



Technical Proposal of NUCTECH™ XT2100HS X-ray CT Inspection System



**In-line Explosive Detection System (EDS)
EU/ECAC Standard 3.1 Certified Baggage Screening Machine**



Contents

| | | |
|---|---|----|
| 1 | XT2100HS Overview..... | 2 |
| 2 | Technical Features | 4 |
| 3 | Service Area Requirement | 7 |
| 4 | Technical Specification of XT2100HS | 9 |
| 5 | Certification Compliance | 10 |

List of Figure

| | | |
|------------|--|---|
| Figure 1-1 | Disassembly drawing of XT2100HS..... | 2 |
| Figure 2-1 | High-resolution 3D image obtained by XT2100HS..... | 4 |
| Figure 2-2 | Dual-view DR images | 5 |
| Figure 2-3 | Contraband concealed within a double-layer aluminum pipe | 5 |
| Figure 2-4 | A controlled knife hidden at a certain angle | 5 |
| Figure 2-5 | Dual-energy material discrimination..... | 6 |
| Figure 3-1 | XT2100HS service area drawing | 8 |

List of Table

| | | |
|-----------|---|----|
| Table 2-1 | Typical materials and their colors displayed in dual-energy imaging | 6 |
| Table 4-1 | Technical Specification Form of XT2100HS..... | 9 |
| Table 5-1 | Certification Compliance Table | 10 |



1 XT2100HS Overview

XT2100HS is using the matured spiral CT technology combining dual-energy material discrimination theory to measure both density and effective atomic number of each voxel (volumetric pixels) of the scanned object in a non-intrusive way. Thus the system automatically identifies materials whose profiles match those of explosives substances. With full volumetric 3D reconstruction, XT2100HS generates CT slice images and 3D images of the scanned object. It also has an independent DR imaging module to produce high-resolution dual-view DR images, together with the CT slice images, will maximize the information available for operators to make accurate and effective security decisions.

XT2100HS utilizes modular design, including four parts:

- Entrance module: baggage infeed;
- Digital Radiography(DR) module: generating high definition dual view color 2D image;
- Computed Tomography(CT) module: generating high definition color 3D image;
- Exit module: baggage outfeed;

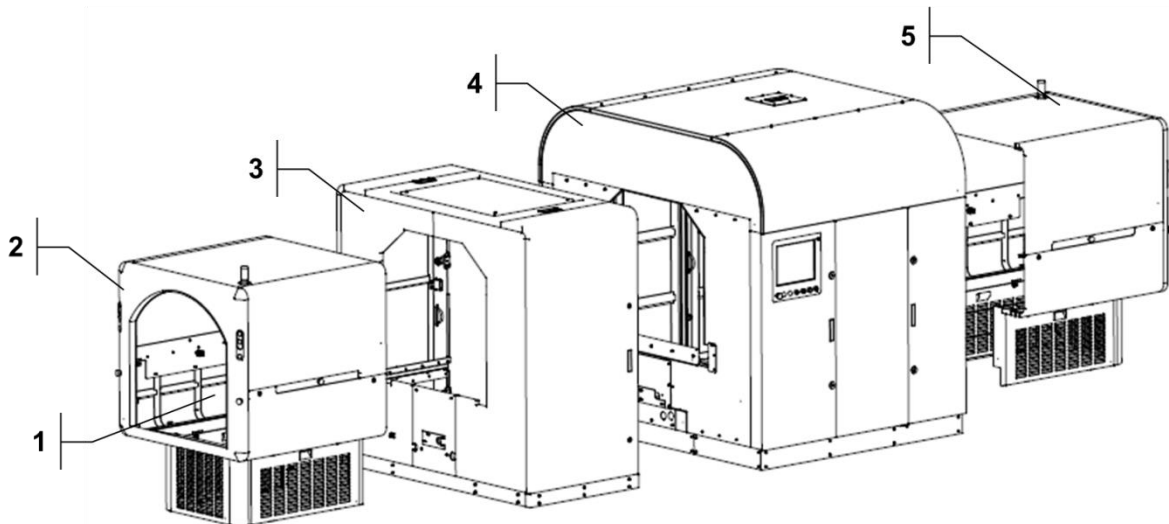


Figure 1-1 Disassembly drawing of XT2100HS

- | | | |
|------------------------|--------------------|----------------------|
| 1. Transmission system | 2. Entrance tunnel | 3. DR imaging system |
| 4. CT imaging system | 5. Exit tunnel | |

There are three (3) generators in XT2100HS. Cooling: Closed loop, oil with forced heat exchanger it can operate without air conditioning. The main subsystems in XT2100HS are as follows:

DR Imaging System



The DR imaging system is consisted of several components such as the X-ray generator, analog board and a data injection board. Fixed X-ray sources and multiple detector arrays to create a high resolution 2D image. During the scanning process, the DR imaging system transforms the analog output into image data, then recombines them and sends them to the OIS, thus the DR image will be acquired.

