

# **MX9080TI Mobile X-ray Inspection System**

## **Technical Proposal**



**同方威视技术股份有限公司**  
NUCTECH COMPANY LIMITED



## 目录

<b>1</b>	<b>Product Introduction</b> .....	<b>1</b>
<b>2</b>	<b>Technical Feature</b> .....	<b>3</b>
<b>3</b>	<b>Technical Principal</b> .....	<b>4</b>
<b>4</b>	<b>System structures and functions</b> .....	<b>6</b>
	4.1 X-ray Generator Subsystem .....	7
	4.2 Detection and Data Acquisition Subsystem .....	7
	4.3 Electric Control Subsystem.....	8
	4.4 Mechanical and Conveying Subsystem.....	8
	4.5 Operating Inspection Subsystem.....	8
	4.6 Radioprotection Subsystem.....	8
	4.7 Video Monitoring Subsystem .....	9
	4.8 Refitted Vehicle Subsystem .....	9
<b>5</b>	<b>Main Function of MX9080TI</b> .....	<b>11</b>
	5.1 Image processing.....	11
	5.2 Automatic Detection .....	17
	5.3 Image Management.....	17
	5.4 Threat Image Projection (TIP) .....	18
	5.5 User management.....	18
	5.6 Log Management .....	18
	5.7 System diagnosis.....	19
<b>6</b>	<b>Accessories</b> .....	<b>19</b>
	6.1 OIS Optional Function .....	19
	6.2 Refitted vehicle .....	19
	6.2.1 Accessory on Vehicle.....	19
	Sun Visor .....	19
	Alarm light.....	20
	Video Monitoring System .....	20
	Broadcasting System.....	20
	6.3 Personal Dose Meter .....	20
<b>7</b>	<b>Training and Services</b> .....	<b>21</b>
	7.1 User Training .....	21
	7.2 After Sales Services .....	21
<b>8</b>	<b>Certificates of MX9080TI</b> .....	<b>22</b>
<b>9</b>	<b>MX9080TI Specifications</b> .....	<b>23</b>



## THSCAN™MX9080TI Mobile X-ray Inspection System

### 1 Product Introduction

THSCAN™ MX9080TI Mobile X-ray Inspection System, abbr. MX9080TI, is an advanced dual-energy X-ray security inspection system invented by NUCTECH COMPANY LIMITED.

MX9080TI employs the most advanced state-of-the-art X-ray imaging technology, which provides excellent image quality, due to its high image resolution. It is perfectly suitable for the inspection of goods and luggage in multi-location situations due to its flexible and relocatable character. It is a reasonable addition to station systems and is ideal for security inspection at airports, customs, railway stations, as well as important public events.

MX9080TI can distinguish between organic and inorganic materials contained within the inspected objects. The X-ray image is colored according to the atomic composition of the material. The inspector can easily identify material with the following coloring scheme:

- Organic material: orange
- Inorganic material: blue
- Mixture: green

At the same time MX9080TI has many optional functions e.g. drug and explosive assistant detection.



MX9080TI Appearance



## 2 Technical Feature

- ❑ **High agility and relocatability** ensure MX9080 an ideal inspection system in all kinds of public events that require fast response ability as well as other stationary situations
- ❑ **High image quality:** Wire resolution is 36AWG (diameter of metal wire: 0.13 mm) ;.Penetration is up to 30 mm of steel; and image resolution is 1280×1024
- ❑ **Advanced material identification.** With the dual-energy technology, MX9080TI can easily identify material and color them as the following scheme:
  - Organic material: orange
  - Inorganic: blue
  - Mixture and lighter metal: green
- ❑ **Low X-ray leakage dose rate.** Environment radiation dose rate around the device is closed to the natural background and complies with all published National/International standards , guaranteeing the safe for environment as well as the operators and passengers
- ❑ **Low X-Ray Dose per Inspection.** Less than 2μSv per inspection ensures the film safety complying ASA/ISO 1600
- ❑ **New ergonomic user interface.** Specially designed keyboard and image display make a friendly man-machine interface that presenting a more comfortable working environment.
- ❑ **Free selection and continuous zoom features.** MX9080TI offers multiple zoom in/out modes which combine with the miniature display make the inspection more efficient e.g. continuous zoom in/out, stepwise zoom in/out and local zoom in/out.
- ❑ **Super practical image management.** More powerful and flexible image archiving and query modes, and images can be saved as format BMP, JPG and GIF locally as well as to USB devices.
- ❑ **Threats image projection (TIP),** which can check the image identify



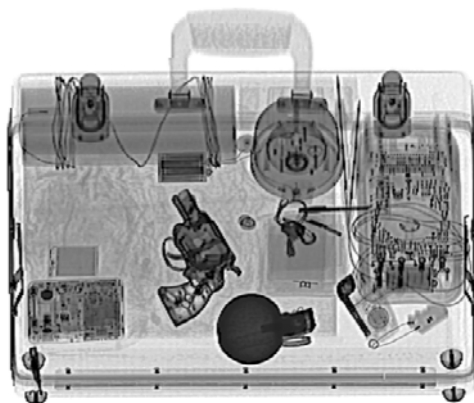
ability of the operators and effectively reduce the miss identification for suspicious objects due to the ennui of the operators

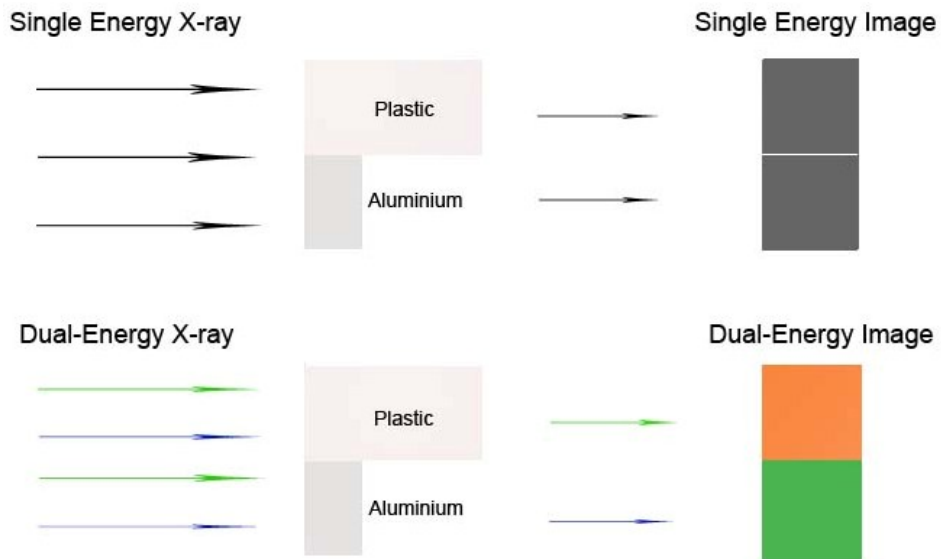
- ❑ **Explosive & drugs automatic detection.** Automatically mark the suspicious image.
- ❑ **Modularized design and Self-diagnosis.** Diagnostic diagnosis for x-ray generator, detectors, keyboard and data communication, which ensure a faster trouble shooting and resolving.
- ❑ **Windows XP Professional** ensures the system stability and the starting time is limited in 60 seconds, and makes the modification of the system easier.

