International Civil Aviation Organization
CAR/SAM REGIONAL PLANNING IMPLEMENTATION GROUP (GREPECAS)
Fifth Meeting of the GREPECAS Aviation Security Committee (AVSEC/COMM/5)
Buenos Aires, Argentina, 11 to 13 May 2006

Agenda Item 4 Development of the AVSEC/COMM Work Programme
4.1 Hold Baggage Screening Task Force Developments (AVSEC/HBS/TF)

GUIDANCE MATERIAL TO FACILITATE THE IMPLEMENTATION OF HOLD BAGGAGE SCREENING ON A GLOBAL BASIS

(Presented by the International Air Transport Association [IATA])

SUMMARY

In order for the ICAO requirement for 100% Hold Baggage Screening to be fully effective, technical screening methods must be used in conjunction with standardized procedures for all directly and indirectly involved in the process of Hold Baggage Screening. This paper present the IATA view on how best to implement 100% HBS and ensure that screening procedures are formalized in order to ensure that screening standards meet globally accepted standards.

References:

- IATA Position Paper on 100% Hold Baggage Screening (September 2003) (**Appendix 1**)

1. Introduction

1.1 The air transport industry operates in an extremely complex environment. In order to properly service their customers, air carriers must operate a multiplicity of routes, through numerous transfer and transit points involving numerous States, airports and often air carriers.

1.2 Superimposed on this already complex network are decisions made by individual States regarding the security and facilitation standards that they require within their territories as well as security and facilitation measures to be adopted by their registered air carriers when they operate in another State. This regulatory/operational environment has been made even more complex and difficult since the tragic events of 11 September, 2001.

1.3 This makes it essential for industry to participate with the regulatory and border control agencies and other security related organizations in their States at an early stage in the planning process so as to ensure that hold baggage screening (HBS) is introduced in the most cost-effective way and to avoid unnecessary costs which may otherwise be imposed upon them.

2. Implementing 100% HBS Systems

2.1 Numerous States have already implemented 100% HBS, however the efficiency and effectiveness of these systems varies substantially from State to State and often from airport to airport within a State.

2.2 The efficiency and effectiveness of the HBS system in a particular airport can have a major impact on facilitation of passengers. As an example, the speed with which hold baggage is processed has a direct impact on originating passenger processing time as well as the Minimum Connect Time (MCT) for those passengers transiting or transferring through a particular airport.

2.3 The impact of HBS systems on passenger processing not only directly impacts on the efficiency with which passengers can be handled and therefore the customer service that they receive, but also on the operational efficiency of the air carriers. Longer processing times place restrictions on the number of flights that an air carrier can operate out of a certain airport in a given period of time, which in turn has a direct financial impact on that air carrier.

2.4 Additionally the efficiency of an HBS system often has a direct impact on the screening effectiveness of the system. The industry has learned through years of experience that there is often a direct correlation between the efficiency of a particular HBS system and its effectiveness in screening out potential threat items.

2.5 The implementation of an efficient and effective 100% HBS system will also facilitate the implementation of the so-called "one-stop security" concept not only on a regional basis but globally. Key to implementation of such a concept, from industries point of view, is the exemption from the need to screen transfer and transit bags. This not only provides tremendous benefits to industry in the form of shorter MCTs but also to States and their designated screening authorities who are able to free up resources for other tasks.

2.6 The screening authority (be it airport operator or other specified screening authority) should be responsible for all elements of the HBS system. This would include the baggage reconciliation system (BRS), as appropriate, which preferably should be automated and run concurrent with the technical screening systems.

2.7 IATA encourages States to implement an HBS system that is suitable to the configuration of the airport as well as to the operational requirements (baggage throughput, etc.). States should also consider projected increased capacity when determining the most suitable HBS option. Implementing 100% HBS, may result in temporary disturbances of normal airport operations, frequent refurbishment should, as far as practicable, be avoided.