❑ **CT Imaging System**

CT imaging system contains X-ray generator, detector modules and a signal processing module. The components are fixed on a rotatable slip ring. In the scanning process, the detectors, with the high-speed rotation of the slip ring, will capture the image information of the same cross-section from different angles. These data are transmitted to the host computer. After the complex reconstruction process, the CT slice images and 3D image will be acquired.

❑ **Electrical Control Subsystem**

The electrical control subsystem of XT2100HS is used to control the normal running of the modules of the equipment. Its functions include controlling the operation of slip ring transducer and conveyor transducer, controlling the operation of the sound-light alarm system, monitoring photoelectric sensor signals, receiving instructions from the operation inspection subsystem, completing logic control for the equipment, and performing power distribution management for devices in the system.

❑ **Mechanical Subsystem**

The mechanical subsystem consists of the conveyor belt, frame, DR imaging part, CT imaging part, tunnel etc., as shown in Figure above.

The dimensions of XT2100HS are at the maximum of 1004mm(W) and 890mm(H), which can process the IATA standard checked baggage.

The conveyor of XT2100HS can bear a max. load of 200kg. The conveyor belt is zipper type which is smooth-surfaced, has no absorption of X-ray and will not affect the image quality.

❑ **Human-Machine Interactive System**

The human-machine interactive system mainly contains the monitor, the special keyboard and the mouse. The monitor has resolution of 1920×1080; the keyboard is specially designed for XT2100HS operation.



2 Technical Features

☐ Dual-energy material discrimination

XT2100HS innovatively combines dual-energy material discrimination with the advanced spiral CT technology, and together with NUCTECH's unique dual-energy spiral CT reconstruction algorithm, XT2100HS is capable of automated detection and alarm for explosives, liquid explosives and narcotics with high POD and low FAR.

- **Explosives:** TNT, RDX, C4, Semtex, Emulsive explosive, Nitroglycerin, ammonium nitrate explosives, etc.
- **Liquid explosives:** H₂O₂, gasoline, ethanol, acetone, mirbane, etc.
- **Narcotics:** Heroin, Cocaine, marijuana, methamphetamine, ketamine, etc.
- **Impenetrable:** Discriminate heavy, dense and impenetrable metals

☐ High-resolution 3D images

Inspecting objects in 360 degrees free of blind corners and identifying the contraband more easily with a more intuitive image.

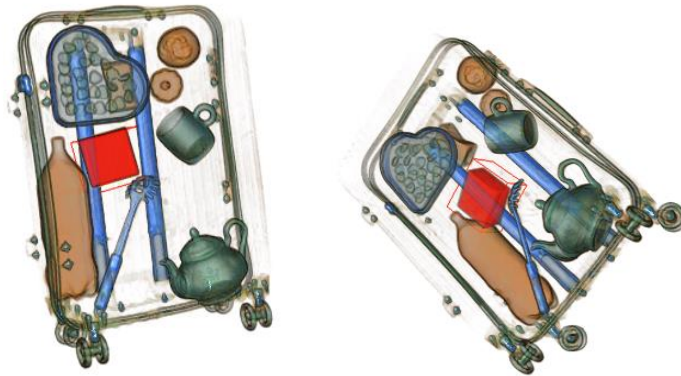


Figure 2-1 High-resolution 3D image obtained by XT2100HS

☐ High-resolution dual-view 2D (DR) images

Designed with an independent dual-view DR screening system, XT2100HS provides high-resolution DR images in two directions, with the world's leading wire resolution of 40AWG (CAAC Standard), and steel penetration up to 40mm (CAAC Standard), increasing both effectiveness and convenience of the image analysis process.

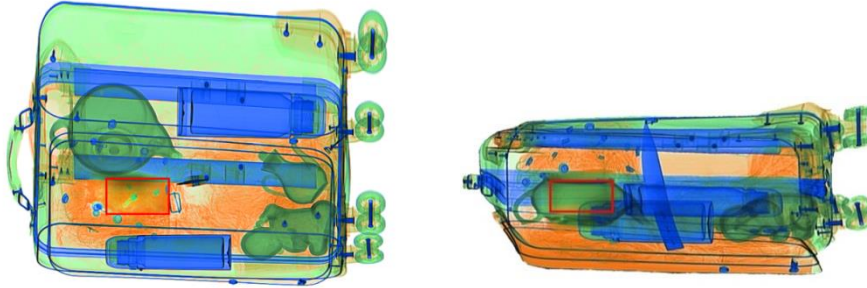


Figure 2-2 Dual-view DR images

□ Distinct CT slice images

The DR images in conventional X-ray inspection systems are incompetent in detecting contraband concealed in interlayers, while the CT slice images in XT2100HS provide the cross-sectional view of scanned objects, which maximizes the information available to make accurate and efficient security decisions. As shown in figure below:

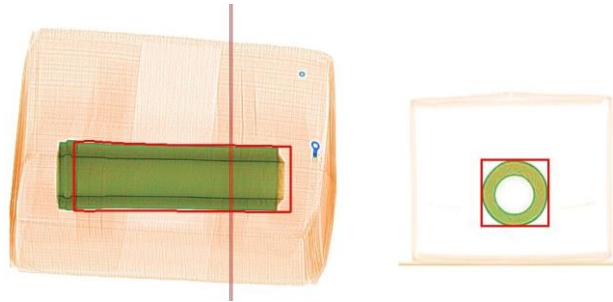


Figure 2-3 Contraband concealed within a double-layer aluminum pipe

The DR image (left) and the CT slice image (right)

The DR images in conventional X-ray inspection systems are incompetent in detecting contraband concealed at certain angles. The CT slice images in the XT2100HS system, however, provide a new viewing angle, making it easier to detect contraband hidden inside the scanned object.

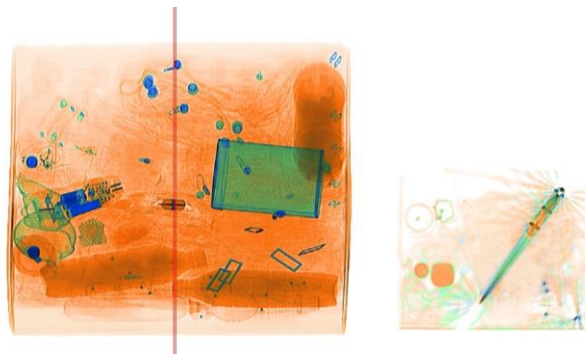


Figure 2-4 A controlled knife hidden at a certain angle

The DR image (left) and the CT slice image (right)






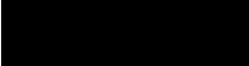
☐ Accurate and abundant color information

XT2100HS combines dual-energy material discrimination with spiral CT to obtain multi-dimensional information of the scanned object, such as high/low energy attenuation coefficient, densities and effective atomic numbers, which enables the automated detection and alarm for concealed contraband with high POD and low FAR. However, the conventional single-energy screening can only measure the single energy attenuation coefficient, so it has a low accuracy in material discrimination.

The dual-energy material discrimination technology enables XT2100HS to obtain more accurate material information, separating the scanned object materials into organic, inorganic, mixtures (or light metals) and impenetrable respectively displayed in orange, blue, green and black in DR images, CT slice images and 3D images. The conventional single-energy CT technology, however, can only display the grayscale image of the scanned object.

For the typical materials and their colors, please see Table 2-1:

Table 2-1 Typical materials and their colors displayed in dual-energy imaging

| Category | Color | Typical Material |
|-------------------------|---|--|
| Organic |  | Drinks, fruits, meat, plastic, paper, etc. |
| Mixtures & Light Metals |  | Aluminum, salt, glass, ceramics, PVC, etc. |
| Inorganic |  | Metal knives, guns, keys, etc. |
| Impenetrable |  | Plumbum |

With the dual-energy CT technology, material information is acquired to colorize different materials with different colors in 3D images, which helps the operators to get the properties of the detected objects quickly.

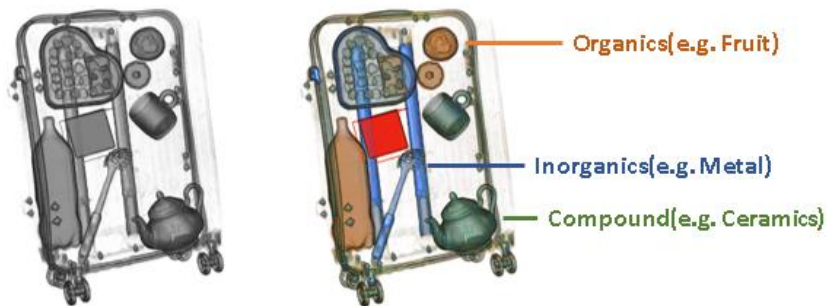


Figure 2-5 Dual-energy material discrimination



❑ **Powerful 3D image processing Functions**

XT2100HS exclusively provides 3D image processing functions such as 3D measurement, 3D marking, 3D image cropping, 3D super penetration, three-level-contrast etc., as well as negative, grayscale display, mineral/organic striping, surface enhancement, edge enhancement etc. With stepwise / stepless amplification up to 64 times in selectable image zoom regions, XT2100HS helps the operators identify the threats more effectively and efficiently.

❑ **Powerful network management and in-line screening**

XT2100HS provides network management functions such as remote resolutions, operations and diagnoses. It also provides customized design for interface protocols of different BHS suppliers to realize integration and communication with different brands of BHS.

❑ **Convenient maintenance design**

XT2100HS uses compact design with dimensions / weight of 5525mm(L) x2360mm(W) x2320mm(H) / 7500kg and runs on three-phase power (380V), avoiding modification to the installation field. The modular design provides easy replacement of key components and convenient maintenance, saving time and labors.

3 Service Area Requirement

XT2100HS is a product developed on the XT series platform. It shares the same module within the platform so that components and parts can be easily maintained and the spare parts can be employed universally with other products.

The XT2100HS requests minimized space for maintenance, it only needs 713mm for maintenance at each side (The longest point of door opening is 660mm). There is also no need for maintenance above the machine on the Mezzanine level. The service area requirement of XT2100HS is as shown in Figure 3-1.

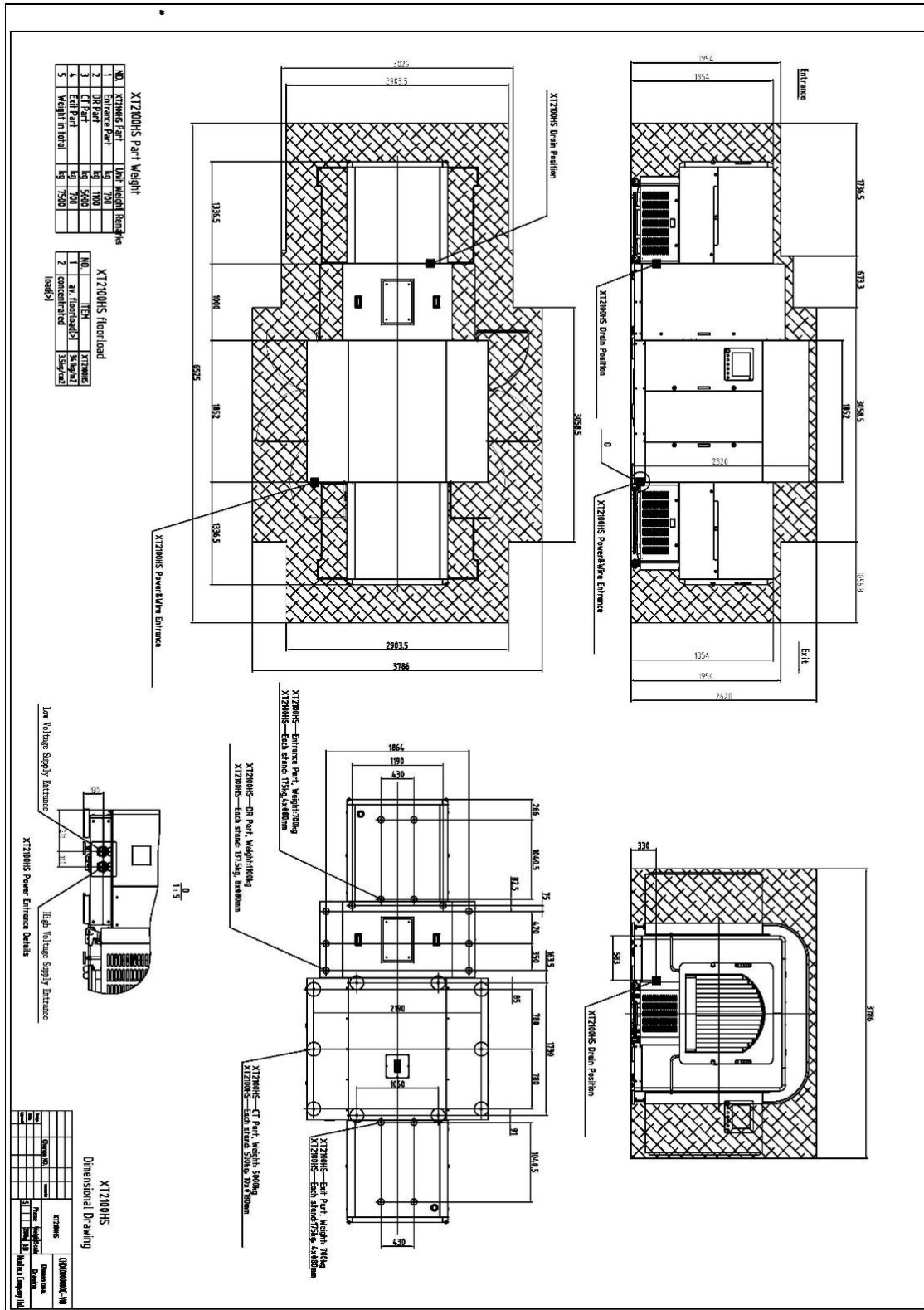


Figure 3-1 XT2100HS service area drawing

2/F Block A, Tongfang Building, Shuangqinglu, Haidian District, Beijing 100084, P. R. China

Tel: +86 10 62780909 - Fax: +86 10 62788896 - Website: www.nuctech.com



4 Technical Specification of XT2100HS

Table 4-1 Technical Specification Form of XT2100HS

| General Specifications | |
|---|---|
| Tunnel Dimensions | Width 1004mm, Max. height 890mm |
| Conveyor Height | 848mm |
| Max. Baggage Size | 1000mm(L) × 750mm(W) × 600mm(H) |
| Min. Load | 0.5kg (with the size of 210mm x 140mm x 70mm (LxWxH)) |
| Max. Load | 200kg (uniformly distributed) |
| Throughput | 1800BPH |
| Conveyor Speed | 0.5m/s |
| DR Wire Resolution | 40AWG (CAAC Standard) |
| DR Steel Penetration | 40mm (CAAC Standard) |
| Display Monitor | 24" flat color monitor / high resolution of 1920×1080, flicker free, low radiation |
| Max Noise level | 65 dB(A) (at a distance of 1 meter) |
| X-ray Leakage | Less than 1μSv/h |
| CT machine start up time | Less than 5 minutes 30 seconds (Including start up calibration time) |
| CT machine power off time | Less than 2 minutes |
| The minimum of contrast sensitivity of 4096 grey levels | Consigned to 256 colors and 32-bit visible levels. |
| Magnetic media safety | After screening process done by the system, there is no damage of magnetic recording media. |
| System Functions | |
| Image Processing Functions | Color / Black-and-white, Negative, Organic / Inorganic striping, Edge enhancement, Surface enhancement, Super penetration, 3D marking, Measurement, Clip, 3-level-contrast etc. |
| Image Zooming | 1~64 times enlargement, stepless magnification |
| Image Storage Management Functions | Over 50,000 images (standalone) Date/Time display, Bags counter, User management, System-on/ X-ray-on timers, Image saving and query, Power on self-test, Built-in diagnosis, Pervious scanned images review |
| Installation Data | |
| Dimensions/Weight | 5525mm (L) × 2360mm (W) × 2320mm (H) / 7500kg |
| Operating Temperature / Humidity | 0°C~+40°C/0%~90% (Non-condensing) |
| Storage Temperature / Humidity | -40°C~+60°C/0%~90% (Non-condensing) |
| Power Supply | Three-phase supply, 380VAC(-15%~+10%), 50Hz/60Hz±3Hz |



5 Certification Compliance

XT2100HS has already met the following standards:

Table 5-1 Certification Compliance Table

| Standards | Authority |
|-----------------------|--|
| ECAC EDS Standard 3 | ECAC |
| ECAC EDS Standard 3.1 | ECAC |
| EDS Norme 3 | STAC |
| CAAC Certification | CAAC |
| DfT | DfT |
| ENAC | ENAC |
| Radiation Protection | 21 CFR 1020.40 (Food and Drug Administration – FDA, USA) Certified Accession Number: 1711250-001 in USA Customs |
| | NF C 74-100 (Française de Normalisation – AFNOR, France) |
| | Röntgenverordnung - RöV (Bundesministerium der Justiz und für Verbraucherschutz – BMJV, Germany) |
| | Real Decreto 35/2008 (Ministerio de Industria Comercio y Turismo, Spain) |
| | GB15208-2005 (China) |
| CE | European Notified Body |