### 3 Technical Principal

X-ray, like visible light, is also electromagnetic wave while has shorter wave length and better solid penetration. Different materials have different absorbing ability to X-ray according to their thickness, density and effective atomic number. X-ray attenuates more rapidly when it goes through thicker, heavier and higher atomic number material than the others. Therefore, different material are identified and the inner information of the material is exposed.

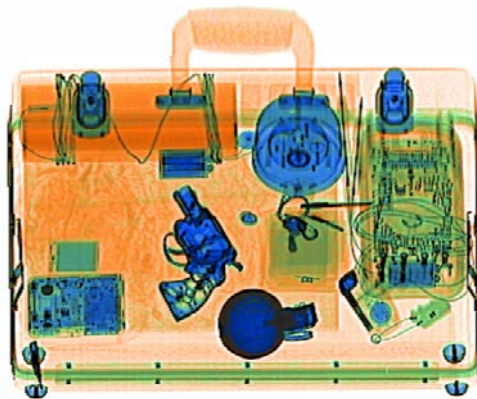
When baggage is screened by an x-ray inspection system, the penetrating signal is detected, analyzed and digitalized by the system, and the following black & white image is formed which shows the silhouette of the baggage inner information.





X-rays have another feature which is applied to MX9080TI that the absorbing features vary according to the X-ray energy and the material atomic number.

Based on the features above, MX9080TI is equipped with dual-energy detector-lines which compare the attenuation of the high energy X-ray and the low energy X-ray and therefore expose the atomic information of the baggage and classify the material into organic, inorganic and mixture (including lighter metal) and shows in orange, blue and green respectively. As showed in the following image.



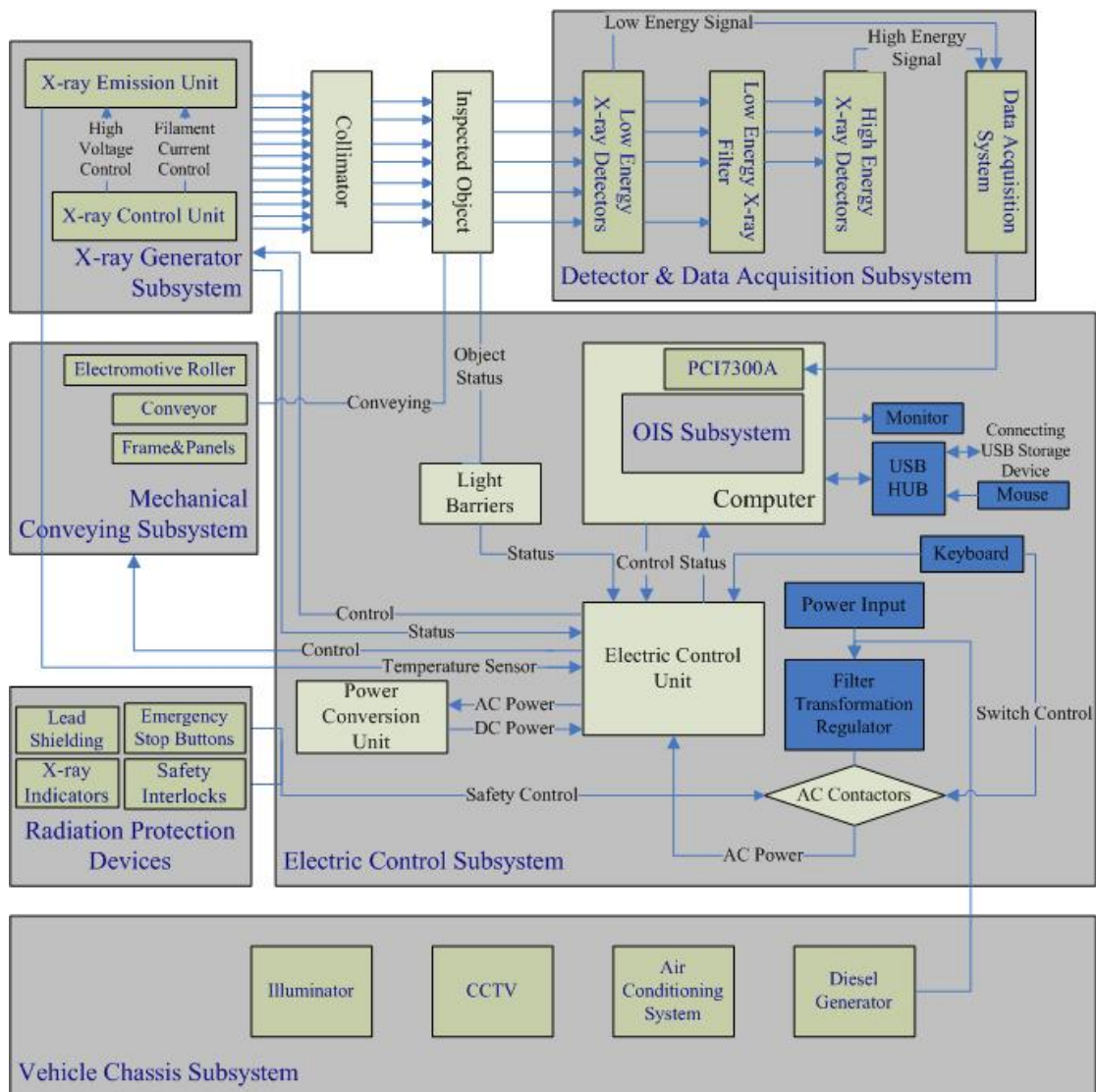
Typical materials and the color definition:



Material type	Color showed	Typical material
Organic		Hydrogen, carbon, nitrogen, oxygen, carbohydrate
Mixture and lighter metals		Aluminum, natrium, silicon, chlorine, salt
Inorganic		Steel, copper, silver

Different colors represent different type of material and the different shade of the colors show the different thickness of the material.

