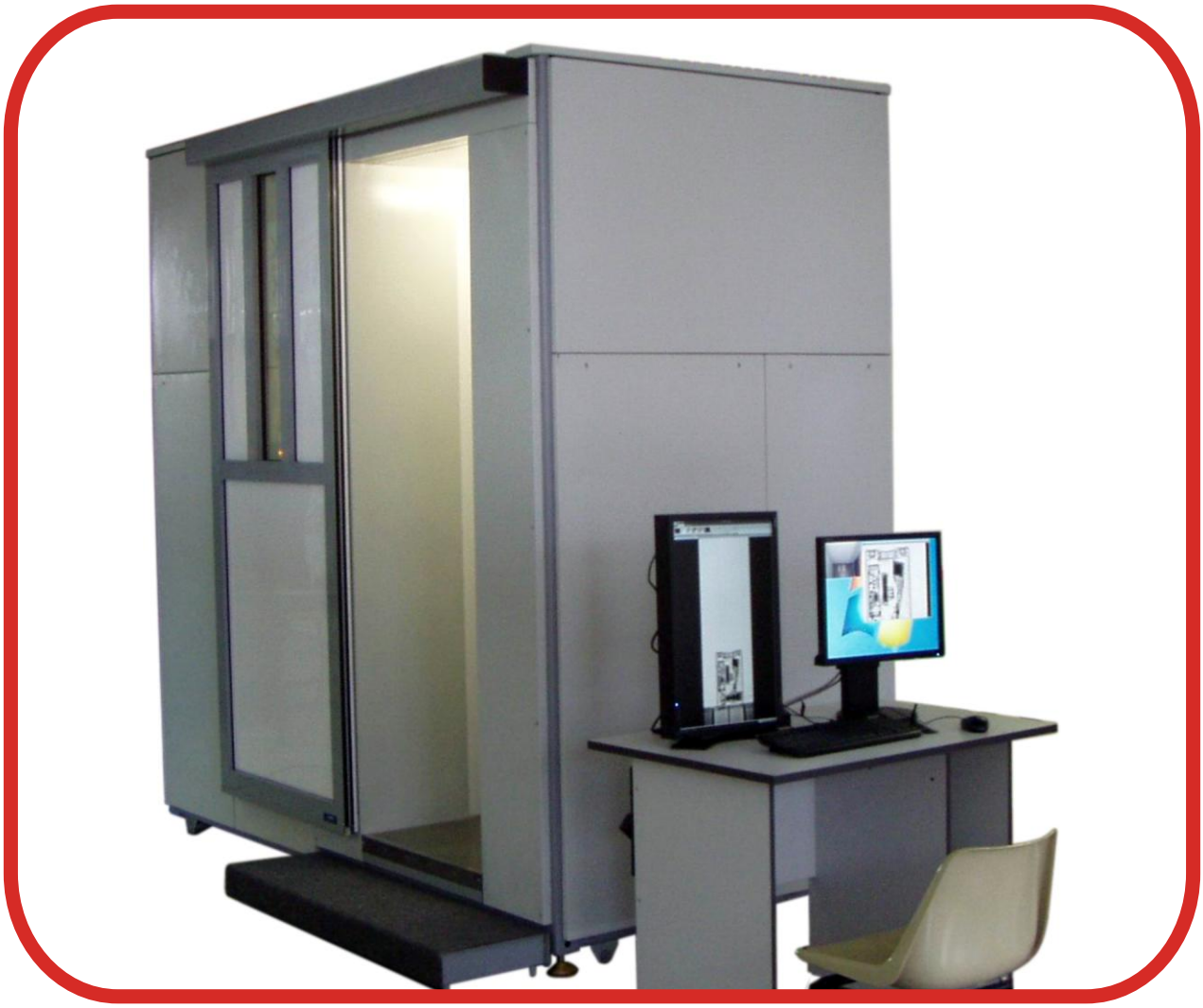
X-RAY BODY SCANNER

VZOR-TS



High throughput

High efficiency

Convenience

Negligible radiation dose

Being able to see various objects concealed in or under the clothes of a person, on or inside the body may be necessary in the following cases:

1. Systematic or selective control of passengers in airports, railway stations, the public at stadiums, theaters, concert halls, places of worship and other places of mass gathering.
2. Control of personnel working with noble metals, precious stones.
3. Control at customs station.
4. Control of visitors at strategic and sensitive sites.

The goal of such control is to uncover any suspicious objects (metallic and non-metallic) and illegal substances concealed in and under clothes, in the shoes, on and inside the body. In other situations, it might also be desirable to screen people wearing prosthesis.

Today, the standard practice around the world is to use metal detectors, followed by pat-down over the entire body, or even thorough checks requiring the person to undress and be subjected to possibly humiliating controls. These procedures are demanding and embarrassing for both parties and prove to be time consuming. These problems are even more exacerbated in countries with cold weather where people wear a lot of warm and thick clothes.

The emergence of modern technologies now makes it possible to conduct such controls using equipments such as X-ray Body Scanner “VZOR-TS”.

Based on the need expressed around the world to screen people for weapons, contraband and explosives concealed in or under their clothes, on their body or even inside their body, it is now possible to derive the main requirements for full body inspection equipments such as the “VZOR-TS”.

a) Technical requirements

- High sensitivity to contrast to be able to discover small low contrast objects hidden on or inside the body which have a density very close to that of human tissues;
- High spatial resolution of the image in order to identify not only the boundaries (shapes) of concealed objects but also their internal structure.
- Small geometric distortions of the images in order to facilitate the identification of the objects and the nature of the danger;
- Full Body image (size up to 2 m) to discover objects hidden in any part of the body or in his clothes and shoes;
- Short inspection time.

b) Operational requirements

- The inspection must be innocuous for the person screened and for the operators;
- The system must provide a high throughput (3-4 persons per minute);
- The system must not create any inconvenience or discomfort to the person screened, especially it must not require the person to take any cloth off or to take any uncomfortable position;
- The equipment must have a high reliability;
- Negligible radiation dose.

Two main approaches can be explored to address the requirements stated above:

1. Solutions based on “surface detection” all over the body of the person using a narrow planar fanning beam of either radio-waves or soft X-rays followed by the detection of reflected (scattered) radiation to detect concealed objects. Such an approach would require people being screened to take their shoes and street clothes off, and take uncomfortable positions that permit the inspection of areas of the body that are naturally inaccessible, i.e. the armpits or the area between the legs.

2. Solutions based on scanning the body using penetrating X-rays. With such a solution, no object concealed on the body or in the body can evade screening; furthermore, the person being checked does not need to take any of its clothes off nor to take any special position during the screening.

There is a widespread mis-perception that the first solutions are quite innocuous while second solutions are dangerous for the health.

The first solutions can, at best, only partially address the requirements because radio waves have a limited penetration capability. Heavy clothes and shoes must be removed during inspection. As a consequence, this type of equipment is not widely used.

From the technical point of view, it is obvious that only equipment of the second type can solve the problem of mass inspection, assuming that the irradiation dose for the inspected person is negligible.

In many countries, health regulations impose that people be not exposed to a radiation dose that exceeds 250 μSv per year. This means that the dose obtained during X-ray inspections must not significantly exceed the average dose obtained from the natural radiation background. For airport security, this means that the average dose per inspection for a passenger flying a round trip everyday must be less than 0,5 μSv.

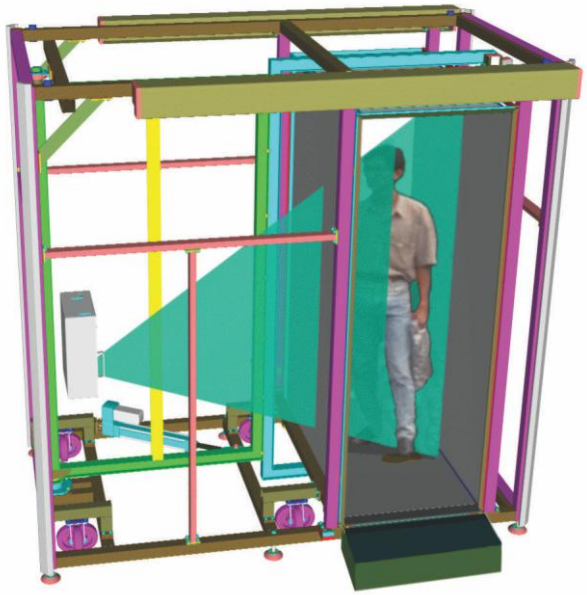
To satisfy this requirement the body scanner must provide an extremely low exposition dose of radiation. This means that both the flux of quantum and their energy must be as low as possible. A low flux of quantum leads to a very low number of quantum to be digitally registered per detector cell, thus leading to a relative statistic error of registered quanta as high as 20-30 percents. This, in turn results in images of poor quality (images are not clear). In other words, the lower the dose is, the worst the image quality is.

To avoid this problem, developers of modern X-ray machines have generally increased the size of the pixel (higher pixel size – more quanta per pixel – better clarity of images). The drawback of this approach is that it reduces the ability to detect small details of the object being inspected.

