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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
- TechnoTrak 2 / Wide Range Neupit  
PADC Plastic Solid State Track Detector
- D-Shuttle: Gamma-ray Dosimeter  
for the General Public

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 50 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



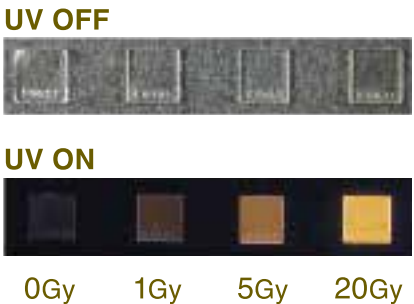
Assembly line

## OUR INNOVATION Glass Badge or RPL Dosimetry

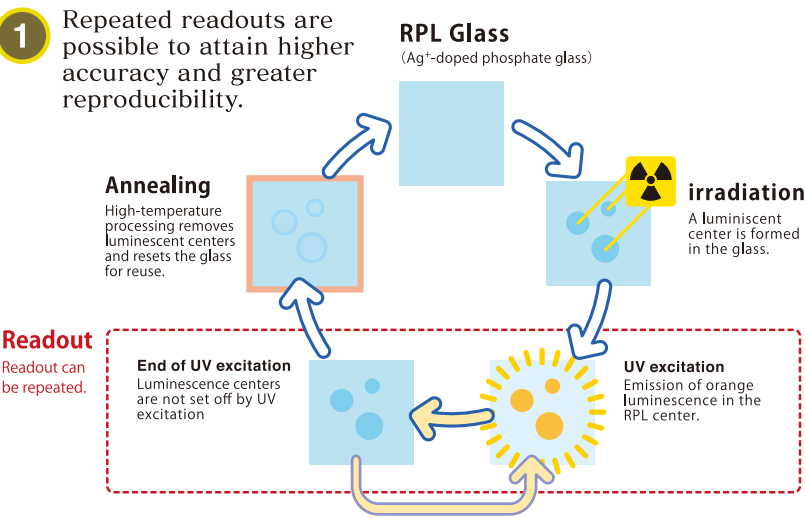
### Principle of Glass Badge or RPL Dosimetry

**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.



### Advantages of RPL Glass Badge Dosimeter



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

Item
Sensitivity variation between RPL glass pieces from different batches: $0.944\% \pm 0.036$
Sensitivity variation between RPL glass pieces from the same batch: $\pm 1.31\%$
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

Controller PC



Reader (top opened)



Holder



External view of GLASS Detector:  
GD-300 SERIES

Real scale

### Components

- 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.
- 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.



Setting the magazine in the reader



Magazine and glass detector



Read the numbers



Annealing Tray Mini (Mini Tray)



G-Slider



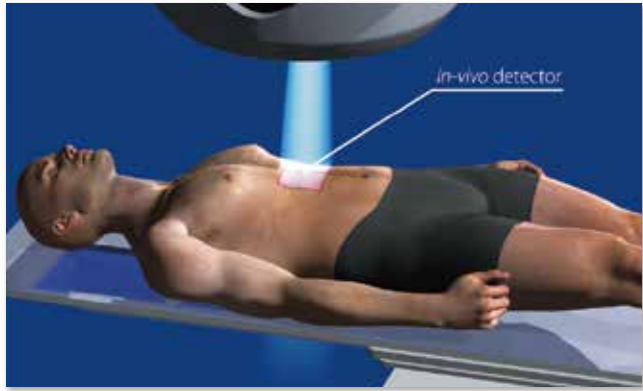
Water-Proof Holder

### 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



Image

### Specifications

Dosimeter element	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 (FGD-1000SE)	Measuring range	Photon (gamma ray & X-ray) 10 μGy (Sv) to 10 Gy (Sv) [to 500 Gy (Sv) by option]	
	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.