#### 4 System structures and functions



MX9080TI is mainly consists of X-ray generator subsystem, detection and data





acquisition sub-system, electronic control sub-system, operation and inspection sub-system, mechanic and conveying sub-system, radiation protection sub-system and modified vehicle subsystem

#### **4.1 X-ray Generator Subsystem**

The X-ray generator subsystem generates the X-ray that imaging system needs, and is made up of an X-ray launcher and an X-ray controller. The X-ray launcher is housed in an oil-cold case which includes a high-pressure generator and an X-ray tube inside. The X-ray controller is consisted of a control circuit of high-pressure and tube electric current and an isolated electrical source of intermediate frequency. The operation principle of X-ray generator is that after being electrified, metal filaments are heated up in the vacuum room at high temperature, electrons are generated then. After being accelerated, electrons hit on metal target (tungsten) which then produces X-rays.

The X-ray generator applies the pulse-width-modulated technology. Voltage and current can be adjusted in closed loop and is equipped with multiple protective measures such as over voltage protection and over current protection. The Performance is highly stable and safe to use.

#### **4.2 Detection and Data Acquisition Subsystem**

Detection and Data acquisition Subsystem mainly consists of detectors and data acquisition modules. The main function of the detectors is to turn the incident X-rays into analog electric signals. After data acquisition modules amplified analog electric signals, they are transferred into digital signals which are conveyed into computer to be analyzed and processed.

The detector and data acquisition module make up the detector module. The detector module that system adopts is L-shaped and installed with X-ray launcher in opposite angle position. X-rays that X-ray launcher emits can scan the cross section of whole tunnel. This design can make it check any parts of



inspected articles entering into tunnel and avoid scanning dead angle.

#### **4.3 Electric Control Subsystem**

Electric control subsystem mainly consists of computer (including the monitor), electric control case, power supply control case, operation keyboard, light barriers, emergency stop switch, power-on indicator lamp, X-ray indicator lamp and interface parts of other subsystems.

Electric control subsystem supplies power loop for the entire system and realizes electrically control conveying process of conveying equipment. Electric control subsystem gathers and transacts the signal of X-ray generator subsystem and mechanical conveying subsystem. At the same time, this subsystem offers control platform (a keyboard and a mouse) for operating inspection subsystem to realize human-machine interaction and meet systematic security interlocking demand.

#### **4.4 Mechanical and Conveying Subsystem**

Mechanical and conveying subsystem output a steady conveyer speed of 0.2m/s which transports the baggage to the screener. Mechanical and conveying subsystem consists of equipment frame, external panel, electro motion roller, belt, etc.

#### **4.5 Operating Inspection Subsystem**

Operating inspection subsystem mainly refers to the workstation (OIS software) and its main function is to reconstruct and enhance the image.

It can produce the image of inspected article and check the image, control and record systematic operation state at the mean time.

#### **4.6 Radioprotection Devices**

Radioprotection devices minimizes the X-rays leakage to the environment, and caution the operator and the passenger when X-ray is emitted or in emergency.



- 1) Lead shielding, preventing X-ray from leaking out.
- 2) Red light warning, the red "X-ray indicator LED" is getting bright when X-rays are emitted.
- 3) Emergency stops (1 in keyboard and 4 at the striking position above the both ends of check tunnel) . When pressed, the power of X-ray generator is immediately cut off and the system is then shut down.
- 4) Safety interlock switched (lying behind the external panel of the equipment). When either the external panels is opened, the system is shut down automatically.

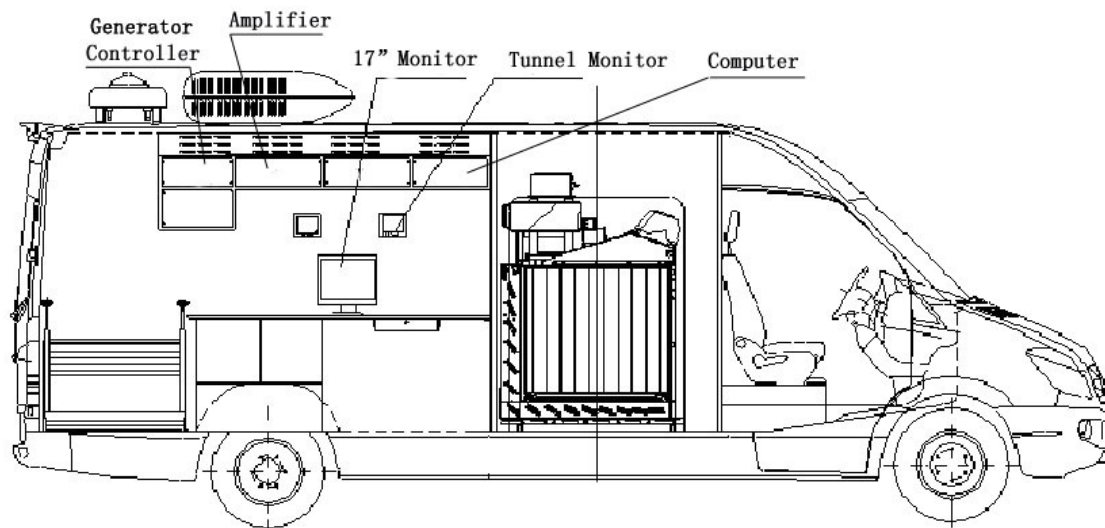
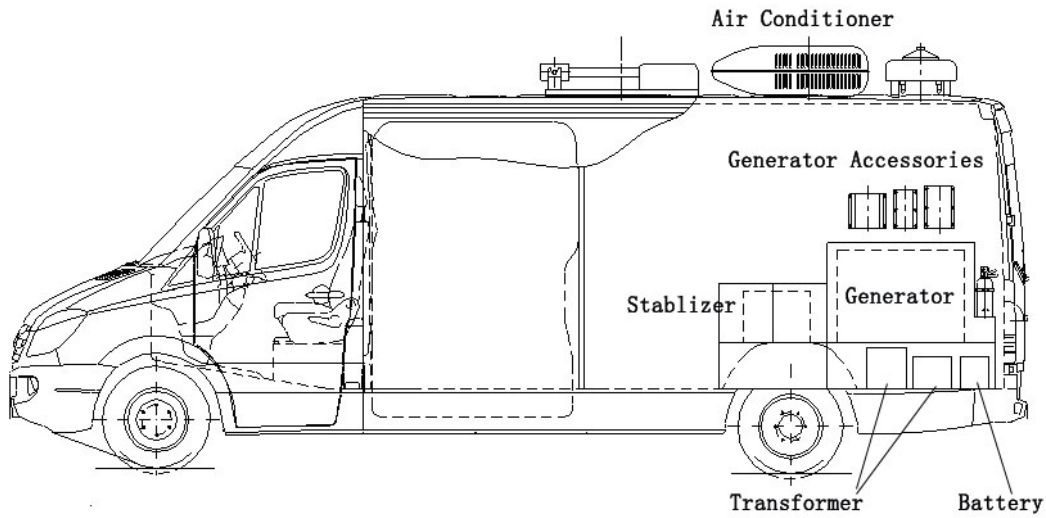
#### **4.7 Video Monitoring Subsystem**

