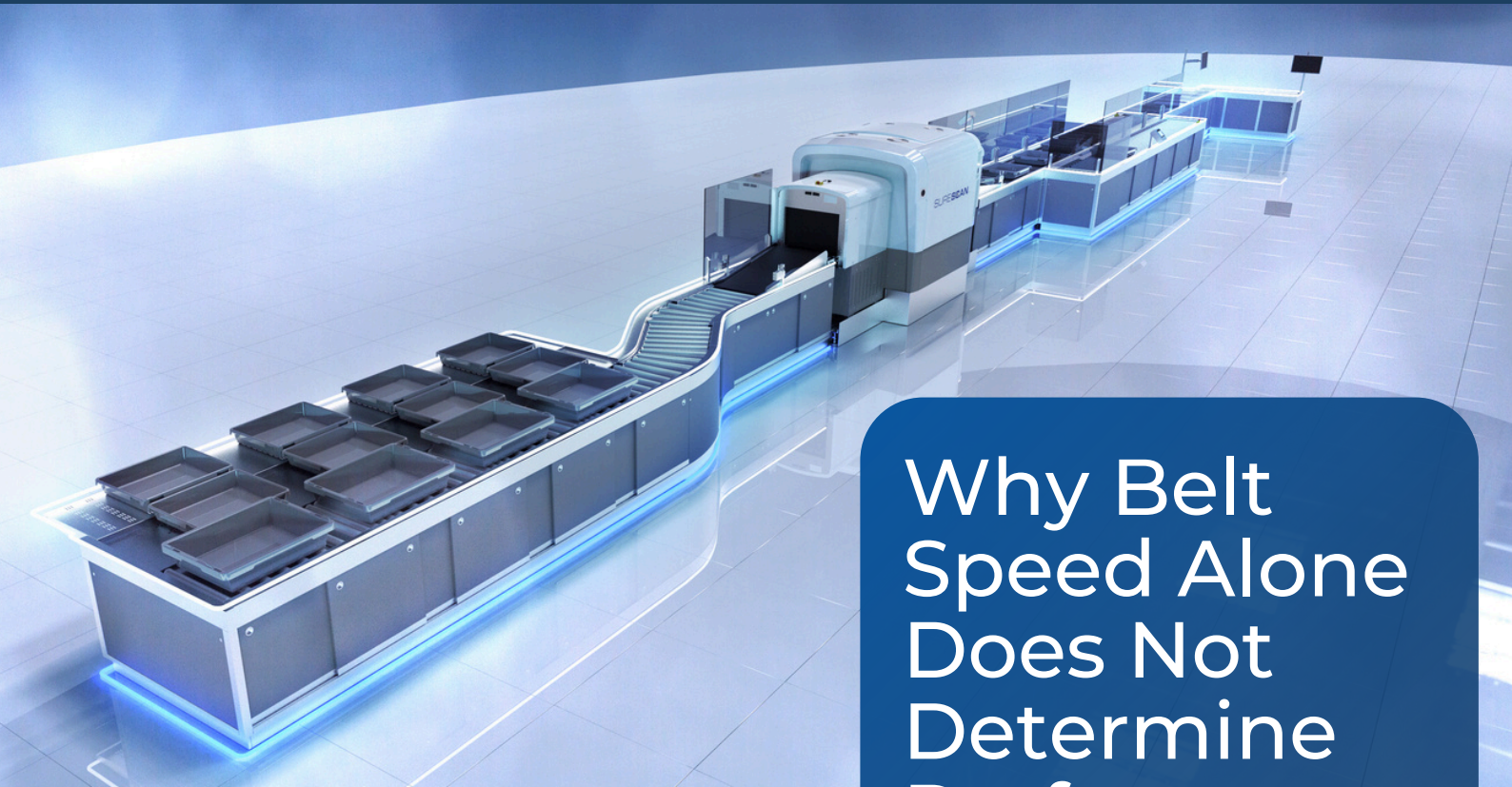


THE MYTH OF CHECKPOINT SECURITY LANE BELT SPEED ON OVERALL LANE THROUGHPUT



Why Belt
Speed Alone
Does Not
Determine
Performance

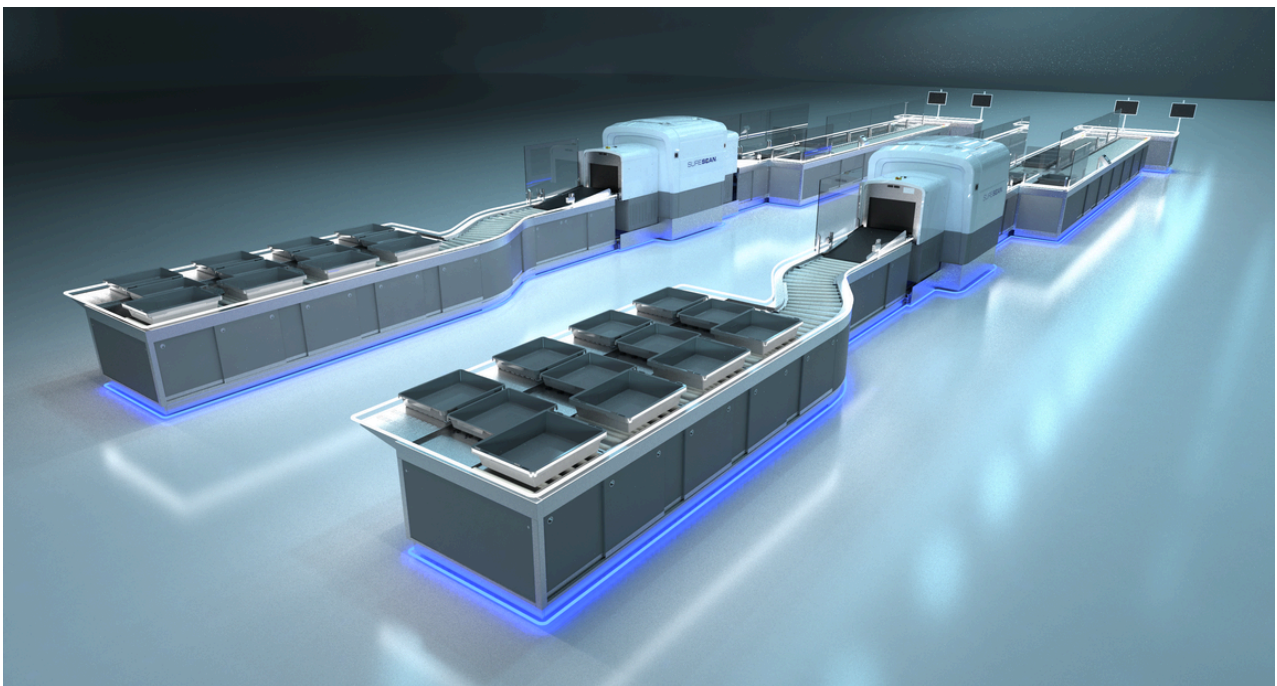
SURESCAN™

Executive Overview

In a system as complex as an advanced checkpoint security lane, overall performance depends on many factors, with belt speed being only one of them. Without optimizing all the elements that influence throughput, high belt speed systems alone will not achieve the promised throughput.

While some factors influencing performance are well known, such as Screener Review Time, Screener Multiplexing, and System Alarm Rate, others are less apparent. These include the number of queuing spaces between the scanner