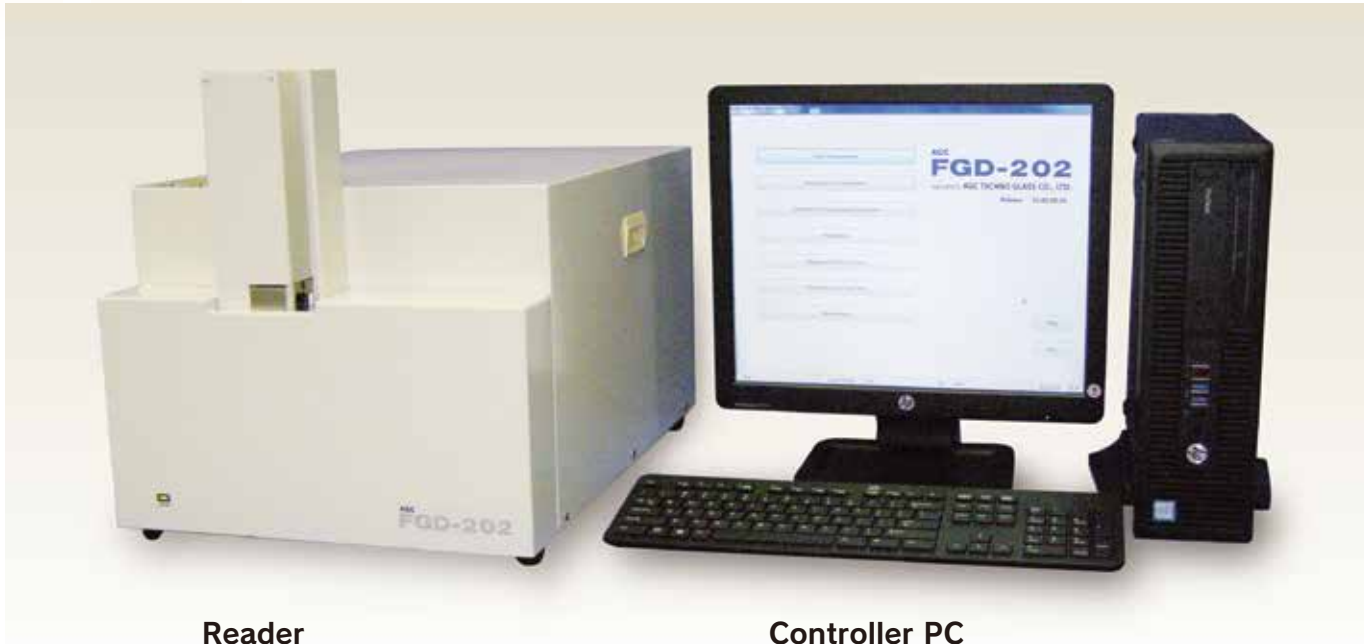
Please refer "Dose Ace" video  
<https://youtu.be/PYLtvX5MZCE>



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.



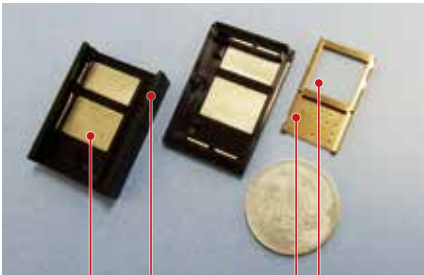
Reader

Controller PC

## Components

- Detector
- Reader
- Controller PC

## Structure of SC-1 Detector

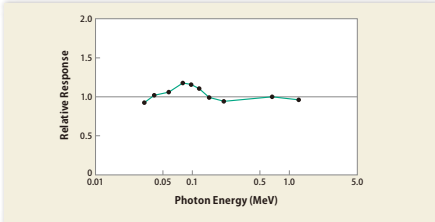


## Advantages

- 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



## Applications

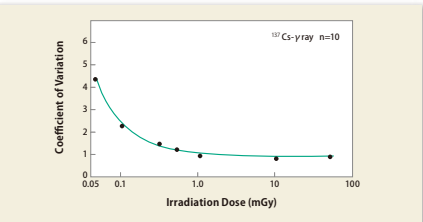
- Gamma-ray monitoring around nuclear power plants,
- Environmental monitoring for healthcare X-ray, radioisotope, or other facilities.
- Air-absorbed dose monitoring on the border of controlled areas
- Personal dose monitoring\*