Video monitoring subsystem consists of reverse sensor and camera, rear view monitor, tunnel (in/exit) camera and tunnel view monitor.

#### **4.8 Refitted Vehicle Subsystem**

Refitted vehicle subsystem mainly refers to the vehicle that carrying the X-ray Inspection system and the refitted modular. MX9080TI uses IVECO NJ5056XXYN (diesel) as its vehicle chassis.

The layout of the refitted Vehicle is shown below.



**Air conditioner** makes the operator room more comfortable: Electronic power: 1687~2117W, cooling power: 4000 W, and heating power 1650W.

**Diesel generator:** Fuel is taken directly from fuel tank with fuel acquisition safety threshold.

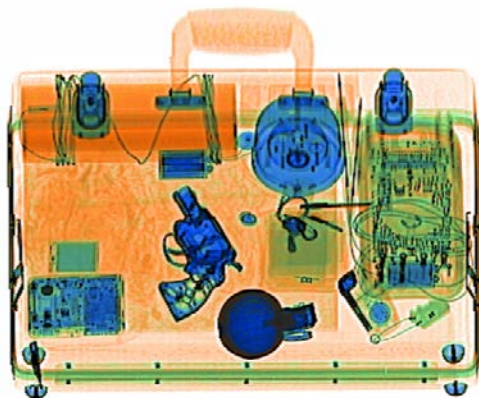


## 5 Main Function of MX9080TI

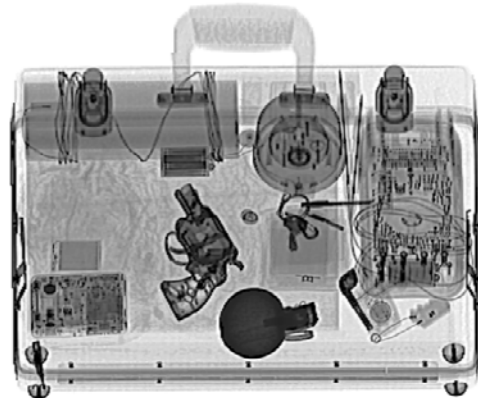
### 5.1 Image processing

OIS provides plenty of image processing functions which assist the image analyzing.

- ❑ **Color display**, Organic, inorganic and Mixture (including lighter metals) are displayed in orange blue and green respectively. And the color saturation represents the absorb rate.
- ❑ **Black and white display**, absorb rate is showed as grayscale image, by analyzing the data from both high energy and low energy detectors arrays, image quality of both higher absorb rate material area and lower absorb rate material area can be enhanced;

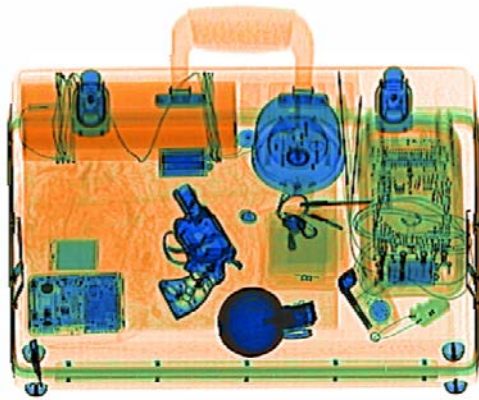


**Color display**

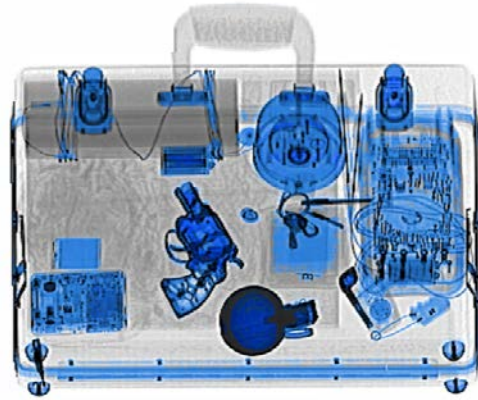


**Grayscale display**

- ❑ **Organic stripping**, in this mode, organic materials are display in grayscale image while inorganic materials are display in color image;
- ❑ **Inorganic material stripping**, in this mode inorganic materials are display in grayscale image while organic materials are display in color image,
- ❑ **Organic only**, Mixtures (including lighter metals) and inorganic materials are displayed in grayscale image and organic materials are displayed in color image.