and the tray diverter, approach to recovering from dieback, overall Automated Tray Return System (ATRS) optimization, and even the approach to Radiation Safety. By addressing both the obvious and subtle contributors to efficiency, a solution can be developed which can deliver consistent, measurable gains in real-world performance.

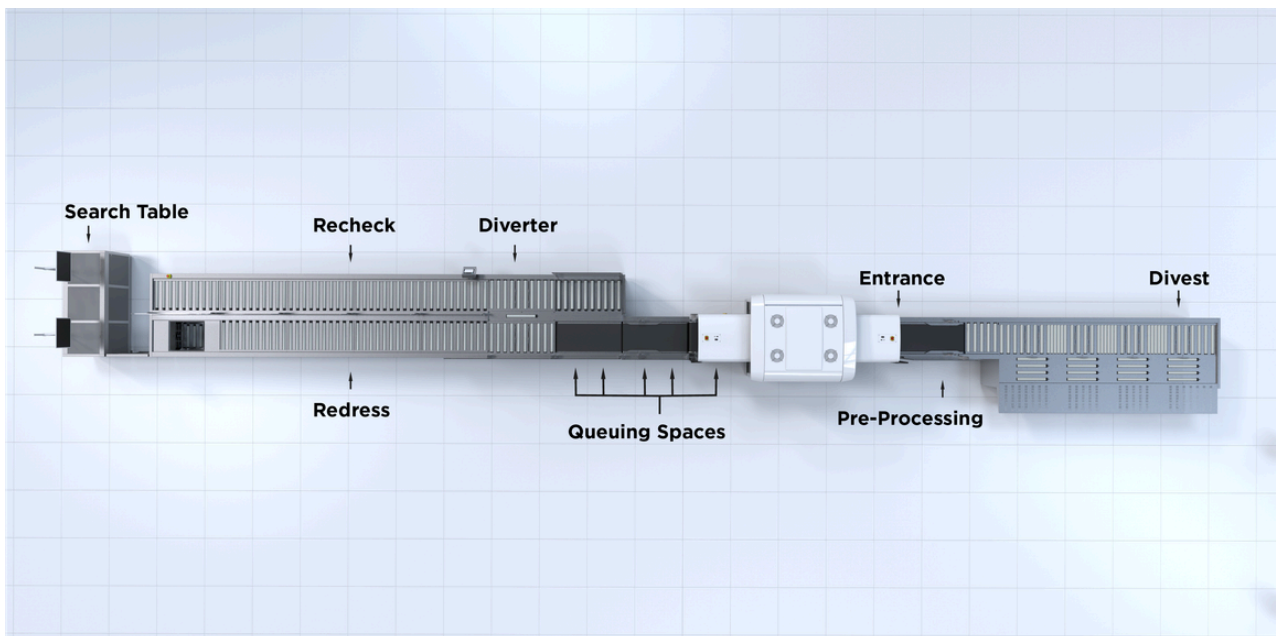
SureScan had developed its DETECT™ 1000 checkpoint computed tomography (CT) unit to optimize these visible and subtle contributors, achieving high throughput by optimizing the CT design coupled with a tight integration with an ATRS to achieve significantly higher throughput than competing systems, as demonstrated at Las Vegas's McCarran Airport (LAS) Innovation Checkpoint.