## Users

- Nuclear facilities
- Radiology department
- Personnel\*

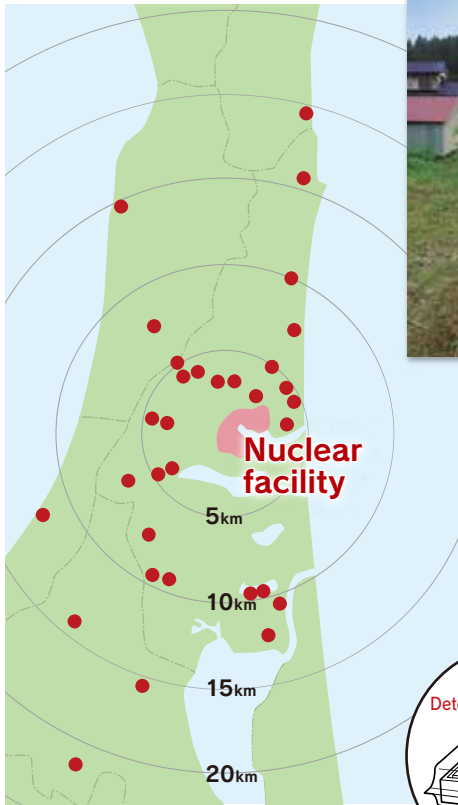
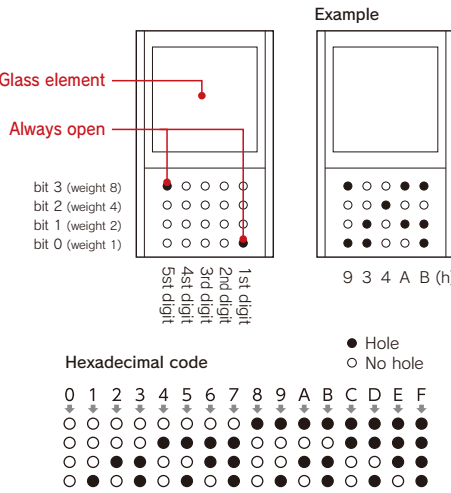
\* Another calibration is required.

### Sensitivity Variation



## 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".

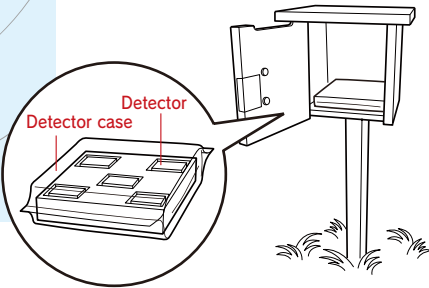


● Monitoring point  
Source: Aomori Prefectural Government



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.

SC-1 post



## Specifications

Dosimeter element	Model	SC-1
Measuring Range	Photon : 30 keV to 3 MeV 10 $\mu$ Gy to 10 Gy (10 $\mu$ Sv to 10 Sv)	
Sensitivity Variation	Cv 4.5% or less (Cs- $\gamma$ 200 $\mu$ Gy)	
Energy Dependency	Within $\pm 20$ % (32 keV to 1.25 MeV)	
Dimension	30 $\times$ 40 $\times$ 9 mm	
Weight	Approx. 15 g	
Reader	Model	FGD-201 / FGD-202 (* with energy estimation system)
Indication Range	1 $\mu$ Gy to 10 Gy (1 $\mu$ Sv to 10 Sv)	
Reading Reproducibility	Cv	5% or less (Cs- $\gamma$ 0.1 mGy) 2% or less (Cs- $\gamma$ 1 mGy) 1% or less (Cs- $\gamma$ 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) $\times$ 570(D) $\times$ 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 Personal 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 personal 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

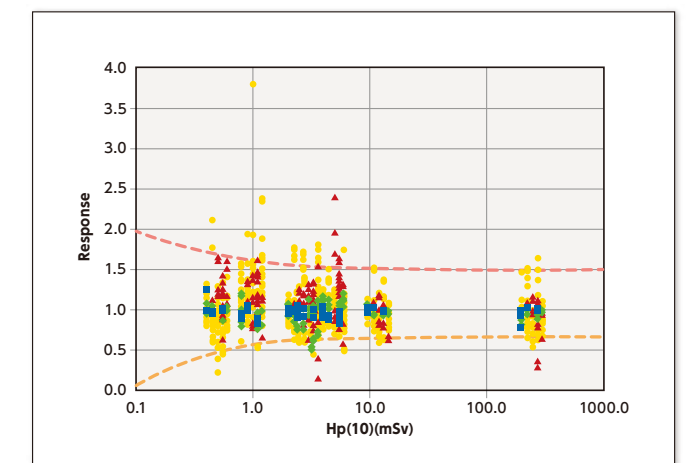
## Specifications

	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



A container has a capacity of 20 trays.



Glass detector on the tray



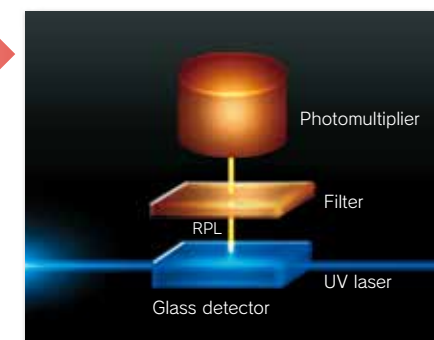
Container



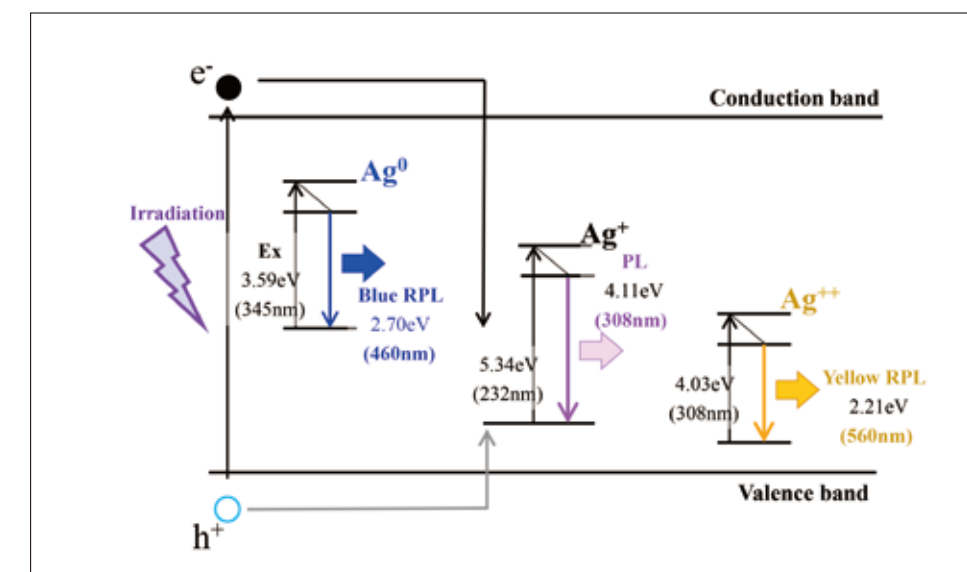
Automatic Reader FGD-660

## Automatic Reader FGD-660

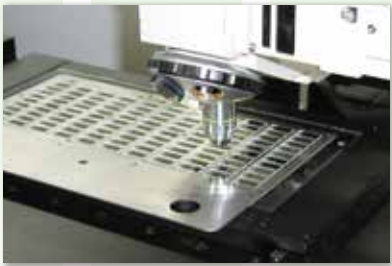
RPL is the only dosimeter with non-destructive reading center that is able to routinely take 50 measurement points per dosimeter which can be read repeatedly without fading. We associated it with RPL Dosimetry Reader (FGD-660), the read-out system for glass detector, using solid-state (UV) laser that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



