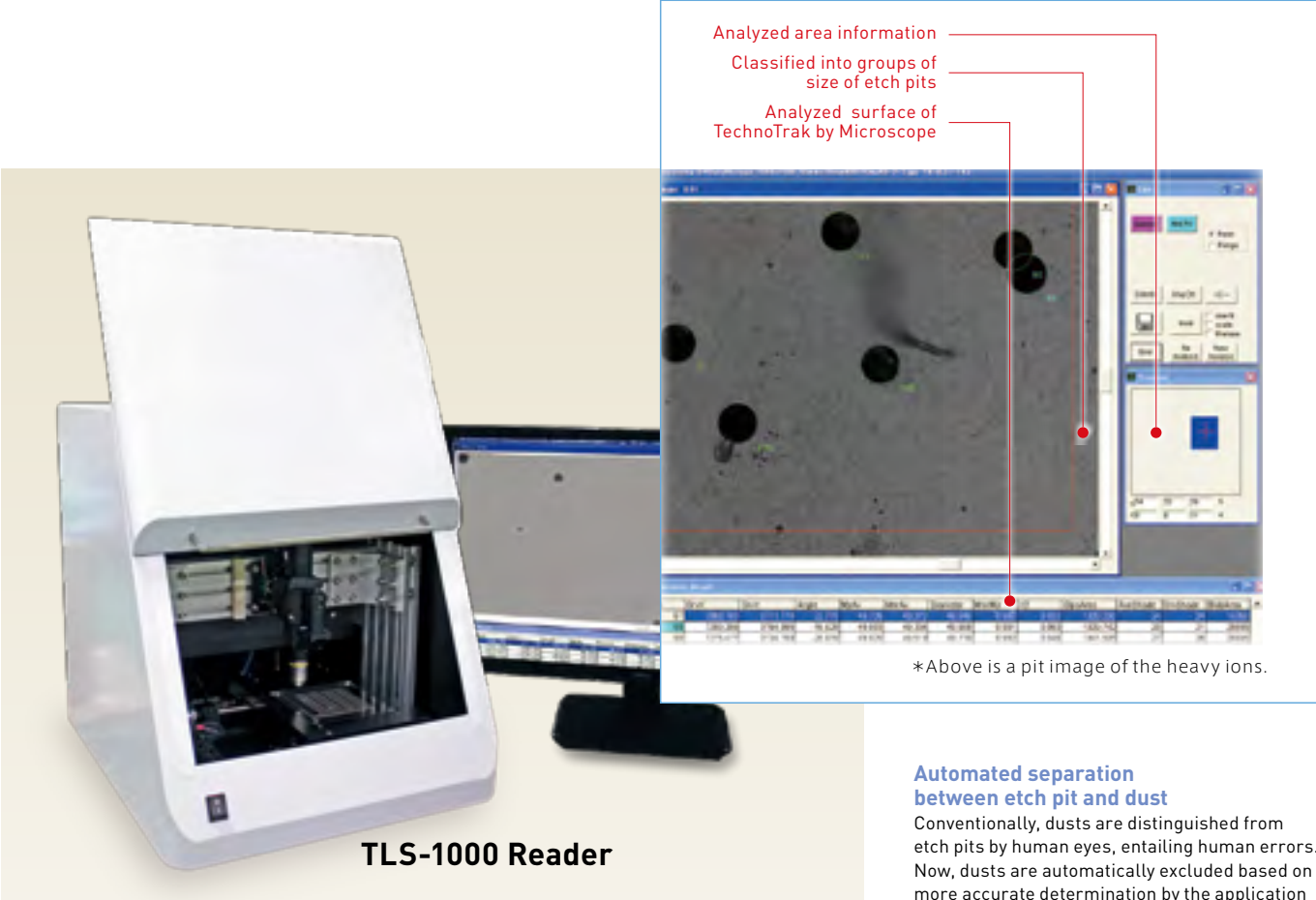
Energy characteristics of WNP

## Products

- TechnoTrak2/WNP holder
- Reader (Microscope): TLS-1000
- Etching kit (optional)