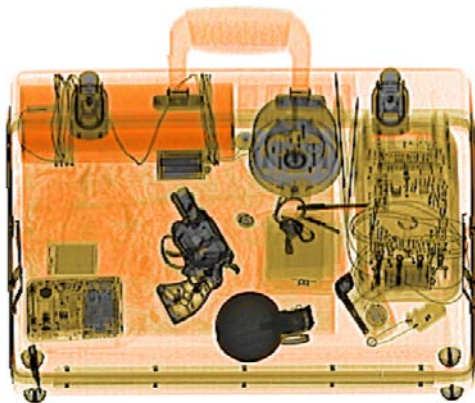


Defaulted image

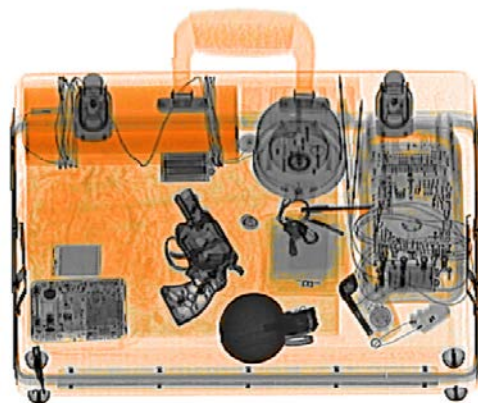


Organic only

- ❑ **Inorganic only**, Mixtures (including lighter metals) and organic materials are displayed in grayscale image and inorganic materials are displayed in color image.



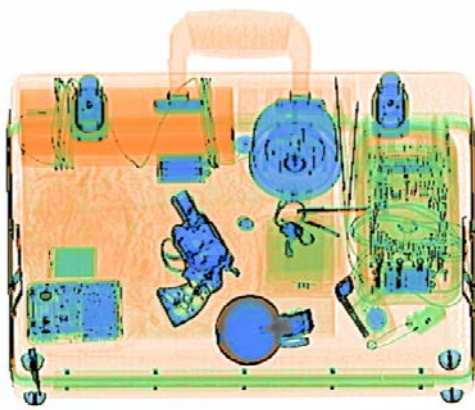
Inorganic stripping



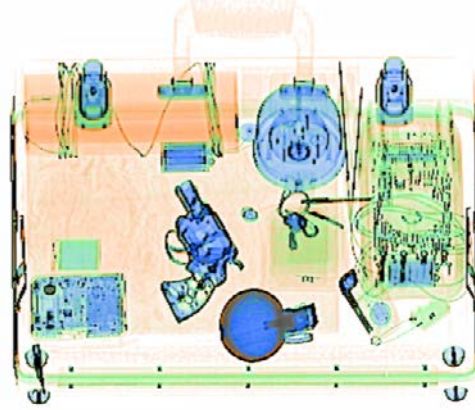
Organic Only

- ❑ **High-energy penetration**, heighten the contrast of high absorbing material and strengthen the detail display effect against the background of high absorbability material;
- ❑ **Logarithmic transform**, heighten the contrast of high absorbing material by non-linear transform, and the higher the absorbability is, the higher the image contrast will be;



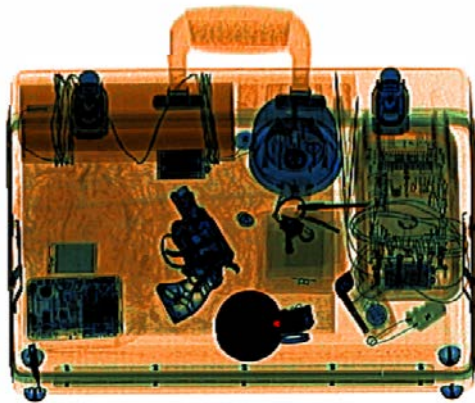


High penetration

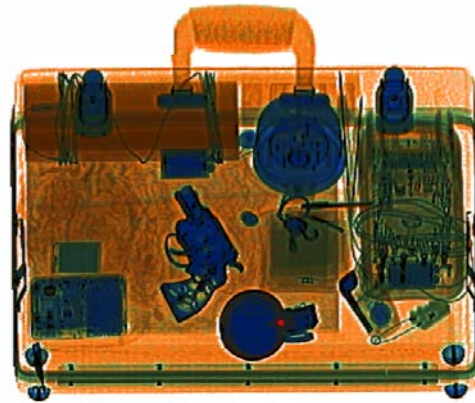


logarithmic transform

- ❑ **Low energy penetration**, heighten the contrast of low absorbing material and strengthen the detail display effect against the background of low absorbability material;
- ❑ **Exponential transform**, heighten the contrast of low absorbing material by non-liner transform, and the lower the absorbability is, the higher the image contrast will be;

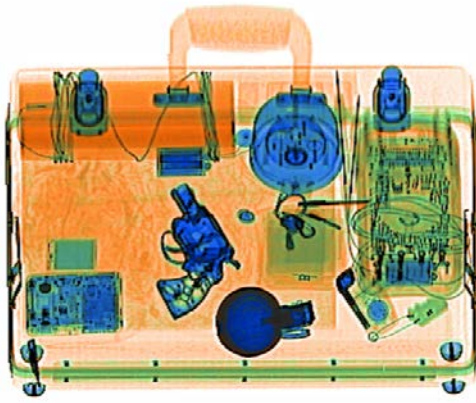


Low penetration

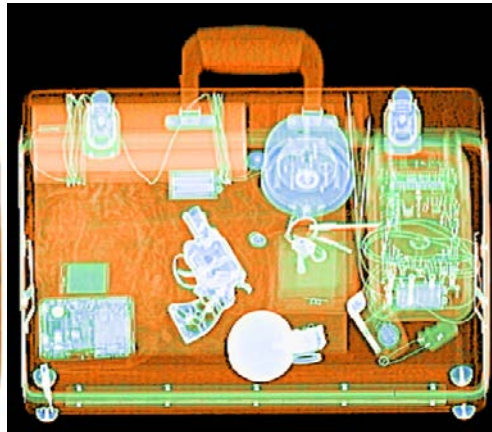


Exponential transform

- ❑ **Negative**, keep the color tone of the image unchanged, and negative the saturation (or grayscale for black and white image), i.e. the higher absorbing materials are displayed lighter than the lower absorbing materials, and consequently, the higher absorbing material will be highlighted due to human eye's higher sensitivity to lighter colors;