SureScan's DETECT™ 1000 CT system integrated with the SureFlow ATRS, optimizing both visible and less apparent contributors to checkpoint throughput.

Keep Trays Moving

One of the key points in maximizing throughput is ensuring that **trays never stop moving**. CT scanners are most efficient when they operate with a **continuous belt**, maximizing the **valuable X-ray resource**. Stopping the CT belt, whether a bag is in the beam or not, idles the entire ATRS immediately impacting passenger throughput. A critical design consideration is the number of **“queuing spaces”** between the scanner and the **tray diverter**. As a tray is delivered to an image workstation for analysis, we want screeners to finish the review before the tray reaches the diverter and the scanner has filled up all the queuing spaces behind that tray. As soon as queuing spaces are filled, the scanner must pause, wasting valuable X-ray capacity and directly reducing passenger throughput.



Checkpoint layout showing tray flow from divest through CT scanning to the diverter, highlighting queuing spaces as the critical buffer that prevents scanner stoppages and preserves throughput.

In this assessment, it is important to consider not only the **average decision time** for a screener but also the **maximum typical decision time**. For example, consider a scanner capable of **processing a tray every 6 seconds**, and screener data indicating an average decision time of approximately 12 seconds. It may seem reasonable to assume that two queuing spaces would be sufficient to accommodate the screener's review process. However, an “average” decision time of 12 seconds means that while some bags are processed more quickly, many require longer. With only two queuing spaces, the **system will have to stop** for every tray that exceeds the average time. This could be as much as half of all trays, resulting in **significant throughput losses**.

Keep Trays Moving

As soon as queuing spaces are filled, the scanner must pause, wasting valuable X-ray capacity and directly reducing passenger throughput.

Stoppage will occur **regardless of how many screeners are available** or whether the system operates in **Image On Alarm Only (IOAO)** mode. Even if additional screeners are available to receive and clear the images for the two trays behind the delayed bag, the system will be forced to stop once the available queuing spaces are full. There is simply **nowhere for additional trays to go!** The same applies to IOAO systems, and the queued bags have been cleared by the scanner. The system will still have to stop, and throughput will be lost.

Rather than consider only the average, it is important to consider the maximum typical decision time; while the average may be 12 seconds, some images take longer, and if **10% take at least 24 seconds, designing the ATRS with 4 Queuing spaces** limits throughput impact to that 10%, while 5 queuing spaces with a 30-second timeout ensures **continuous belt speed** through the CT.



Checkpoint operation illustrating how filled queuing spaces force the CT scanner to pause, reducing throughput regardless of available screeners or operating mode.

Of course, **queuing spaces are not “free”**. There is always a tradeoff between the throughput benefits of additional Queuing spaces and the difficulty of fitting a longer lane into constricted airport spaces. Checkpoint lane designers need to **trade off the lane length versus throughput** as an integral part of the **overall system design**.

Tray Design

Another key part of impacting throughput is **tray design**. While many people might assume that “a Tray is a Tray,” characteristics of the trays will impact the **overall throughput** of the system. For example, a tray that is **too small** will force many passengers to require two or more trays, while a tray that is **too large** will waste scanner time on mostly empty trays. SureScan offers our SureFlow system in two tray lengths (700 and 630 mm). This allows airport screeners to standardize to the tray length that best meets their passenger base. At a width of 550 mm, the SureFlow trays are also designed to **take full advantage of the width of the scanner tunnel**. (Wide trays take no more time to scan than narrow ones). Tray height is also an important factor. Lightly loaded low trays penetrate radiation curtains more easily than similarly loaded tall trays. However, low trays offer little protection to their contents as they pass through those curtains. Consequently, belongings can be more readily swept out from low trays than from taller trays. This can result in loose items (mittens, stuffed animals, etc.) getting dislodged and stuck inside the scanner. Stopping operations to recover such articles from the scanner is devastating to throughput.