## Applications

- Personal dosimeter



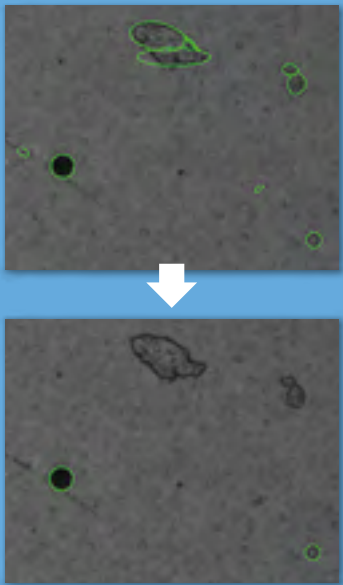
## Specifications

Dosimeter	Detector	TechnoTrak2 (TT2) 360 detectors/sheet
		8.5 mm x 19 mm with ID number
	Holder	WNP Holder
		Radiator: High Density Poly Ethylene (HDPE)
		Converter: Boron Nitride (BN)
		Size: W11.5 x D22 x H3.5 mm (see drawing left)
Reader	Energy range	Neutron: 0.025 eV to 15 MeV
	Dose range	Fast neutron: 0.1 mSv to 60 mSv
		Thermal neutron: 0.1 mSv to 8 mSv
	Neutron sensitivity ( <sup>241</sup> Am-Be)	1240 ± 30(1σ) etch-pits/cm <sup>2</sup> /mSv (with HDPE)
	Background noise	20 ± 20(1σ) etch-pits/cm <sup>2</sup>
	ID	1 alphabet and 4 digits number
	Dissolution	0.550 μm/pixel
	Viewing field	1.268 mm <sup>2</sup> (1.126 mm x 1.126 mm)
	Auto focus	Contrast mode/Surface detection mode
	ID reading	Automatic ID recognition unit
	Readout time	It can measure 100 TT2 detectors within 2 hours successively.
	Continuous reading	100 detectors
	Analysis function	PitFit2 can present the distribution chart of pit.
	Power supply	200 V, Power Consumption 500 VA or less
	Power consumption	Max. 500 W
	Dimensions/weight (excluding PC unit)	W660 x D610 x H600 mm, 60 kg
	Imaging	Multi-layer imaging: Automatical recognition of adhered dusts in the image

## Automated separation between etch pit and dust

Conventionally, dusts are distinguished from etch pits by human eyes, entailing human errors. Now, dusts are automatically excluded based on more accurate determination by the application algorithm.

## Automatically eliminate the adhered dust



# We endeavor to ensure radiation safety and draw only advantages from radiation.

Chiyoda Technol Corporation is the pioneer of radiation protection and established the first radiation monitoring service using film badges in Japan in 1954. In 2000, we successfully switched from film to glass and set up the first large-scale monitoring service using glass dosimeters in the world. Eight years later, our glass dosimeter monitoring system was introduced into the monitoring service of the Institut de Radioprotection et de Sûreté Nucléaire, France, which is one of the most authoritative radiological research institutions in Europe. This is proof of the excellent quality of our products.

## Our main business

### Personal Dose Monitoring Service (Radiation Monitoring Center)

- We process over 380,000 RPL dosimeters called "Glass Badges" monthly

### Nuclear Power Plant Support Service

- Radiation measurement system
- Protective equipment
- Environmental monitoring system
- Survey meters
- Electric personal dosimeters
- Nuclear Waste related products

### Supply of and Services

- Manufacture and deliver radiation sources for industrial and medical use
- import radiation sources

### Support and Control of Radioisotope Utilization

- Consulting, design and construction services for RI facilities
- Environmental monitoring services

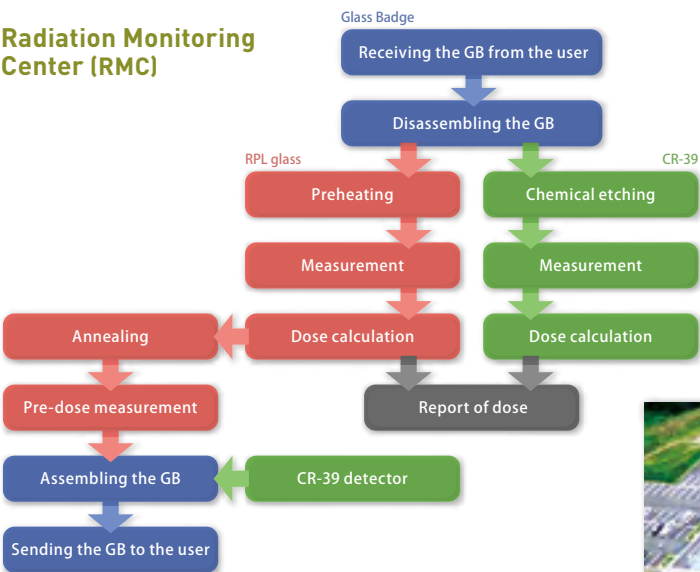
### Supply of Medical Equipment

- Radiotherapy equipment and QA products

### Research and Development (Oarai Research Center)

- R&D of personal dosimeters
- Calibration service for radiation meters

## Radiation Monitoring Center (RMC)

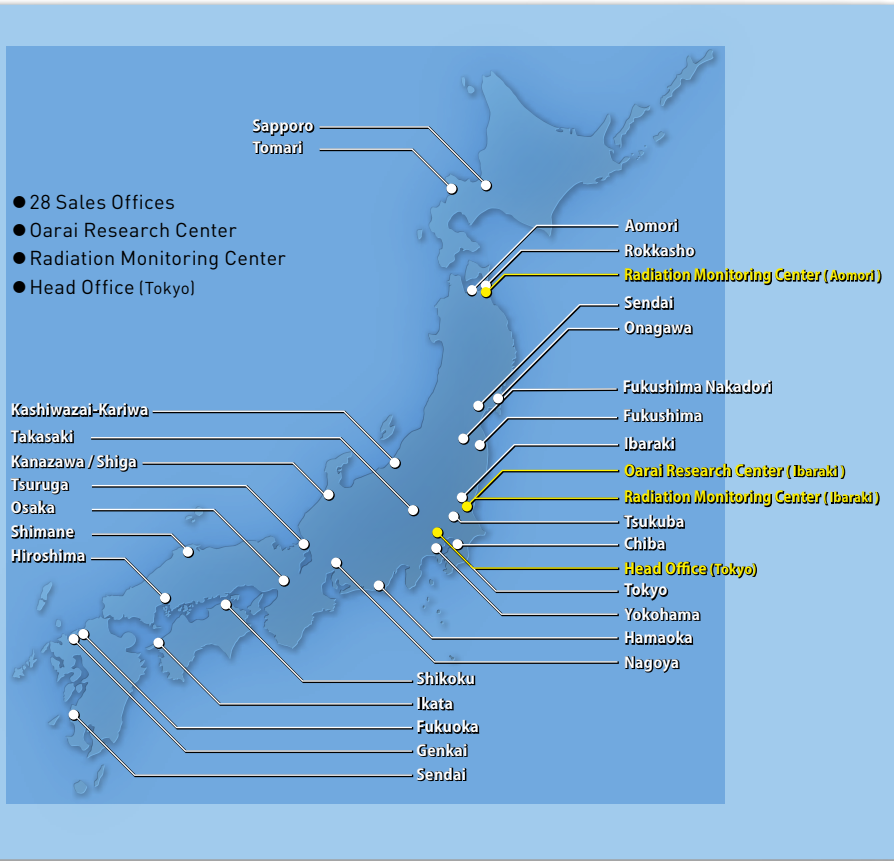


Glass Badge monitoring service process flow in RMC

## Head Office



## Our Locations



RMC process line (Main room)



Radiation Monitoring Center (Aomori)



Radiation Monitoring Center (Ibaraki)



## Oarai Research Center

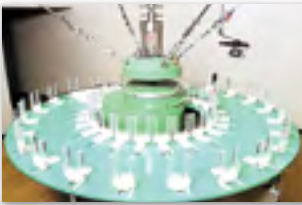
Oarai Laboratory is an accredited calibration laboratory with ILAC-MRA. Our laboratory is authorized to issue a Japan Calibration Service System (JCSS) certificate that confirms the laboratory's measurements meet national measurement standards.



Collimated gamma-ray irradiator



Oarai Research Center



Panoramic γ-ray irradiator

We design, develop, and supply original irradiation equipment.

## Associate Companies

Technol Support System Corporation  
Technol Aomori Corporation  
A Atom Technol Kindai, K.K.  
SRS Technol Co. Ltd. (Korea)  
Onukidai Kosan

## Annual sales

\$282.37 million (year ending June 2016)  
\$231.62 million (year ending June 2017)  
\$275.30 million (year ending June 2018)

## Company Profile

Company name :  
Chiyoda Technol Corporation

President :  
Toshikazu Hosoda

Foundation :  
May 1, 1956

Establishment :  
June 12, 1958

Capital :  
90,000,000 yen

Number of employees :  
689 (as of 30 July, 2019)

Headquarters :  
1-7-12 Yushima, Bunkyo-ku,  
Tokyo 113-8681, Japan

Website :  
<http://www.c-technol.co.jp/eng>