2.8 IATA hopes that States and Airport authority will consider implementing permanent solutions immediately rather than utilize temporary measures and then develop permanent solutions later on. Whilst installation of temporary 100% HBS would probably only cause slight disturbance to airport operations, it would nonetheless cause a duplication of operational disturbance and resources allocated to this project. Also, temporary HBS system may not be as effective as permanent solutions as they may not be perfectly suited to their environment.

3. IATA Position Paper

3.1 The industry has developed a policy position/guidance document on 100% HBS. A summary of this document is presented as an attachment to this paper. The position paper itself was originally developed by the Airports Council International (ACI) and slightly modified by IATA to account for additional air carrier issues. IATA fully supports the ACI position and for that reason used their document as the basis for the air carrier industry position. This document fully accounts for recent changes to civil aviation regulations introduced since 11 September 2001.

3.2 This document all builds on other industry papers on HBS as well as the work carried out by the European Civil Aviation Conference (ECAC) Security Working Group in its guidance paper to Member States, in which IATA and ACI played a significant contributory role offering essential operational experience and advice. In addition, the document also takes into account recent technological advances and experience in baggage screening processes already in daily operation at many airports around the world.

4. Action by the Committee

4.1 The AVSEC/COMM is invited to consider the IATA position paper on 100% HBS **(Appendix)** as guidance material to facilitate the implementation of 100% at airports as required.

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APPENDIX

IATA POSITION PAPER
100% HOLD BAGGAGE SCREENING (HBS)

Executive Summary

1. Introduction

The IATA 100% Hold Baggage Screening (HBS) Industry Position Paper was drafted by the IATA Security Committee. The paper is based on the Airports Council International (ACI) position paper and builds on other industry documents and the work carried out by the European Civil Aviation Conference (ECAC) Security Working Group. The position paper also takes into account recent changes to international civil aviation security regulations and the measures introduced as a direct consequence of the tragic events of 11 September 2001.

The screening authority (be it airport operator or other specified screening authority) should be responsible for all elements of the hold baggage screening (HBS) system. This would include the baggage reconciliation system (BRS), as appropriate, which preferably should be automated and run concurrent with the technical screening system.

Ground Security:
IATA supports development of effective, efficient and operationally manageable ground security measures which meet or exceed the provisions of ICAO Annex 17, to be applied using a globally agreed Risk Management Matrix, on the basis of the level of risk as assessed by the appropriate national authority.

Passenger and Baggage Security Controls:
IATA supports the development of long term solutions to screen and reconcile passengers and their hold baggage through effective application of new technology and procedures, which do not impede the flow of traffic.

IATA believes that governments must combine resources in a co-operative manner to share information and research and development costs for explosive detection technology and other technologies to enhance the current systems of screening passengers and baggage.

IATA believes that airports, airlines and regulatory authorities should jointly develop measures that would improve the flow of passengers and their hand baggage through security checkpoints.

2. Methods Available for Screening Hold Baggage

Advantages and limitations of different screening methods are addressed. The screening methods discussed are:

- Manual Search
- Trace Detection
- Explosive Detection Dogs (K-9)
- Conventional X-ray
- Computer Assisted (Smart) X-ray Systems
- Passenger Risk Assessment Techniques

3. Possible Locations for Screening Hold Baggage

Each airport differs in its design and traffic characteristics, the screening method applied should be a system that suits local conditions. Each airport needs to consider the impact of cost, capacity and local operating conditions when developing appropriate solutions for both the location of screening and the methods/technologies to be used. For each possible HBS location the paper highlights the advantages, moderate disadvantages and major disadvantages.

The section is designed to be a guide to assist stakeholders determine which solution is best suited for their environment keeping in mind that each airport is very unique. The locations for HBS discussed are:

- Off-Airport Screening
- Sterile Terminal
- Sterile Security Area Before Check-in
- Screening in Front of Check-in
- Screening During Check-in
- Manual Screening
- Screening Downstream in the Baggage System (Conventional X-ray Equipment)
- Certified EDS Lobby Installations
- Combined Technologies: Three models are discussed in details:
    - Certified EDS – Profile Filter (C'EDS-PF)
    - Certified EDS Automated Filter (C'EDS-AF)
    - German Option (Developed by the German Ministry of the Interior – Civil Aviation Security and tested at Nuremberg Airport)

4. Planning HBS Facilities

As each airport has its own characteristics, there is no single solution that is suitable for all airports. The fundamental aim is to ensure that the system that is developed can deal with current baggage throughput (including peak demand) and future forecasts (i.e. the planning has to be demand-led) and delivers an effective and efficient screening process that meets the required standards at a viable cost.

Key considerations in the successful management of HBS systems with the introduction of an in-line integrated baggage handling system include:

- The requirement to synchronise the belt speed of conveying equipment to the processing speed and capacity of the explosive detection system (EDS) technology employed
- The elimination of any potential 'bottle-necks' from hindering facilitation and the baggage transfer process by minimising inclines on the baggage sortation system and baggage handling systems
- The minimisation of inclines on the baggage sortation system, where any alterations are made to integrate with or accommodate the HBS solution in operation.

The following factors also need to be taken into consideration when planning an HBS facility:

- Testing Phase
- Traffic Characteristics
- Passenger Traffic Flows – including peak demand
- Baggage Types

- Demand Forecast
- General Constraints
- Space Requirement and Location
- Airport Structures
- Check-in Islands and Zones
- Existing Handling Facilities and Modes of Operation
- Operational Issues
- HBS Issues
- Detection Performance
- Throughput Reject Rates
- 'False Alarm' Rates
- Consistency with Passenger and Cabin Baggage Screening
- Space Requirements
- Integration with Layered Security Architectures
- Passenger Reconciliation
- Transfer and Transit Baggage
- Pre-Screening Prior to Check-in
- Size and Weight of Security Equipment
- Operation Environment of Equipment
- Redundancy of Equipment
- Operational Specifications of Equipment (including Staff Issues)
- Legislative Changes

5. Key Factors in the Screening Process

All relevant baggage must be searched/screened by a means acceptable to the relevant regulatory body. It is recommended that security staff should adopt the principle that, before security controls are carried out, the status of each bag presented for examination is assumed to be "uncleared". A bag can be designated as "clear" only when it is determined that the bag and its contents do not contain any prohibited articles. Where a bag screened by X-ray has not been "cleared", further examination procedures must be applied in an attempt to resolve the cause of the concern. The bag cannot be allowed to proceed for carriage until such concerns are resolved fully and effectively.

Where a multi-level search process is adopted, the following general principles should be applied:

- The number of search levels must be kept to a minimum.
- Relevant information must be passed on from one level to the next.
- Each successive search level must provide added security value.
- The search process should always be "fail safe".

Each successive screening level should provide clear additional security value derived from increased depth, quality and or detail of the examination.

Where the status of a bag is ambiguous, the bag should be treated as "uncleared" and subjected to the appropriate screening procedures. It is essential to ensure that no assumptions about the clearance status of a bag are allowed. X-ray operators must not clear a bag unless they are satisfied that no prohibited article is present, or in other words they must reject any bag about which they have any reservations or doubts. The system should reject automatically when:

- The operator fails to make a decision
- The bag mistracks within the HBS system
- The screening equipment fails to make a decision because insufficient information was obtained

Also, operational issues are discussed and guidelines are provided for the following topics:

- General Screening Principles (including screening of dense/opaque materials)
- Hand Searches
- Process for Out-of-Gauge (OOG)/Super-Out-of-Gauge (SOOG) Baggage
- Explosive Trace Detection Equipment
- Time on Task for X-ray Operators
- Minimum/Preferred Time for Viewing Images
- Operator Proficiency Testing
- Procedures for Dealing with Firearms, other Non-IED Prohibited Articles, Contraband and Dangerous Goods
- Communication
- Record and System Information
- Control and Management of the System (Software and Hardware Management and Operating Protocols)

6. Contingencies

Effective contingency plans have to be in place to assure that, in the event of a breakdown or failure of the HBS system, all relevant bags can continue to be screened to required standards. Examples of contingency options include:

- Diverting bags to other available HBS facilities that are in operation
- Moving passengers to other check-in desks that are linked to operational HBS facilities
- Asking some passengers to take their baggage to central search facilities
- Setting up additional hand search facilities
- Bringing in mobile X-ray equipment, etc.
- Utilizing State approved emergency baggage screening mitigation techniques

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8. Contingency Plans

IATA Position Paper
100% HOLD BAGGAGE SCREENING (HBS)

1. Introduction

Air travel is complex enough already with its multiplicity of routes, transfer and transit connections involving States, air carriers and airports. But superimposed upon this network are the decisions made by individual States regarding the security standards they require within their territories, as well as security measures to be adopted by their registered air carriers when they operate in another State. This makes it essential for industry to participate with the regulatory agencies and other security related organizations in their States at an early stage in the planning process so as to ensure that hold baggage screening is introduced in the most cost-effective way and to avoid unnecessary costs which may otherwise be imposed upon them.

The screening authority (be it airport operator or other specified screening authority) should be responsible for all elements of the hold baggage screening (HBS) system. This would include the baggage reconciliation system (BRS), as appropriate, which preferably should be automated and run concurrent with the technical screening systems.

This guidance has been prepared by the IATA Security Committee to assist IATA Member air carriers review the methods available to airports to implement a security screening process that meets the IATA policy position on 100 per cent hold baggage screening. This document is based on the Airports Council International (ACI) document and has taken into account the recent changes in international civil aviation regulations and the measures introduced as a direct consequence of the tragic events of 11 September 2001.

This document builds on other industry papers on hold baggage screening prepared and the work carried out by the European Civil Aviation Conference (ECAC) Security Working Group in its guidance paper to signatory States, in which IATA and ACI played a significant contributory role by offering essential operational experience and advice to the ECAC working groups. In addition, the document also takes into account recent technological advances and experience of baggage screening processes already in daily operation at many airports.

In recognition of the significance of hold baggage screening for airport operators and the complexities of the respective implementation programmes, IATA is offering this guidance for Member air carriers whose governments have either made the decision to implement 100 per cent hold baggage screening or which have started to evaluate the techniques available.

2. IATA Policies on Ground Security and Passenger and Baggage Security Controls

2.1 Ground Security

IATA supports development of effective, efficient and operationally manageable ground security measures which meet or exceed the provisions of ICAO Annex 17, to be applied using a globally agreed Risk Management Matrix, on the basis of the level of risk as assessed by the appropriate national authority.

2.2 Passenger and Baggage Security Controls

IATA supports the development of long term solutions to screen and reconcile passengers and their hold baggage through effective application of new technology and procedures, which do not impede the flow of traffic.

IATA believes that governments must combine resources in a co-operative manner to share information and research and development costs for explosive detection technology and other technologies to enhance the current systems of screening passengers and baggage.

IATA believes that airports, airlines and regulatory authorities should jointly develop measures that would improve the flow of passengers and their hand baggage through security checkpoints.

3. ICAO SARPS

The comprehensive screening of hold baggage (100 percent) has been an ICAO Strategic Objective (No. 1) and Recommended Practice for a number of years. The 7th edition of Annex 17, effective from 1 July 2002, elevated this to a standard (4.4.8) to be achieved as from 1 January 2006.

3.1 Recommendation 4.4.9

Each Contracting State should establish measures to ensure that originating hold baggage intended to be carried in an aircraft engaged in international civil aviation operations is screened prior to being loaded into an aircraft.

3.2 Standard 4.4.8

From 1 January 2006, each Contracting State shall establish measures to ensure that originating hold baggage intended to be carried in an aircraft engaged in civil aviation operations is screened prior to being loaded into the aircraft.

4. Methods Available for Screening Hold Baggage

The ICAO definition of screening set out in the 7th edition of ICAO Annex 17 is: *"The application of technical or other means which are intended to detect weapons, explosives or other dangerous devices which may be used to commit an act of unlawful interference"*. This definition of screening is used throughout the present document.

Screening methods that satisfy the ICAO definition are also outlined in paragraphs 4.5.8 to 4.5.11 of the ICAO Security Manual for Safeguarding Civil Aviation against Acts of Unlawful Interference (Doc. 8973, Sixth Edition - 2002). Despite the fact that the ICAO deadline for implementation of 100% HBS is 1 January, 2006, several States have and will decide to implement this measure in advance of this deadline and may actually apply the measure to domestic as well as international operations. These issues may have an impact on the screening methods and types of HBS systems implemented at a given airport.

These methods include:

4.1 Manual Search

A method for the detection of threat items by visual and physical examination of the bag and its contents.

Manual searching is a resource-intensive task and is generally considered suitable only for low volume locations. At high volume facilities this method should only be used to supplement technical means and should not be used as a standard screening method. The process requires significant numbers of well-trained and motivated staff, often fully employed for only short periods of time, as well as dedicated areas set aside for the search process. Passengers and their baggage must be segregated from the public during the process and cleared bags kept under security supervision after being searched and until checked in. This process may place severe constraints on terminal space and can reduce terminal capacity.

It is also the usual method of final arbitration for all other techniques.

4.2 Trace Detection

Trace detection systems are only suitable for use in support of the other technologies described below. Trace detection systems are very accurate and effective. They can make a significant contribution to security when used correctly and in the right context. They are particularly useful in support of manual searching.

An item of hold baggage cannot be cleared for carriage on an aircraft on the basis that there is no trace of explosives on the outside of a bag. For effective detection of explosives, the contents of the bag (particularly any electronic or battery-operated systems) must also be checked for explosive residue.

Trace detection systems are only suitable for use as part of a larger system and cannot be used as the only arbiter in determining whether a suitcase contains an improvised explosive device (IED).

4.3 Explosive Detection Dogs (K-9)

This consists of the detection of explosives by specifically trained dogs. The dogs need to be rested frequently and require dedicated infrastructure, handlers and significant (real) samples of all threat explosives in the airport for high frequency training. This tends to reduce the operational availability of teams (the dedicated handler and the dog).

The use of dogs is generally best suited for low volume or short operations, such as occasional random searches, to search in emergency situations such as bomb threats, etc. or to search facilities such as passenger terminals, maintenance hangars, cargo warehouses, etc. and in some cases to supplement existing screening methods during periods of increased threat, but not for routine controls.

4.4 Conventional X-ray

Conventional X-ray technology is commonly used at many airports for passenger carry-on baggage screening. A number of airports use larger machines for the screening of hold baggage. For this technology to be used as an effective process for hold baggage, a minimum of 10 per cent of all screened items should be subjected to a manual search. The 10 per cent manual search should be continuous at both peak and off-peak periods and should include items already rejected by operators. However, some States do not permit the inclusion of rejected items in the random manual search requirement and this would have to be accounted for. The additional items should be chosen at random by the X-ray operator for manual search. This process requires the provision

of a dedicated search area. Some States also require that items are screened twice with the bag's orientation changed at each pass through the machine.

The use of conventional X-ray equipment for the screening of hold baggage in the baggage sorting area or within the baggage handling system is not recommended due to the need for the passenger's presence during the manual search.

Manual screening in the check-in area avoids the problem of reuniting passengers and bags after they have separated, but this process probably requires up to 20 per cent of the check-in area. The use of this space limits terminal check-in capacity, and high rejection rates during screening further increase the demand for terminal space.

These systems have no capability for the automatic detection of threat items and detection performance depends on the skill and alertness of operators.

These systems can also be manpower intensive due to the lack of flexibility to multiplex machines and operators should not be looking at more than one monitor at a time.

4.5 Computer Assisted (Smart) X-ray Systems

This equipment identifies potential threat items and dense areas, based on an automatic assessment of the bag or item from the X-ray information. The system can produce an image for an operator to view, which highlights the threat/dense areas to assist examination and assessment of the image.

The combined use of new technologies, such as advanced technology (AT) X-ray and United States FAA certified explosive detection systems which feature computed tomography (CT) technology, offers a significantly higher level of confidence than can be achieved with conventional X-ray systems. The need to add a manual search is dramatically reduced, with the result that a much lower number of passengers need to be reunited with their bags.

The systems can be installed in the check-in concourse area as stand-alone units. In airports in which space is at a premium, the use of combined technologies offers the advantage of minimizing demand for additional terminal space, since the screening process can be installed in the baggage system "downstream" of check-in.

4.6 Passenger Risk Assessment Technique

This technique is used by some States and air carriers to identify passengers who should be subjected to special security attention, however it should not be used as a replacement for a standard screening method. Passenger Risk Assessment, especially if not properly implemented, has the potential to be a very subjective technique. Space is required for this process near the check-in counters. The passenger risk assessment procedures require more processing time for passengers and close coordination between security and intelligence organizations. The process involves a sophisticated understanding of the relevant threat profiles and specialist staff to interpret and apply this information operationally. The technique can be used in conjunction with 100 per cent hold baggage screening to focus special attention (more detailed examination) on certain select passengers. Due attention must be paid to choosing the correct methods of passenger risk assessment, in compliance with national legislation, and the need to train staff appropriately in applying the techniques required

5. Possible Locations for Screening Hold Baggage

As each airport differs in its design and traffic characteristics, the screening method applied should be a system that suits local conditions. Each airport needs to consider the impact of cost, capacity and local operating conditions when developing appropriate solutions for both the location of screening and the methods/technologies to be used.

In determining the most effective and efficient solution, the following principles should be applied:

- The system must provide screening solutions for originating, transfer, crew and oversize (out of gauge – OOG) baggage.
- The impact on valuable airport and terminal capacity should be minimized, while maintaining acceptable security and customer service standards.
- Investment in buildings, equipment and personnel should be minimized, while maintaining acceptable security and customer service standards.
- There should be minimal inconvenience to the airport operation and the travelling public, both during construction and installation and day-to-day operation.
- Preference should be given to implementing a system that would enable the passenger and their bag to be reunited before any threat item is permitted into the baggage handling system (BHS). If this cannot be done, the reconciliation of the bag and the passenger, should there be an alert, should be facilitated in order to avoid delays. However, care must be taken to ensure the security status of the bag is ascertained before loading and that bags whose status remain unresolved are handled and stored such that they do not pose a hazard to passengers, employees or the facility itself.
- There is a need to strive for implementation of systems which incorporate screening systems using equipment which meet internationally recognized standards (e.g. ECAC, TSA, etc.) and processes such as those to deal with alarms involving airport operators, air carriers and screening authorities.

Locations of baggage screening systems may include:

- off airport check-in (city centre, hotels, etc.)
- sterile terminal complexes
- sterile security area before check-in
- screening in front of check-in
- screening devices at or behind check-in
- screening downstream in the baggage system

5.1 Off-Airport Screening

Screening of all or a proportion of hold bags can be carried out either off-airport or in areas away from existing terminals. Off-airport locations can include air carrier downtown or city centre check-ins, as well as hotels, railway stations, etc.

After screening, all baggage must be kept under strict security control during storage and transportation to the aircraft.

The depth of screening should be identical to that in airport locations, and probably requires dedicated check-in facilities.

Advantages

- Increased level of service for some customers using railways or staying in local hotels when screening is carried out in hotels/stations
- Can be used for high-risk flights
- Releases capacity in existing terminals if all screening is carried out in a separate building
- Little building work/disruption in existing terminals if a totally new check-in area is constructed
- Passengers are aware of security measures
- Can assist with intermodal transport systems

Moderate Disadvantages

- Large additional space required for new check-in area if all screening is carried out in a separate building, and other activities may have to be relocated
- High cost of building/equipment, operation and the secure transport of screened bags
- