

Development of Customs Capacity for the Use of Technology

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Topics

I . Efforts to Enhance Organizational Capacity for Developments for Customs Inspection Equipment

II. Examples of Recent Developments for Customs Drug-Inspection Equipment

Central Customs Laboratory (CCL)

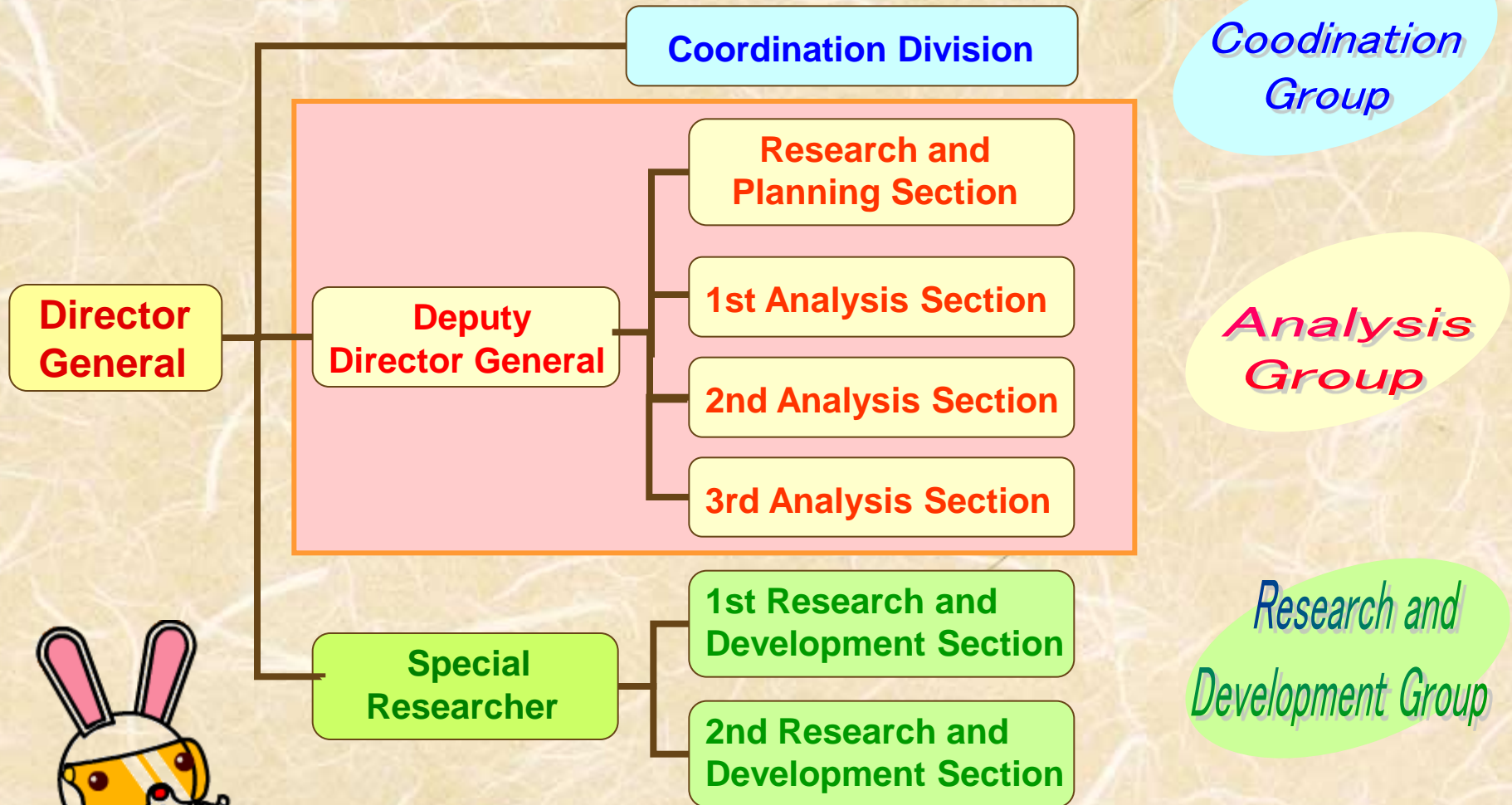
- Established in 1963
- Belonging to Ministry of Finance as Facilities
- Mission
To support the Regional Customs' field-operation from the scientific views



Labot-Kun
(CCL's mascot)



Central Customs Laboratory Organizational Chart



Function of the CCL

**Requested
Analysis
for Tariff Classification**

**Research &
Development
for Tariff Classification,
and
Customs Inspection
Equipments**

**Technical
Guidance**

Japan Customs

**Foreign
Customs
Administrations**



Japan Customs Missions and its Strategy for the achievement

More details: Japan Customs Report 2010 (<http://www.customs.go.jp/zeikan/pamphlet/report2010e/index.htm>)

Three Missions

- Realizing a safe and secure society
- Collecting revenue appropriately and fairly
- Facilitating further trade procedures

X-ray Imaging System for Sea Containers



Six Measures

Cooperation with other government agencies

Installing state-of-the-art inspection equipment

Cooperation with foreign Customs authorities

Further application of ICT

Cooperation with other private enterprises

Human resource development

Drug detector dogs



I . Efforts to Enhance Organizational Capacity for Developments for Customs Inspection Equipment

- Setting up a strategic direction
 - “Recommendations” by Advisory Group on Customs Inspection Equipment
- Implementing the “Recommendations”
 - Re-engineering Business Processing
 - Human Resource Development

Advisory Group on Customs Inspection Equipment

- Established in November 2005
- Members: 6 professors and 3 scholars of research institutes
- Issued Recommendations in June 2006
- Two (2) Major Recommendations
 - Setting-up a more effective structure for R&D
 - Directions for Development of Inspection Equipment

Recommendations

By Advisory Group on Customs Inspection Equipment in June 2006

- Setting-up a more effective structure for R&D
 - Collecting, analyzing & storing various information on detection technology, and establishing a database. WCO will be a good platform.
 - Partnering with academy to get supports/advices.
 - Employing and deploying Customs scientists, and Human Resource Development.

Implementing the “Recommendations”

(1) Information sharing on Detection Technology & Equipment

- Collaboration with WCO
 - Attending International Dialogue on Inspection Equipment, such as WCO Forum
- Realigning relationship among Customs authority

Implementing the “Recommendations”

(2) Partnering with Academy

- Assessment & Evaluation Committee
 - Established in 2009
 - Consisting of CCL senior officers & professors
 - Annual basis
- Working Groups on an individual technology

Implementing the “Recommendations”

(3) Human Resource Development

- Employing post-Doctors
- Dispatching officers to Doctor-Degree Courses to research the most advanced technology related to inspection equipment
- On the Job Training for outstanding junior officers at CCL

II. Recent Developments for Customs Drug-Inspection Equipments

| Name of equipment | Status |
|---|--------------------------|
| <i>On-site tandem mass (MS/MS) spectrometer for trace amount of narcotics and explosives</i> | <i>Deploying</i> |
| <i>Low-energy X-ray mail inspection system</i> | <i>Deploying</i> |
| <i>Raman spectrometer for liquid narcotics</i> | <i>Developing</i> |
| <i>Fluorescence Q-body immunosensor</i> | <i>Developing</i> |
| <i>NQR body inspection system for hidden narcotics inside a human body</i> | <i>Developing</i> |

On-site tandem mass (MS/MS) spectrometer for trace amount of narcotics and explosives (TDS)

Summary

In 2004, CCL developed an on-site tandem mass (MS/MS) spectrometer for cargo screening, called as TDS. MS/MS enables to detect trace amount of narcotics and explosives with low false alarm rate. Therefore, TDS has gained the trust of Customs front-line officer and become one of the main inspection equipments of Japan Customs.

Deployment

Since 2005, 15 systems have been deployed in Japan Customs, and 4 additional systems will be deployed in this year. Before deployment CCL conducts verification test using real narcotics.

Specifications

- Technology: Tandem mass (MS/MS) spectrometry
High sensitive 3D-QMS with APCI ionization.
- Target substance: trace particles of narcotics and explosives
- Sampling: wiping with a special cloth (7.5 cm x 7.5 cm)
- Analysis time: 10 s
- Dimension : 820(W) x 710(D) x 880(H) mm, Weight: 270kg
- Type: Stationary type or Transportable types (by vehicle)



Stationary type

Transportable type



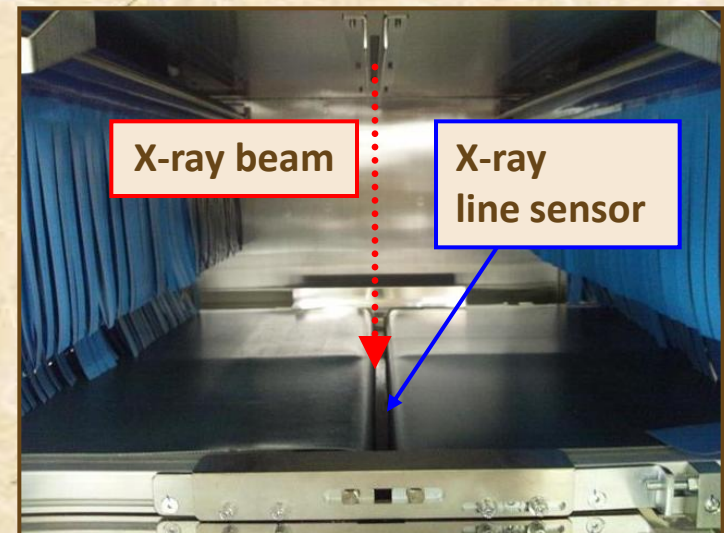
Low-energy X-ray mail inspection system

Aim

- Japan Customs and a private sector company jointly developed the low-energy X-ray mail inspection system in 2011 because X-ray energy of existing X-ray inspection system (80-300 keV) is too strong for mail inspection.
- The system equipped with a lower-powered variable X-ray generator (15 – 75 keV) and a specially developed X-ray line sensor for detection of low-power X-ray.

Specification

- Anode voltage: 15 – 75 keV
- Tunnel Size: 450 mm (W) x 210 mm (H)
- Resolution: up to 0.05 mm (44 AWG)
- Steel penetration: ca. 2 mm
- Image presentation: B/W



Raman Spectrometer for liquid narcotics

Aim

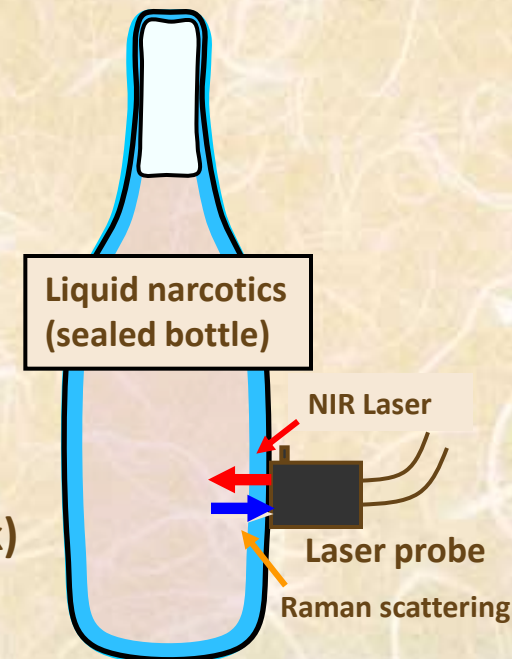
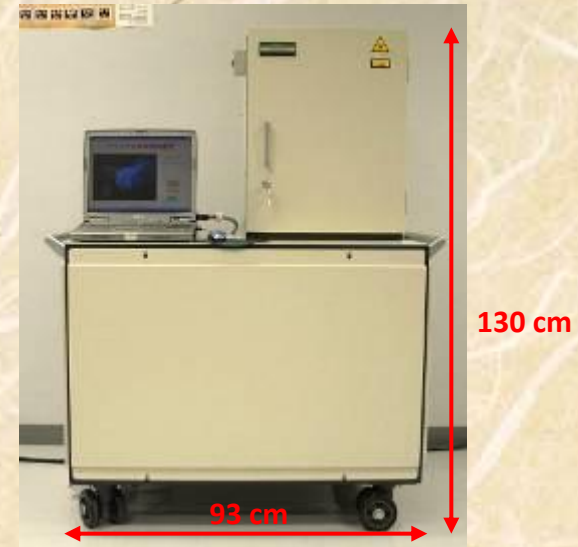
Correspond to increasing smuggling of narcotics dissolved in liquid in sealed bottle, CCL have developed a Raman Spectrometer for identifying liquid narcotics in collaboration with private sector in 2007.

Feature

- The Raman spectrometer enables quick inspection of liquid narcotics in the sealed glass or plastic bottles without opening them.
- Considering safety of the inspector, the instrument is equipped with interlock mechanism

Specification

- Technology: Raman spectroscopy
- Target: Liquid narcotics in sealed bottle
- Safety: Designed to minimize the risk of laser accidents (Inter lock)
- Analysis time: 30 s
- Warm-up time: 7 min



Development of Fluorescence immunosensor for narcotics using Quench-based antibody (Q-body)

CCL have been developing narcotics immunosensor collaborated with academy for use of antibody specificity to its corresponding antigen.

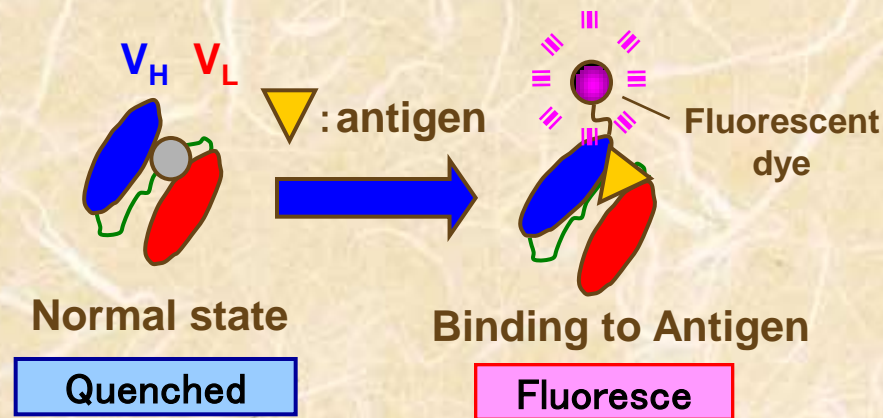
Quenchbody (Q-body) technology

- Q-body is a fluorescence-labeled antibody fragment (scFv) produced by genetic engineering.
- When the Q-body antibody bind to antigen, it fluoresces.
- Q-body is originally developed by Hiroshi Ueda at Tokyo University.

Verification test of detection capability

- Our group conducted a verification test of Q-body effectiveness for narcotics detection.
- For example, the lowest detection limit of Heroin, Morphine, and Codeine is ca. 50 pg

Q-body antibody fragment



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“Quenchbodies”: Quench-Based Antibody Probes That Show Antigen-Dependent Fluorescence

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Ref.) R. Abe, et al. : *J. Am. Chem. Soc.*, 2011, 133 (43), pp 17386–17394.

NQR (Nuclear Quadrupole Resonance) body inspection system for hidden narcotics inside a human body

Aim

Corresponding to recent increase of smuggling cases by airline passengers, CCL have been developing a body inspection system for hidden narcotics inside a human body using nuclear quadrupole resonance (NQR) .

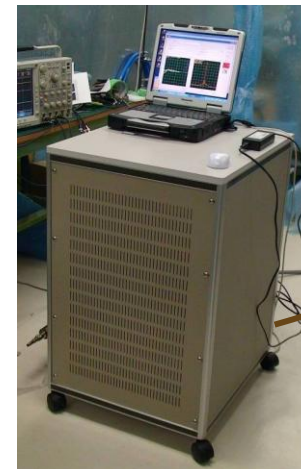
Advantages of NQR

- Completely safe for human body ↔ X-ray inspection
- High permeability (using radio wave)

Specifications of prototype

The developed NQR spectrometer consist of an NQR antenna and a control unit.

- RF range: 0.5 to 5 MHz
- Weight: control unit 30 kg
NQR antenna 3 kg
- Dimension: control unit 80 x 100 x 60 cm
NQR antenna 20 x 30 x 10 cm



Control unit

Prototype



NQR antenna

NQR (Nuclear Quadrupole Resonance) body inspection system for hidden narcotics inside a human body

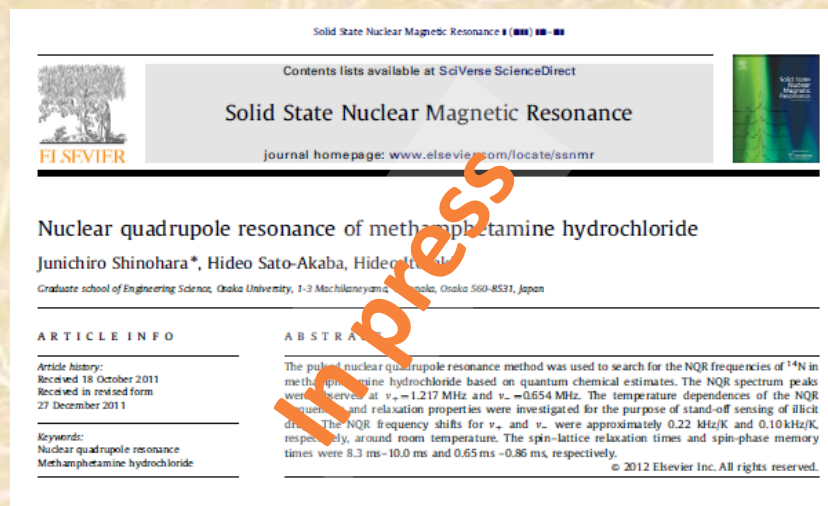
Achievment of collaboration with academy

- In order to promote NQR study, Japan Customs dispatched an official to university as a doctoral course student since 2010.
- As the result of the collaborative study with academy, our group finally found the NQR frequency of methamphetamine for the first time in the world.

Ref.) "Nuclear quadrupole resonance of methamphetamine hydrochloride", J. Shinohara, H. Sato-Akaba, H. Itozaki: *Sol. St. Nucl. Magn. Res.*, in press

Final goal of NQR inspection equipment

- Rapid screening device of narcotics to the airline passengers like metal detector





Thank you



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