There is however another way to solve this problem and get the necessary image quality when operating at low exposition dose. It consists in increasing of efficiency of the registration of X-ray radiation. If the efficiency is maximal, the image quality is the best.

High-performance X-ray receiver (detector) with a pixel area of 1.5 x 3.2 mm is implemented in the system.

To avoid radioactive exposure of the staff and surrounding people the VZOR-TS system is equipped with a protective cabin. Radiation safety for surrounding people is also an important advantage of the VZOR-TS system in comparison with other systems of X-ray inspection.



The new system of personal inspection VZOR-TS has the following features:

- X-ray optical system performes scanning by narrow fan-shaped ray with vertical orientation.

- System's design has a reversible circuit of "the passage" inspection , i.e. two doors, which allows to arrange the inspection procedure more effectively.

- The photograph of a person being screened is stored in special database.

The main VZOR-TS technical characteristics

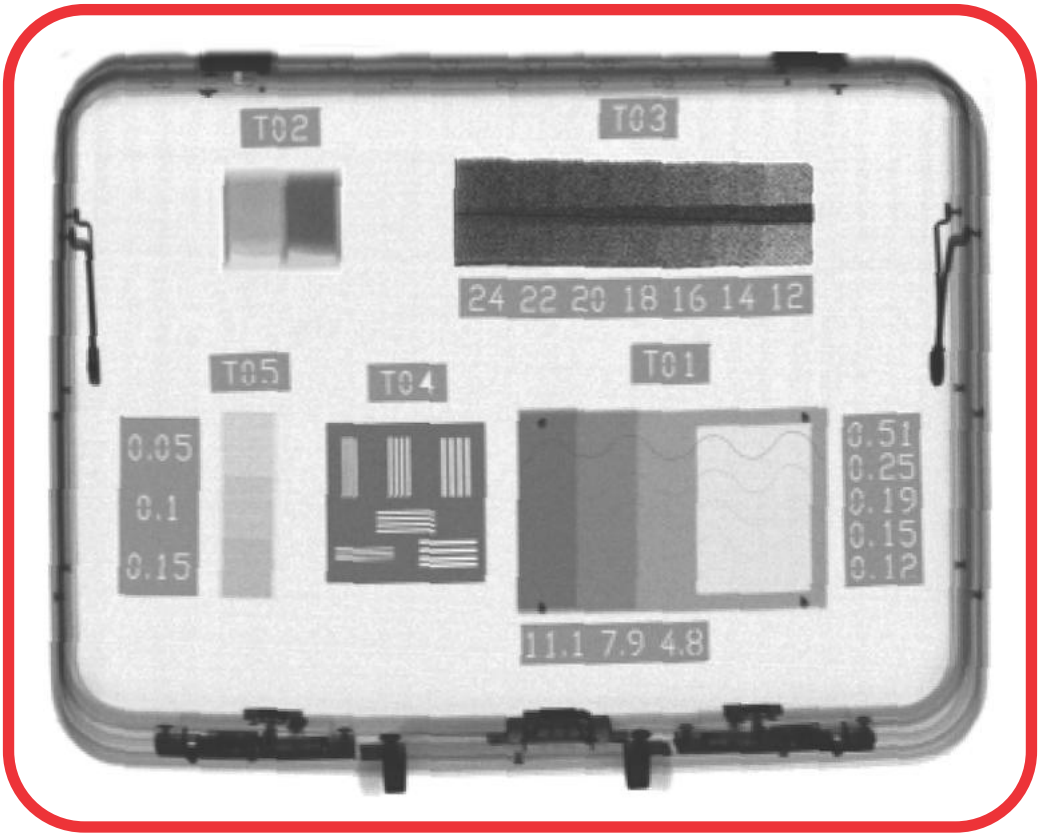
Size of the area inspected	2120 x 850 mm
Resolution	0.33 line pairs / mm
Detectivity for copper wire	not less than Ø 0.19 mm / Ø 0.15 mm*
Penetration power for steel	not less than 20 mm / 22 mm* thickness
Maximal scanning time	3 sec
Throughput	3 persons/min
Radiation dose during one scanning	not more than 0.20 μZv / 0.30 μZv*
Power consumption (without PC)	not more than 0.5 kW
Overall dimensions	not more than 2610 x 1744 x 2600 mm**
Weight netto	not more than 1300 kg

* for the «Normal» mode / for the «Full» mode
** on the floor, without steps

The radiation dose of the “VZOR- TS” is equivalent to the dose, received during 5 minutes flight at the altitude of 10,000 meters, which is only 10% of the daily dose received from natural background.