Tray Design Factors Affecting Throughput



Small trays can increase tray demand per passenger.



Oversized trays waste scanner time on partially empty loads.



Tray width affects how efficiently the scanner tunnel is used.



Low trays provide less containment for loose items.



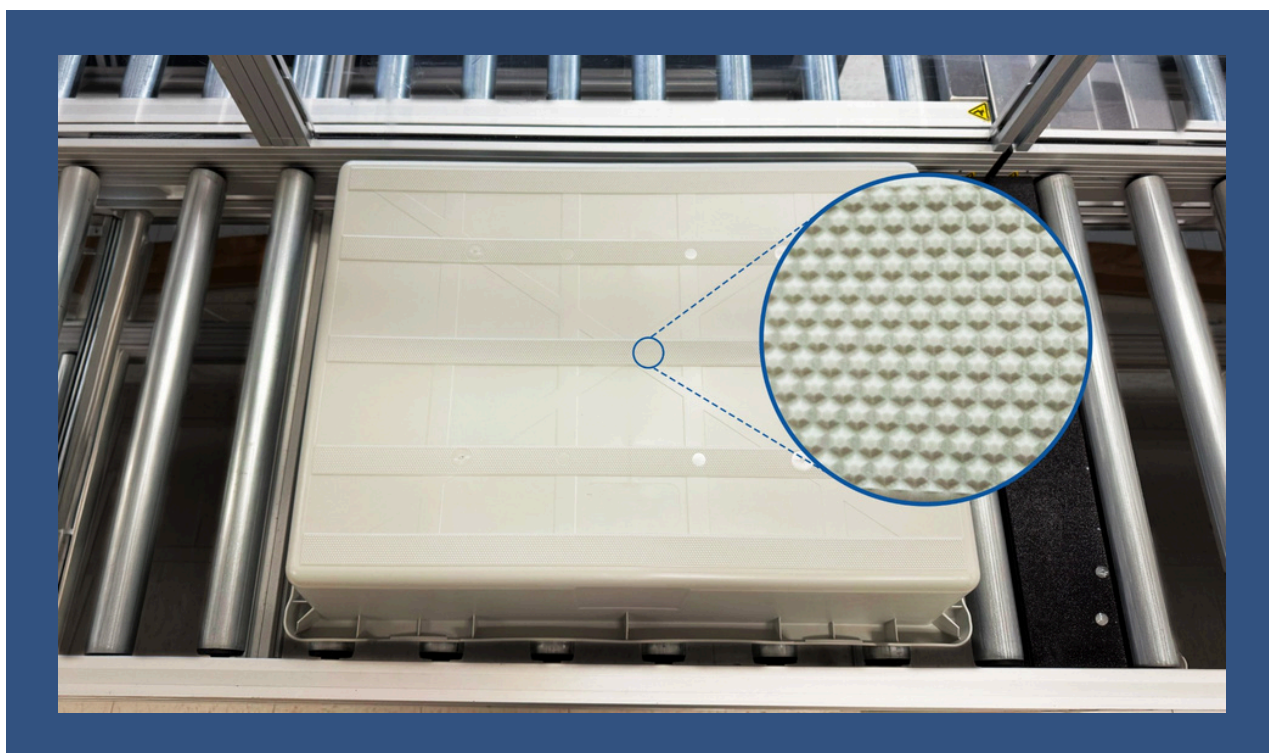
Dislodged items can cause scanner stoppages and reduce throughput.

The SureFlow trays are a medium height of 140 mm, such that they can transit the curtains reliably, but they also incorporate SureScan’s patent-pending innovation of interlocking trays. The interlocking feature allows the passenger or the Divestment officer to protect tray contents with lots of loose elements by flipping a tray over and securely placing it on top of the first. This creates a fully contained tray that protects the items inside from being molested by the curtains.

Tray Design

Stopping operations to recover dislodged items from the scanner can have a severe impact on achievable throughput.

Finally, as an additional innovation, SureFlow trays incorporate built-in traction features to keep the trays from slipping on the conveyor. Most tray manufacturers depend on traction tape attached to the bottom of trays. This works fairly well until the tray is used many times and the adhesive starts to fail. Then the strips separate from the trays, leaving them dangling and giving the operation a decidedly unprofessional look. SureScan builds a traction structure directly into the bottom of the tray, as seen below. This structure allows the tray to grip onto the belt and improves movement through the system.



SureFlow tray with built-in traction structure, improving grip on the conveyor and maintaining consistent movement through the system.