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



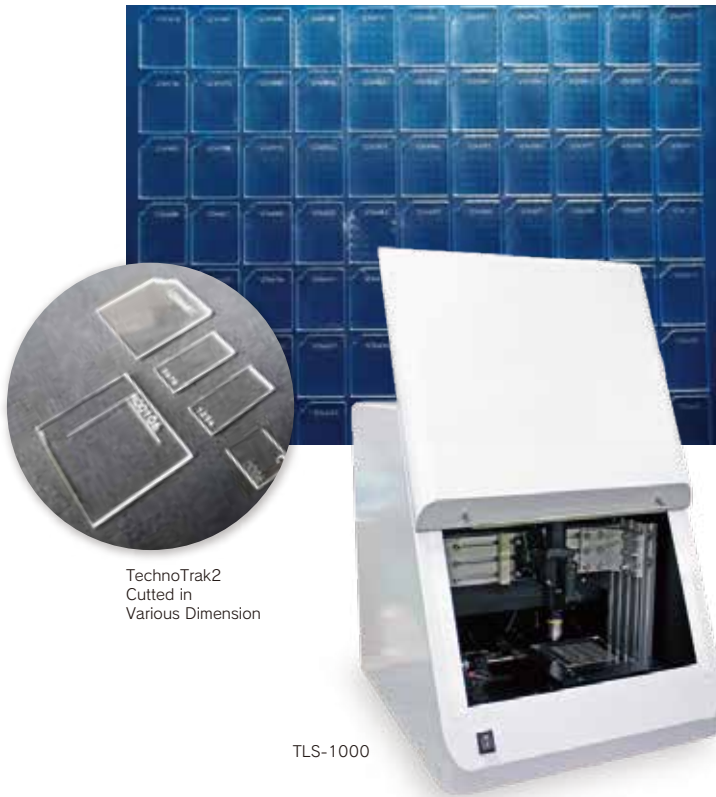
The composition of luminescence of silver doped glass has been clarified by recent research. Please refer to: Y. Miyamoto et al. Radiophotoluminescence from silver-doped phosphate glass, Radiation Measurement 46: 1480-1483, 2011



# TechnoTrak 2 and WIDE RANGE NEUPIT

TechnoTrak 2 (TT2) is our newly developed high-performance neutron-detecting plastic element made from poly allyl di-glycol carbonate (PADC). It is based on our unparalleled success in the control of false pits. WIDE RANGE NEUPIT is our original detector system that uses TT2 with two different types of filter in a dedicated plastic case to allow measurement of a wider neutron energy range.

We offer the TT2 element only or the whole WIDE RANGE NEUPIT. Please contact us for details.



TechnoTrak2  
Cutted in  
Various Dimension

TLS-1000



TT2 with protect filter  
Size: 280 x 280 mm / sheet  
Thickness: 0.8, 1.25, and 1.6 mm  
Custom cutting available.

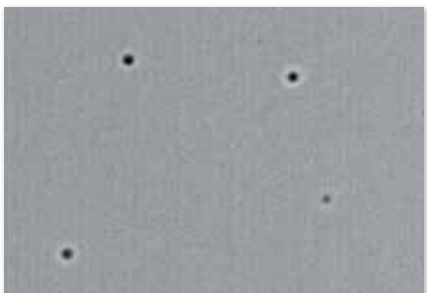
## Products

- Detector: TechnoTrak 2 (TT2)
- Dosimeter: WIDE RANGE NEUPIT
- Neutron Track Microscope System: TLS-1000

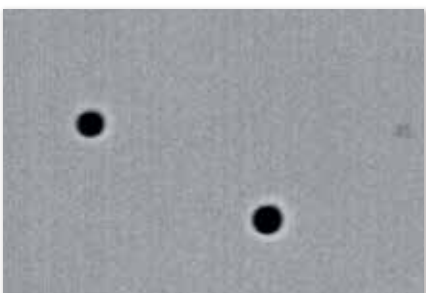
## Features

### TechnoTrak 2

- Supports neutrons, radons, cosmic rays, and others
- Extremely low background (false pits),
  - The average number of false pits is smaller than 100 / cm<sup>2</sup>
- Excellent fading characteristics
- Low cost measurement
  - Rapid chemical etching in high temperatures and easy-to-count round shape etch pits significantly reduce measurement cost.