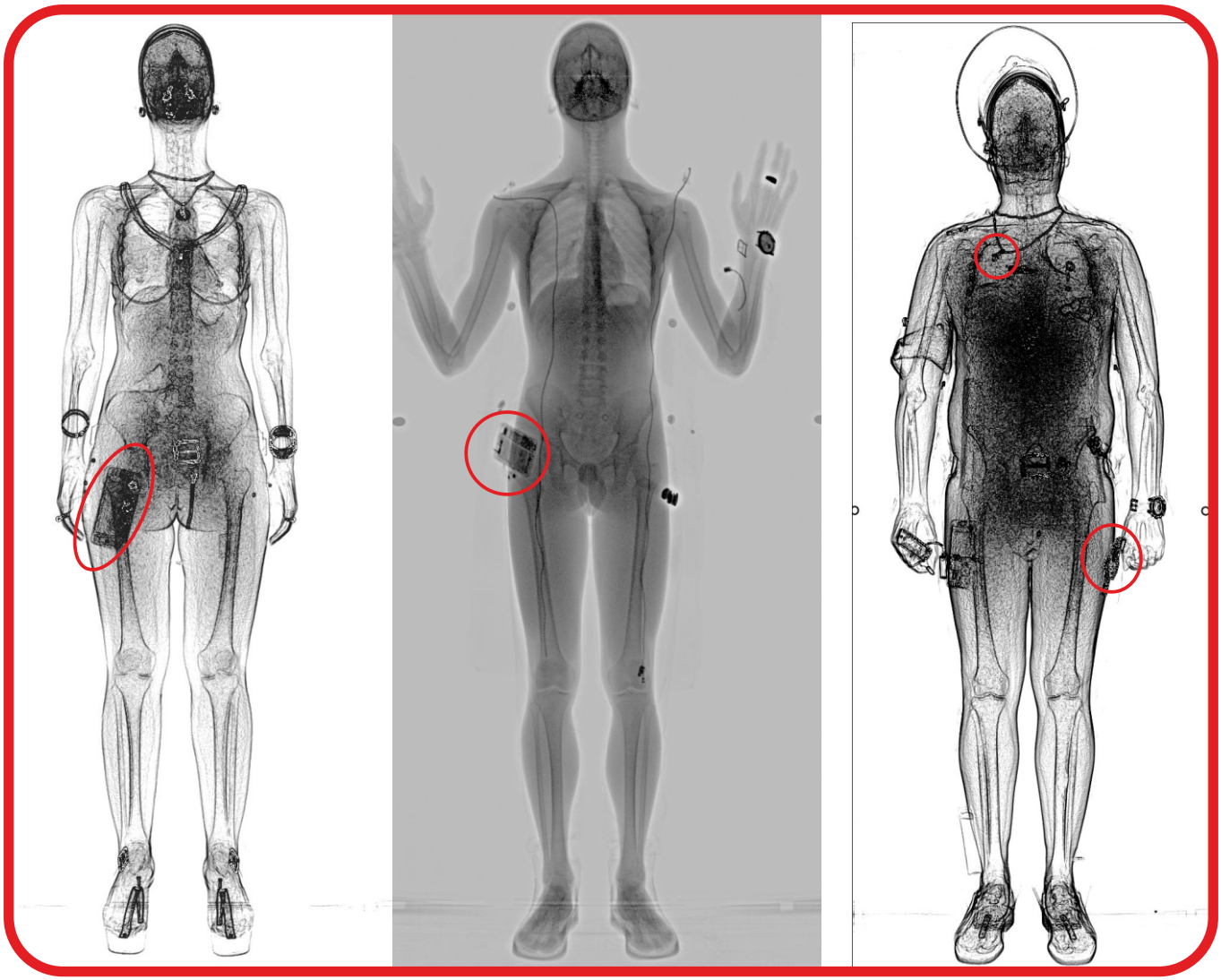
Wide dynamic range, high contrast sensitivity and spatial resolution of the «VZOR-TS» system along with the software images processing allow to detect objects of density similar to human body tissues as well as the objects having a higher density (metal).

Figure below shows the suitcase containing a set of test-objects designed to test the parameters of X-ray systems (introscopes) by a method of the image estimation on a monitor screen. Scanning of the set was performed in "Full" mode.



Powerful software with user-friendly multilingual interface opens wide possibilities for development and application of new inspection techniques.

For example, some metal objects, as well as contours of clothes are visible at the images.



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