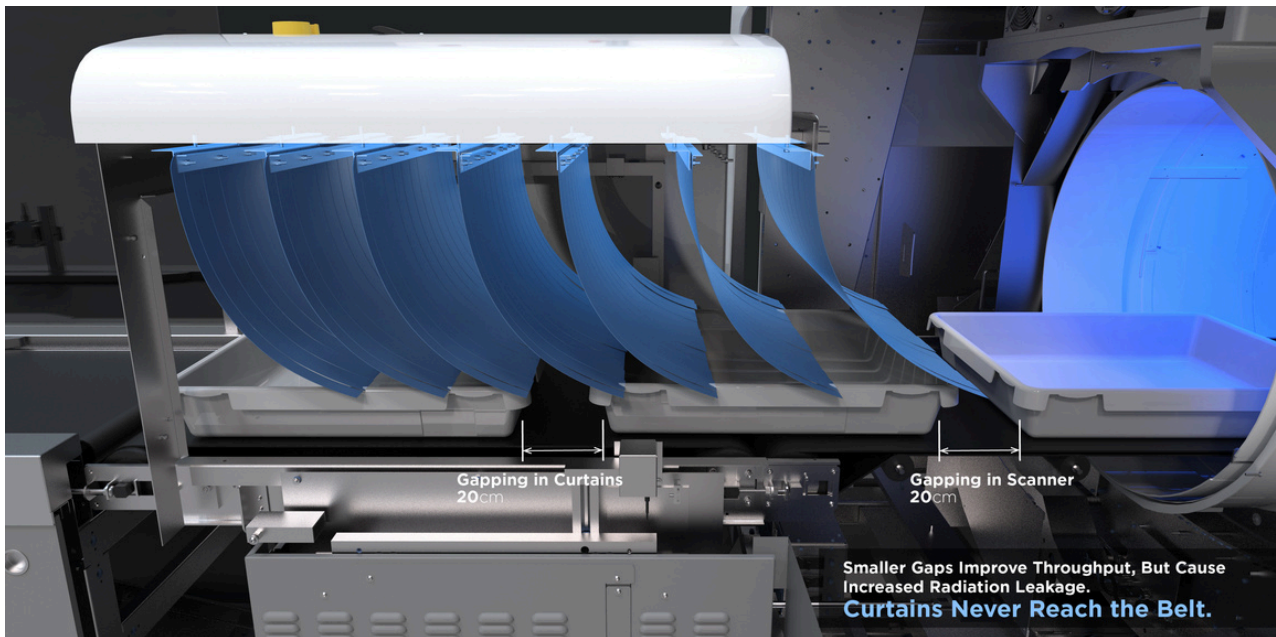
Key Takeaway:

Built-in traction keeps trays from slipping, reducing stoppages and improving movement through the system.

Combined together, these finer aspects of tray design can have a substantial positive impact on overall system throughput.

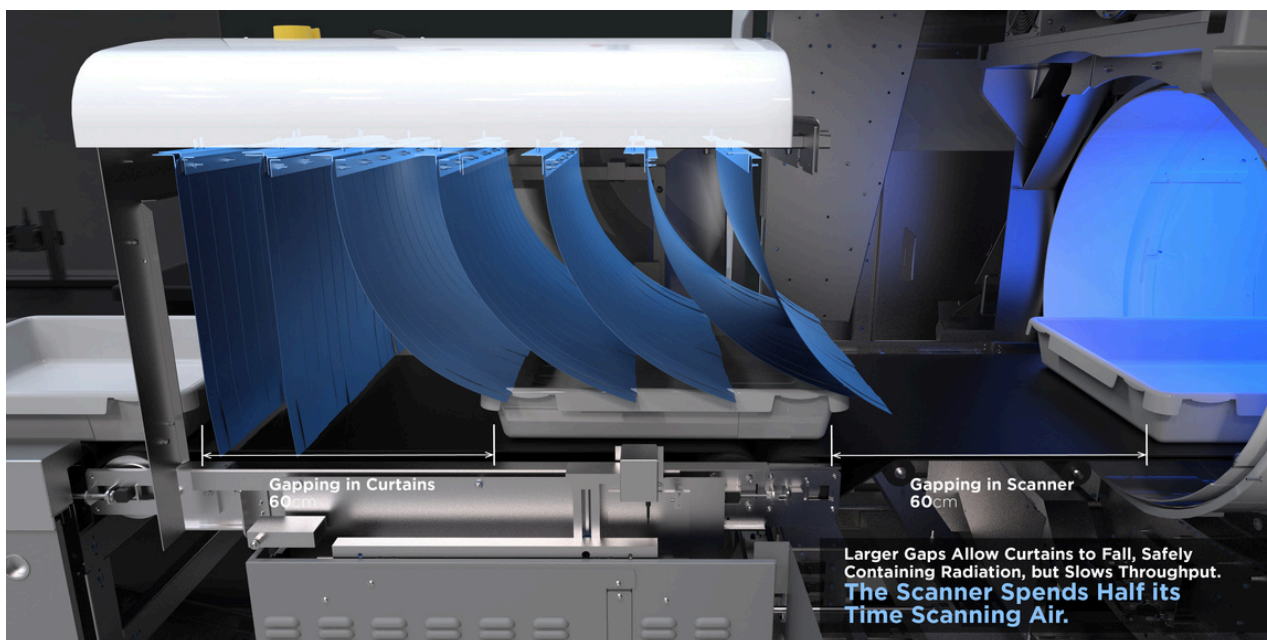
X-ray Containment

Another important, though less obvious, factor affecting throughput is radiation containment. To maximize the number of trays that pass through a scanner at a given belt speed, the goal is to minimize the spacing between trays. Closer spacing reduces wasted scanner capacity spent on empty tunnel space and increases overall efficiency. However, tight spacing creates a significant drawback: it prevents the shielding curtains from fully blocking radiation from escaping into public areas.

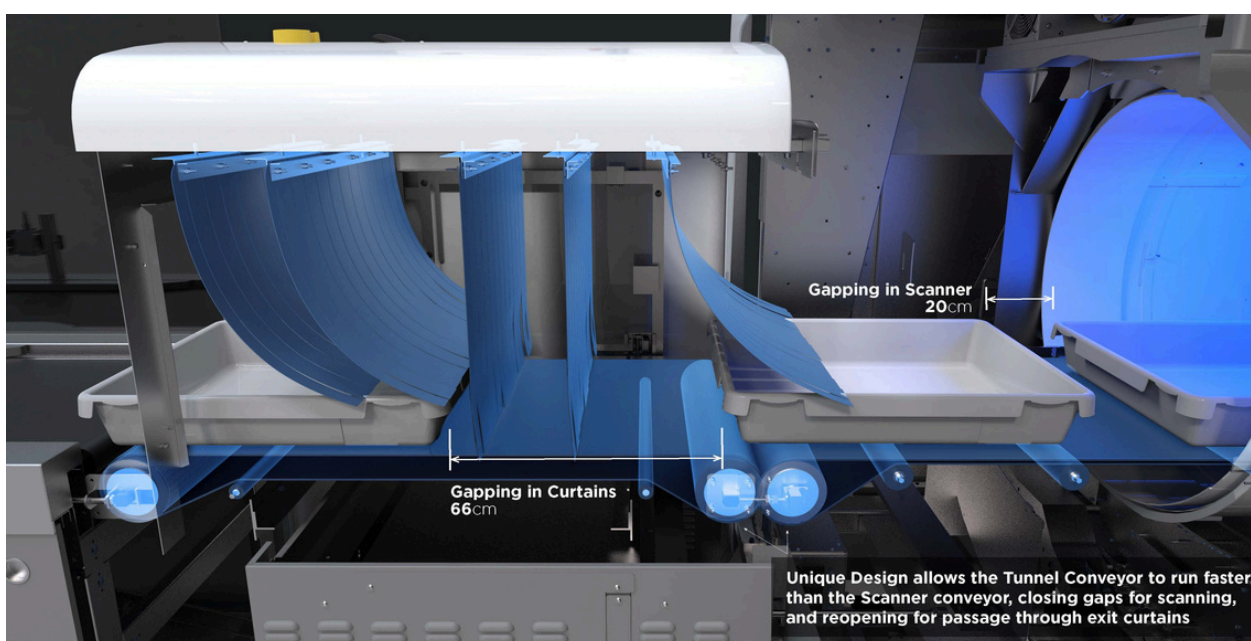


In the diagram above, a series of trays is shown passing through the shielding curtains prior to entering the X-ray imaging section of the scanner. When the curtains are down, they effectively block the X-rays from leaking out. This is confirmed by the standard static measurement of radiation leakage, which is measured without bags moving through the system. However, during real operation, the curtains rise up as the trays pass through. As shown in the figure above, when trays are spaced closely together, such as only 200 mm (8") apart, Tray 3 reaches the 4th curtain plane (attachment point) before the 4th curtain has fully dropped off Tray 2. This means that the 2nd curtain will never be fully down, allowing X-rays to leak through the trays. This problem repeats at each curtain plane. (It is important to note that baggage itself is not an effective radiation shield since X-rays can easily pass through most materials that make up typical luggage). This issue is particularly problematic for CT systems, which generate substantially more X-rays than older projection systems and therefore pose a higher risk of radiation leakage. To prevent this leakage, greater spacing between trays is required to allow one or more layers of the shielding curtains to fully settle onto the belt before the next tray enters the curtain plane.

X-ray Containment



In the diagram above, the trays are separated by 660 mm (26"). SureScan has determined that this spacing, approximately equal to the full length of a tray, is necessary for proper radiation control. In this configuration, two curtains have completely fallen, and the third is about to fall off of Tray 2 before Tray 3 begins lifting the first curtain. This approach controls radiation; however, throughput is severely impacted. Even with a substantially higher belt speed, a scanner spending half its time scanning air will not achieve high throughput. As a result, radiation safety is often traded off against throughput, at least in the case of a single conveyor scanner.