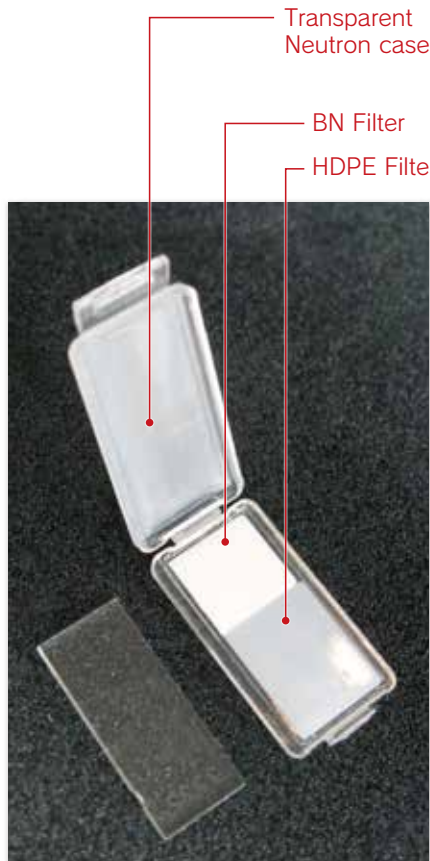
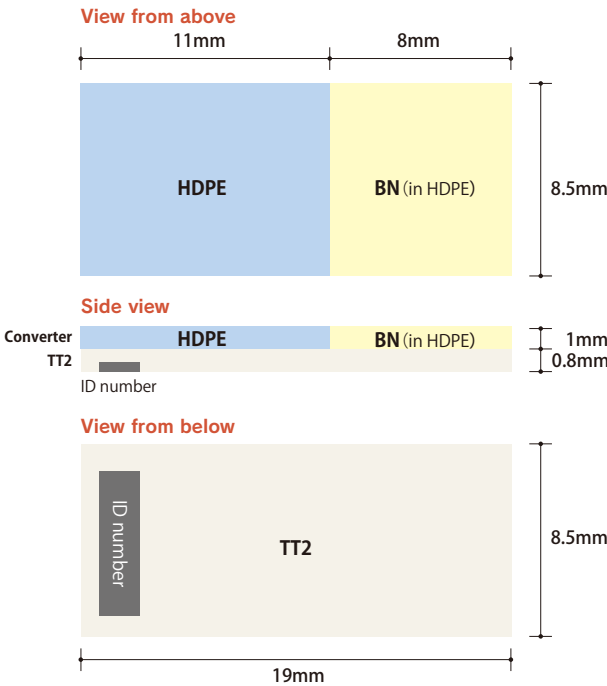


144 keV neutron



565 keV neutron

## Structure of WNP



Transparent neutron case (Reusable)

## Features

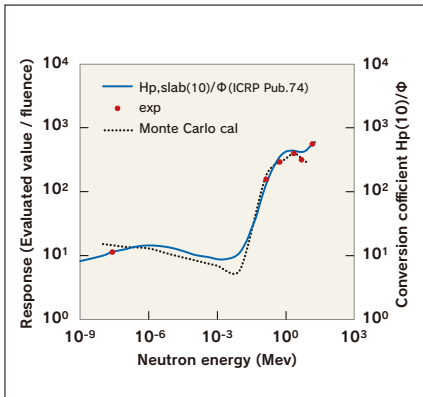
### WIDE RANGE NEUPIT

- Excellent sensitivity to neutrons
  - Combination of two different elements types in our unique transparent case permits continuous measurement of neutrons from 0.025 eV to 15 MeV.
- Excellent energy characteristics
  - Repeated experiments to adjust the focus point and pit dimension have resulted excellent energy characteristics.
- High speed automatic counting system
  - Our image analysis system measures 100 pieces of TT2 detector simultaneously.

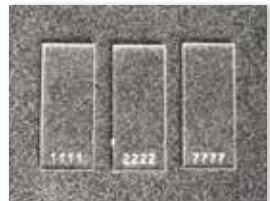
## Applications

- Personal dosimeter
- Treatment rooms using accelerator

## Excellent energy characteristic



Energy characteristics of WNP



TT2 element (3 pcs)



Transparent neutron case (closed)

## Specifications

Measurement energy range	0.025 eV-15 MeV
Reporting dose range	Fast neutron: 0.1 mSv – 60 mSv Thermal neutron: 0.1 mSv- 8 mSv
Environment	-10 °C-40 °C, 95% RH

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

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

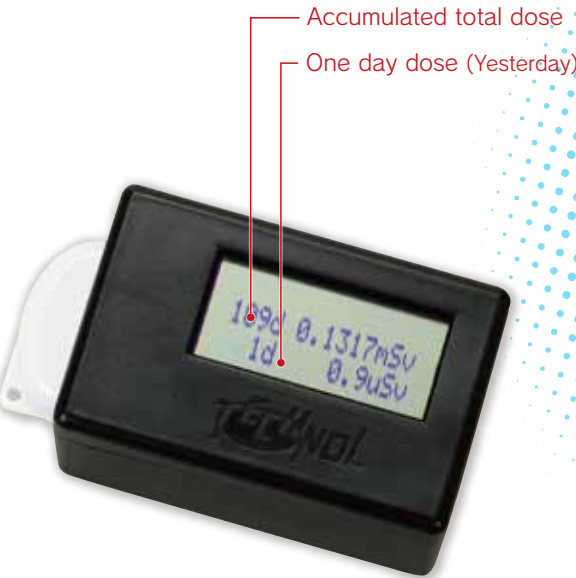


Gamma-ray dosimeter for the general public



# D-Shuttle

This compact personal dosimeter was developed for people around the Fukushima Nuclear Power Plant after the accident on March 11, 2011 caused by the Great East Japan Earthquake and Tsunami. Chiyoda Technol has collaborated with the National Institute of Advanced Industrial Science and Technology (AIST) to develop an accessible dosimeter for those who remained in the surrounding area and were at risk of radiation. The dosimeter is light, compact, and easy to carry to check daily accumulated dose and the previous day's dose. A dedicated workstation displays the dose graphically for easy comprehension.



Handy Indicator



**D-Shuttle Dosimeter**  
68 mm x 32 mm x 14 mm / 23 g



Effective Workstation

### Components

- Detector unit
- Indicator
- Workstation

### Features

- Light-weight and compact, easy to carry for gamma ray detection
- Dose level easily checked by user
- Hourly data displayed graphically on the PC, showing times when the user received high doses.
- Long battery life—one year continuous operation with two readouts per day.
- Annual inspection, calibration, and battery change services are available by Chiyoda Technol (additional charge)



Monitor sample

### Applications

- Residents in areas at risk of radiation
- Personnel in radiation test facilities
- Environmental monitoring after dedicated calibration
- International comparison of daily dose, decontamination control, etc.



Collaborated with National Institute of Advanced Science (AIST)



D-shuttle in the dedicated neck pouch

### Specifications

Personal cumulative dosimeter (D-shuttle main unit)	Scope of radiation	Gamma ray
	Calibration	<sup>137</sup> Cs gamma ray
	Detector	Semiconductor
	Erroneous detection prevention function	Equipped with erroneous detection prevention function using shock sensor
	Measurement range	0.1 μSv to 99.9999 mSv (total cumulative dose)
	Dose rate linearity	≤ ±10% (2 μSv/h or higher) (In the range of 2 μSv/h to 3 mSv/h with <sup>137</sup> Cs-γ)
	Alarm	LED blinking in high dose environment
	Recording	Dose record per hour
	Power supply	Coin type lithium battery (CR2450)
	Battery life	Approximately one year (viewing digital readout twice daily)
	Measurement record display	Option 1: Download the data to the dedicated PC to display the measurement record. Option 2: Insert the dosimeter into the accessory indicator to display the record.
	Size / weight	Approximately 68 mm x 32 mm x 14 mm / 23 g
	Factory setting	Dose set to "0" when shipping
Indicator	Size / weight	Approximately 68 mm x 44 mm x 37 mm / 50 g
	Power supply	Button battery
	Display values	Total cumulative dose, number of days, and cumulative dose readout of the previous day
Dedicated workstation	Function	Downloading the recorded data, resetting the dose record
	Connection method with dosimeter	Optical and wireless connections
	Display values	• Total cumulative dose (number of days) and average dose rate
		• Dose trend graph over the last 24 hours
		• Dose trend graph over the last 7 days
		• Monthly cumulative dose, and the trend graph
		• Daily cumulative dose, and the trend graph for one month
		• Hourly dose and the trend graph

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



# 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

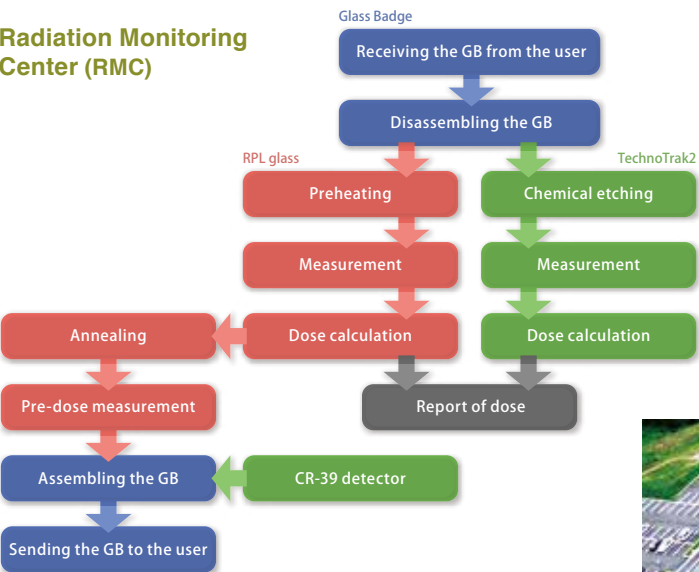
#### Supply of Medical Equipment

- 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)

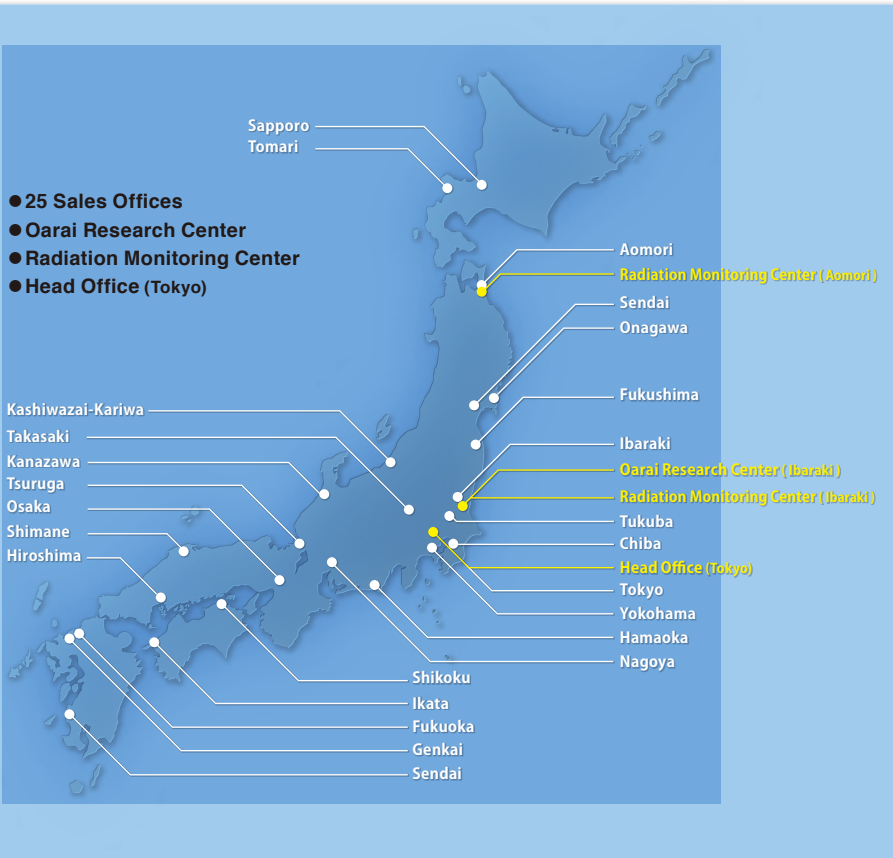


Glass Badge monitoring service process flow in RMC

### Head Office



### Our Locations



RMC process line (Main room)



Automatic Storage System



Reader of G-plate (RPL glass detector)



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 y-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

\$207.59 million (year ending June 2015)  
\$282.37 million (year ending June 2016)  
\$231.62 million (year ending June 2017)

### Company Profile

**Company name :**  
Chiyoda Technol Corporation  
**President :**  
Kazuhiko Yamaguchi  
**Foundation :**  
May 1, 1956  
**Establishment :**  
June 12, 1958  
**Capital :**  
90,000,000 yen  
**Number of employees :**  
512 (as of July 1, 2017)  
**Headquarters :**  
1-7-12 Yushima, Bunkyo-ku,  
Tokyo 113-8681, Japan  
**Website :**  
<http://www.c-technol.co.jp/eng>