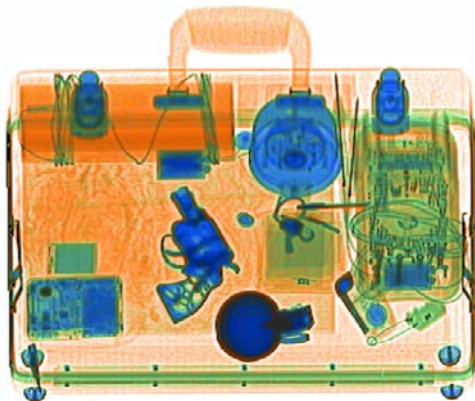


Default image

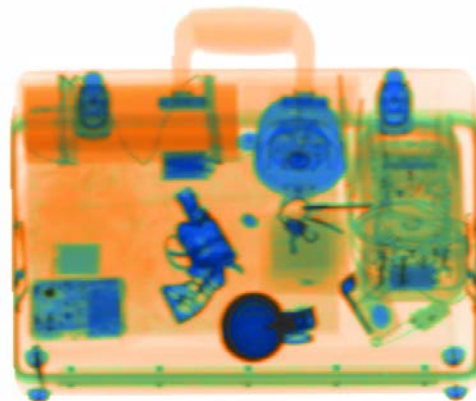


Negative Color

- ❑ **Image gradient**, change the grayscale of the black and white image continuously which make image profile more legible;
- ❑ **Sharpening**, Strengthen the edge of image as well as the parts with high grayscale change rate, therefore the profile information is highlighted;
- ❑ **Smoothing**, make the image even and smooth by filtering the image noise;



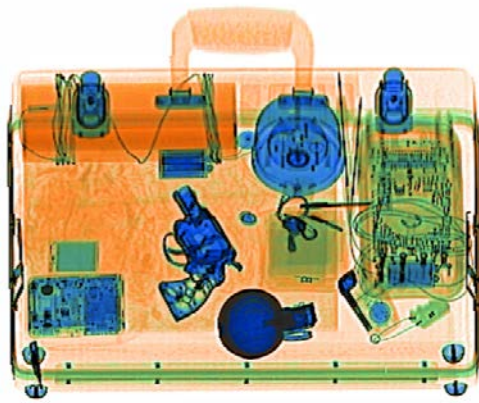
Sharpening



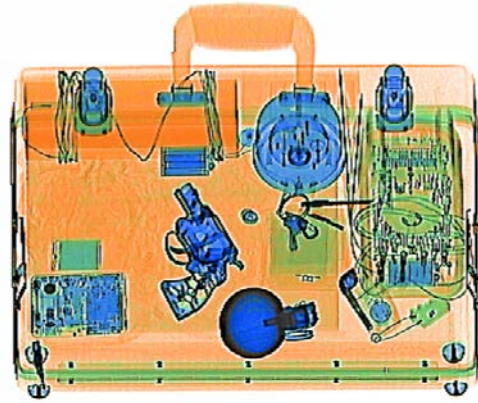
Smoothing

- ❑ **Super enhancement**, Automatically calculate the contrast of different image area to get the best contrast of whole image and display higher absorbing and lower absorbing material simultaneously on screen;



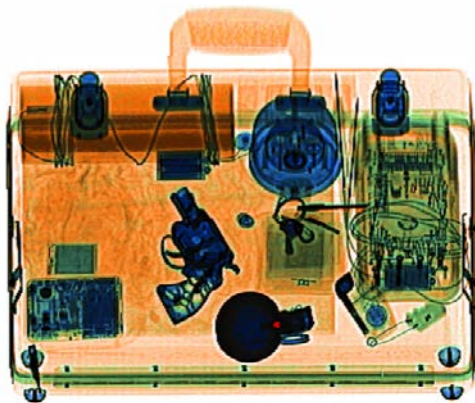


Default image

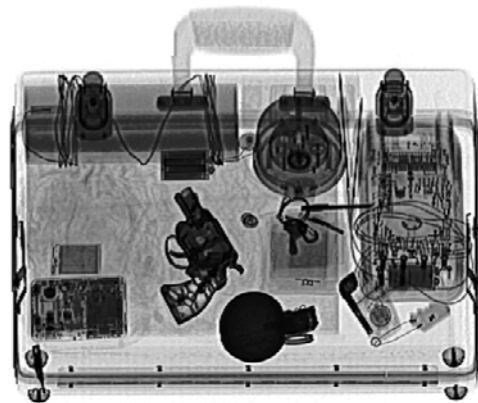


Super enhancement

- ❑ **Variable absorbing rate**, heighten the contrast of some certain absorbing rate material (specified manually);

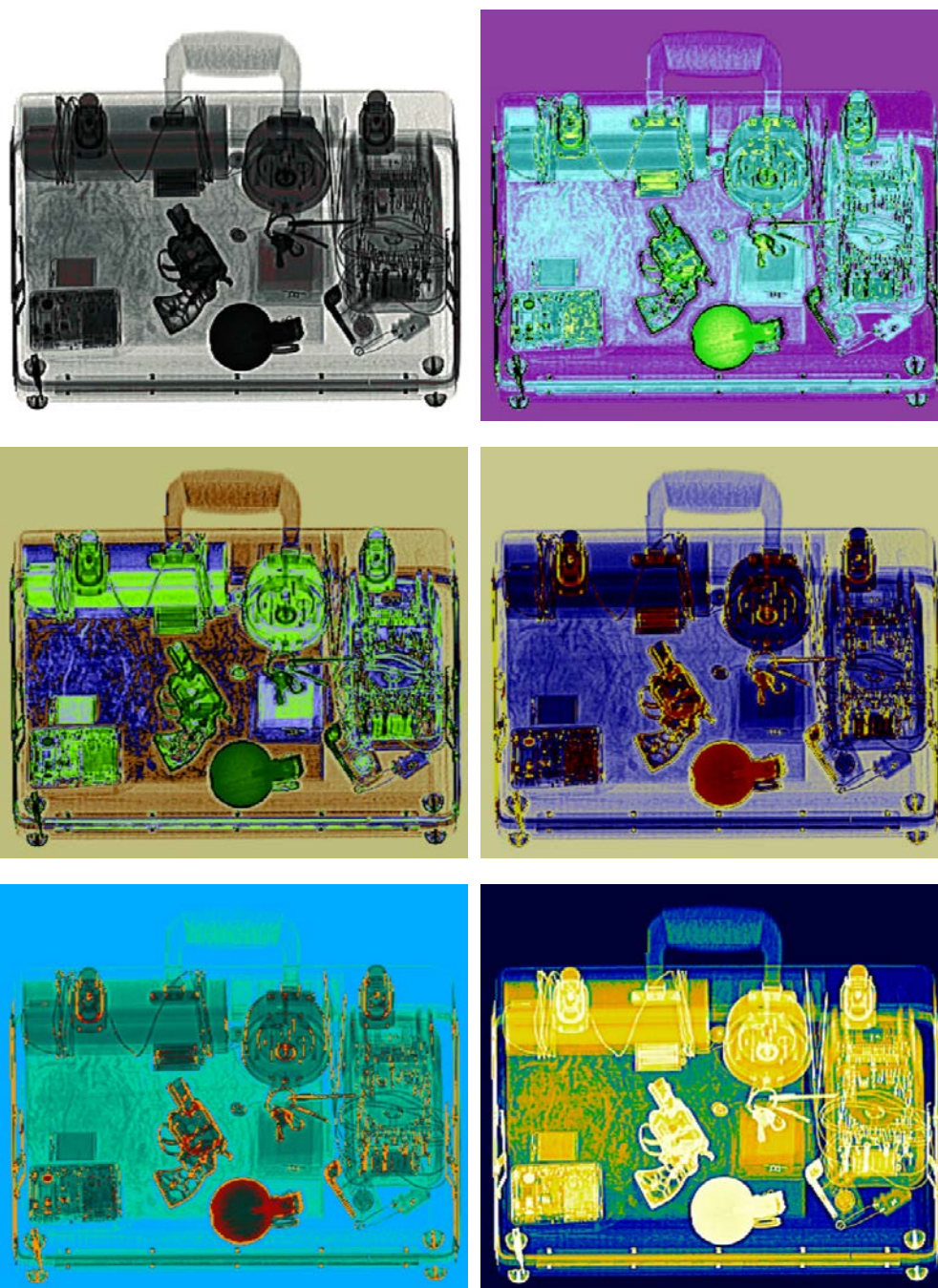


Variable absorbing rate (color)



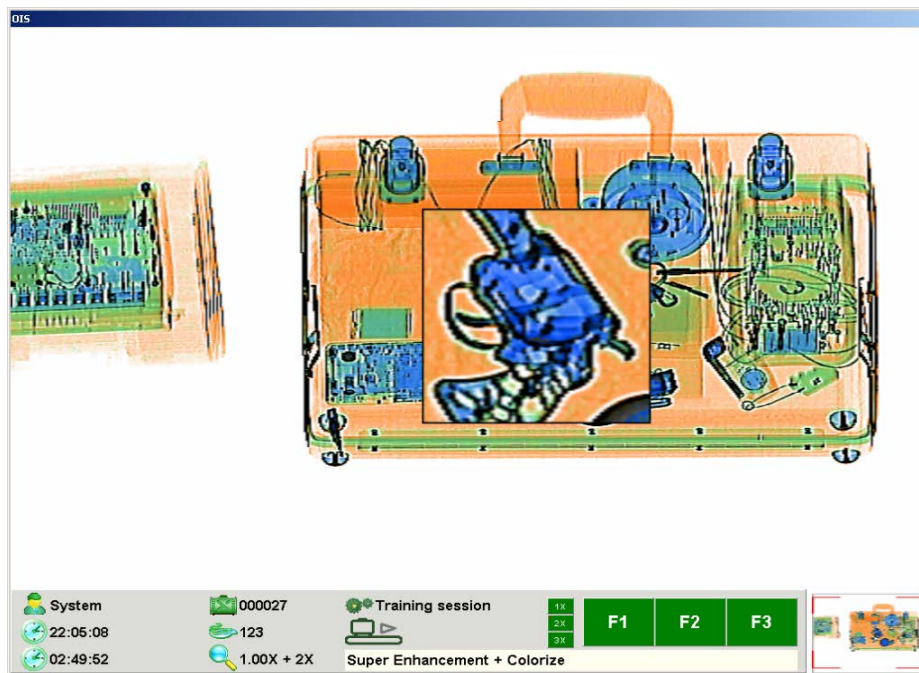
Variable absorbing rate (black & white)

- ❑ **Pseudo color schemes**, human eyes have better resolving power to color differences than grayscale differences, and pseudo image is to show different absorbing material in different colors to get better differentiation. Different pseudo color schemes are designed to strengthen material of different absorbing rate.



Pseudo color

- **Zoom in**, normal zoom in, continuous zoom in and magnifier. Continuous zoom in/out can be operated by mouse scroll and achieve stepless zoom in/out, magnifier can zoom in the area where the pin points.



**Magnifier**

## 5.2 Automatic Detection

- OIS will detect explosives and drugs by analyzing the atomic number of the object being checked and send out alarm information by marking it with color squares. The color of the squares can be defined by users.
- OIS will detect and send out alarm information for impenetrable materials. When material with extremely high absorbing rate is checked, the system will not get enough penetrating information to form an image, system will then mark the impenetrable area with color squares

## 5.3 Image Management

- Images can be saved automatically, manually and will be saved specially when marked. When the system hardware run out of the space, images will be deleted chronologically;
- Images can be queried according to scanning time, user ID, save mode, etc;
- Images can be saved as format JPG, BMP, TIF and GIF, and can be





saved to flash disc via USB plug.

#### **5.4 Threat Image Projection (TIP)**

- Threat images can be projected automatically and randomly at a certain rate as set when TIP is started, TIP can help training and examine the operator.
- Threat image can be projected as a whole package or can be projected as a single object into normal package.
- Advanced users (Administrator) can set frequency and types of the threat images.

#### **5.5 User management**

- Users can be classified as user, administrator and maintenance according to their different privileges;
- Administrator can add, delete or modify user information;
- Under default settings, administrator users have privilege to system setting, as well as system maintenance and diagnosis besides all privileges of normal users, users' privilege can be set by administrator as needed.
- When starting the system, users can choose default login mode, under this mode, user can login without inputting user name and password;

#### **5.6 Log Management**

- System log keeps all user information e.g. user login and logoff, package and image information e.g. package number, marked image number, software and hardware information e.g. TIP examination, X-ray generator emitting time;
- Log can be queried following user ID, time span and other correlative information;
- Log can be exported to USB device as daily, weekly, monthly and seasonal report.



## **5.7 System diagnosis**

- Power on self diagnosis;
- X-ray source high-energy, beam current diagnosis, X-ray source power-on and emitting time query;
- Detector array test and diagnosis;
- Keyboard test;
- Conveyor control and infra-red barrier diagnosis;
- System communication test.

## **6 Accessories**

### **6.1 OIS Optional Function**

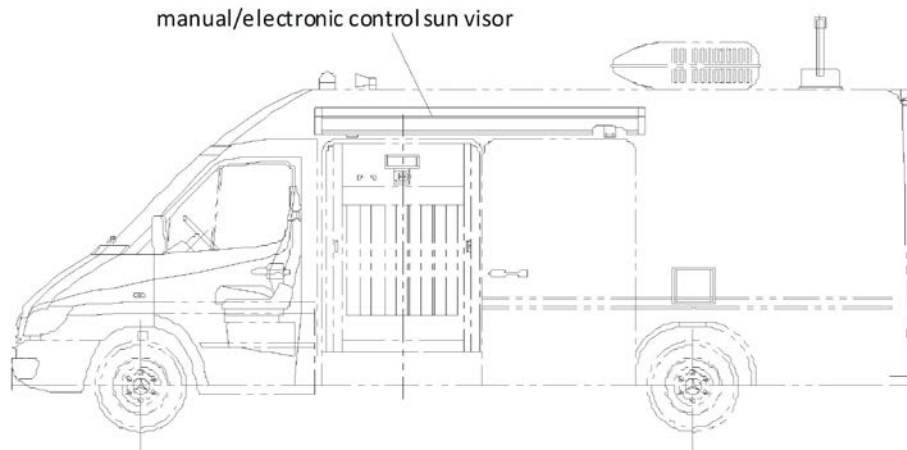
- Explosive and drug automatic detection;
- Impenetrable material alarm;
- Threat image projection (TIP);

### **6.2 Refitted vehicle**

#### **6.2.1 Accessory on Vehicle**

##### **Sun Visor**

Manual/electronic control sun visor are provided. Sun visor is fitted on both sides out of the vehicle, and is designed to keep baggage from exposing directly to the sun.



### **Alarm light**

MX9080TI provide alarm light for special use users. Alarm light is fitted in the front part of the vehicle on the roof.

### **Video Monitoring System**

MX9080TI provides camera video monitoring system to monitor out vehicle circumstance when operators are working in the operation room.

### **Broadcasting System**

Broadcasting system is designed for operator and passenger communication, and is consist of microphone, amplifier and waterproof speaker;

### **6.3 Personal Dose Meter**

Personal dose alarm meter monitors the environment dosage and prevent operators from expose to over dosage environment.



## **7 Training and Services**

### **7.1 User Training**

Operator training courses offered by NUCTECH are carried out individually for each customer on technical principles, system operation, image identification, radiation protection, electronic safety and basic system maintenance knowledge. Advanced training courses for higher managers and maintenance engineers are held in headquarters of NUCTECH, Beijing, China.

### **7.2 After Sales Services**

NUCTECH customer service incorporates professional service groups and teams, quick response systems and comprehensive service networks and provides high-quality after-sales service of mechanical & electrical equipment (e.g. high-tech large container/cargo inspection systems) for worldwide customers. After-sales service centers have been established not only in Northern China, Eastern China and Southern China, but also in Hong Kong and Macao, Northeast Asia, Southeast Asia, the Middle East, Africa, Europe, South America, thus covering more than 60 countries and districts. All the products and projects maintained by NUCTECH Customer Service are



guaranteed to work and function effectively. NUCTECH has gained great



respect from its customers by offering a state-of-art after- sales service, helping to crack down on smuggling activities and contraband cases.

In order to provide professional delivery of turn-key projects, system maintenance and customer training services, NUCTECH Customer Service has established an effective three layer global after-sales service network.

At the foundation level of the service platform, local service stations have been established worldwide. These stations are available wherever large-scale inspection systems are installed, providing quick response 24-hour after-sales service and spare parts.

At the middle level, regional centers serve a certain number of local service stations, and provide site training, consultation, maintenance, spare parts and technical support.

At the summit of the service platform, the Customer Service Centre at NUCTECH headquarters in Beijing provides expert support, software update, spare parts, special tools, training courses and etc.

## 8 Certificates of MX9080TI

MX9080TI have passed the following certificates:

<b>Certificate</b>	<b>Authority</b>
Certificate of the Ministry of Public and services of P.R.CHINA	Testing Center For Quality of Security & Police Electronic Product under The Ministry of Public Security of P.R.CHINA
Certificate of Radiation Protection	Beijing Centers for Diseases Control and Prevention (CDC)& Centers for preventive Medical Research





## 9 MX9080TI Specifications

General Specification	
Tunnel Size	900mm ( W ) × 808mm ( H )
Conveyor Speed	0.20m/s
Conveyor Height	less than 800mm
Max Load	200kg
Image Performance	
Wire Resolution	38AWG
Steel Penetration	34mm
Display Monitor	17" color LCD monitor / high resolution of 1280×1024
Image Processing System	
Image Enhancement	Multi-energy, Color/BW, Negative, High/Low penetration, Organic/Inorganic stripping, Edge enhancement, Super enhancement and Pseudo color, etc
ROI & Zoom	Step/stepless zoom, up to 32 times enlargement
Image Recall	Preceding image recallable
Data Storage Capacity	Up to 50,000 pieces of image
Miscellaneous Functions	
Standard Functions	Time/date display, counters, user management, system-on/X-ray-on timers, power on self test, built-in diagnostic facilities, dual-direction scanning, system log, system standby and training, etc.
Optional Functions	Explosives/narcotics detections, high-density area alert, threat image projection (TIP)
X-Ray Generator	
Anode Voltage	160kV(rated)
Cooling/Duty Cycle	Sealed oil bath / 100%
Health and Safety	
X-Ray Leakage	Less than 1 $\mu$ Sv/hr (5cm from the housing), complies with all published international standards
Film Safety	Guaranteed for high speed film up to ASA/ISO 1600 (33DIN)
Operating Environment	
Power Supply	220VAC/110VAC (-15%~ +10%), 50 Hz/60Hz $\pm$ 3Hz



# 同方威视技术股份有限公司

## NUCTECH COMPANY LIMITED

Storage Temperature/ Humidity	-40℃~+60℃ / 5%~95% (non-condensing)
Operating Temperature/ Humidity	0℃~+40℃ / 5%~95% (non-condensing)
Chassis Data	
Vehicle Type	IVECO NJ5056XXYN VAN
Dimensions(mm)	6880 (L) × 2000 (W) × 2850 (H)
Gross Weight(kg)	5000
Fuel Tank Capacity (L)	70
Engine Type	Diesel oil, Europe III

Note: Image performance specifications are based on test piece complying with GB 15208.2-2006.