SureScan's unique architecture for optimal X-ray containment.

X-ray Containment

Unlike competing systems, the SureScan DETECT™ 1000 is a multi-conveyor scanner. Our system has three (3) independent conveyors in the entrance tunnel, the exit tunnel, and the scan section. Our patented Dynamic Flow Throughput system leverages this unique architecture to provide a solution to maintain proper radiation control while maximizing throughput. The entrance and exit belts operate at significantly higher speeds than the scanner belt, allowing trays to be introduced into the scanner with the larger gaps required for the shielding curtains to fall fully between trays. As illustrated in the figure above, this spacing ensures effective radiation containment by allowing the shielding curtains to fall fully into place between trays. These large gaps are reduced as each tray catches up with those moving on the slower scan belt, resulting in efficient use of the scanner's available imaging capacity. The gaps are then opened up again as each tray transitions onto the exit conveyor, again allowing the curtain to fall properly between trays and contain the X-rays effectively. This approach maximizes throughput while minimizing radiation leakage.

Dynamic Flow Throughput Benefits:

- Maintains proper radiation control while maximizing throughput
- Allows shielding curtains to fall fully between trays
- Uses larger gaps at entry and exit, then closes gaps in the scan section
- Ensures effective radiation containment
- Minimizes radiation leakage while maintaining throughput

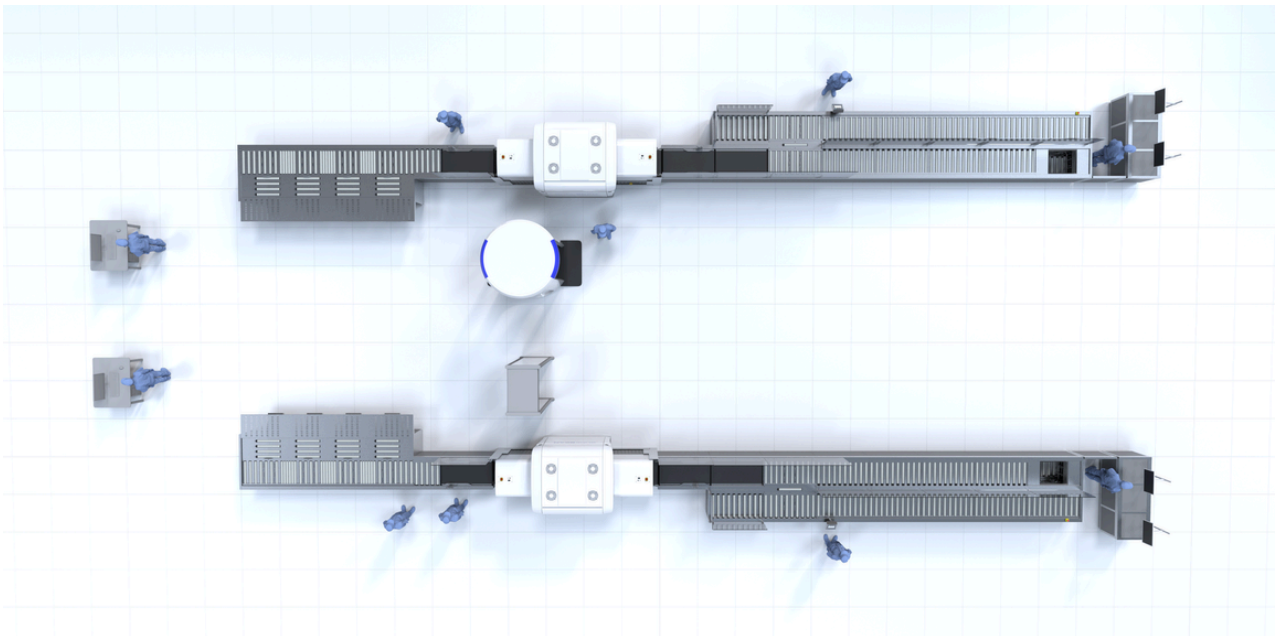
It is important to note that the type of leakage described above can only be assessed in a “dynamic” radiation test. Traditional, or “static” testing measures leakage with the shielding curtains undisturbed and therefore does not reflect the operational reality. In contrast, dynamic radiation testing is performed with loaded trays passing through the system at maximum throughput while radiation meters measure at belt height near or around the system entrance and exit. Dynamic testing provides a far more accurate representation of the radiation load that passengers would receive. By validating performance through dynamic testing, SureScan demonstrates its commitment to delivering maximum throughput without compromising radiation safety.

(Note: for more information on how to conduct dynamic radiation testing, please contact SureScan).

Checkpoint Operations Impact

The analysis presented demonstrates that belt speed alone does not determine throughput. True performance depends on understanding and optimizing all factors that influence how consistently trays continue moving through the system. SureScan's results at LAS confirm that a system designed around real ATRS behavior can outperform higher belt speed competitors by keeping trays moving, maintaining appropriate queuing spaces, and minimizing scanner stoppages. This approach ensures that the scanner operates continuously rather than idling when queues fill or trays bunch together.

In a live security checkpoint processing stream of commerce bags, this analysis – when implemented through exceptional engineering and craftsmanship – results in a 2-lane mod set processing close to 600 standard passengers per hour in a typical TSA checkpoint configuration, as depicted below.

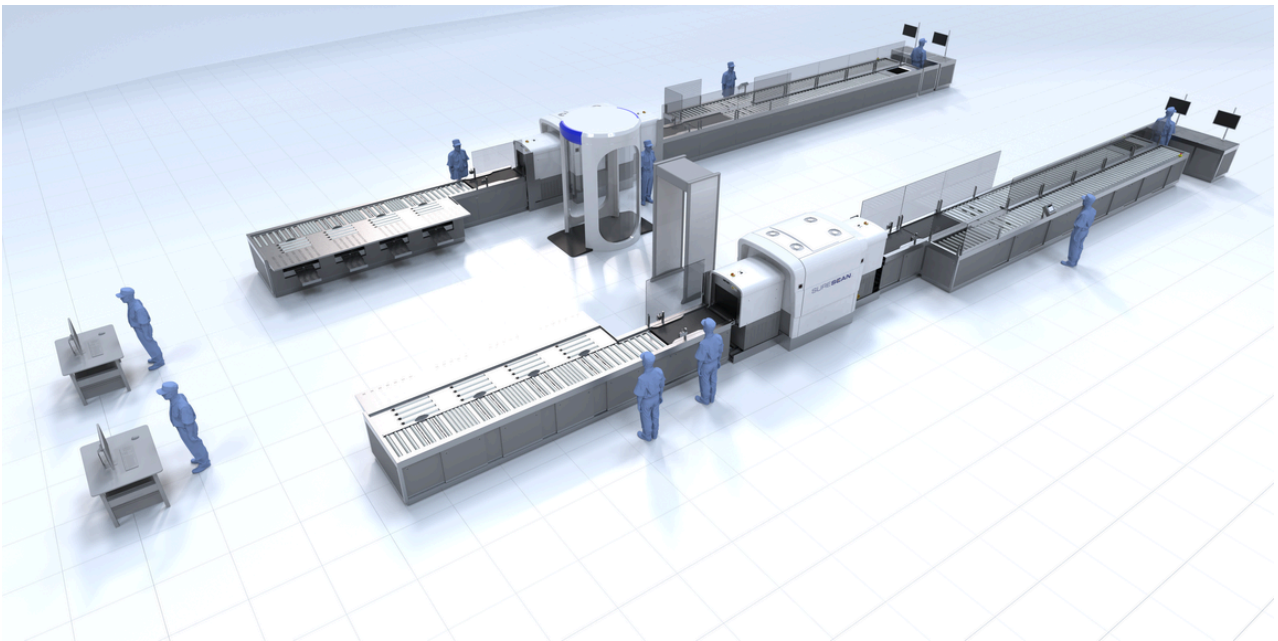


Two-lane checkpoint configuration achieves high throughput by keeping trays moving, maintaining proper queuing, and minimizing scanner stoppages.

This layout, when effectively implemented, can result in significant security cost savings.

Checkpoint Operations Impact

This paper highlights that passenger throughput depends on thoughtful system design, including queuing space configuration, continuous tray flow, and radiation-safe tray spacing. By addressing both the visible and less apparent contributors to performance, SureScan provides consistent and measurable throughput gains in real operating conditions without compromising radiation safety.



Checkpoint system designed to optimize queuing, continuous tray flow, and radiation-safe spacing, delivering consistent and measurable throughput gains.

Increasing passenger loads and shrinking profit margins and budgets suggest airports are forced to do more with less. By upgrading to multiplexed CT technology that offers superior performance at lower costs, airport screeners can better position themselves for the future of aviation passenger loads and security screening by pursuing technologies with an existing and proven performance record. **From fewer lanes required – thereby reducing capital investment and airport space required – to a smaller and better-utilized workforce, the question for airport screeners today changes from, “can we afford to do this?” to, “can we afford not to do this?”**

ABOUT SURESCAN CORPORATION

SureScan Corporation has pioneered next-generation CT and X-ray screening technologies, with products deployed worldwide since 2017. With comprehensive solutions spanning Checked Baggage, Checkpoint, and Cargo security, SureScan is committed to shaping the future of global security through innovation, precision, and reliability.

Building on this foundation, SureScan continues to expand its capabilities with solutions such as the SureFlow tray return system, further enhancing efficiency and performance across security operations. Learn more at [SureScan Corporation](https://www.surescaneds.com).

For further information, please contact SureScan Corporation at info@surescaneds.com



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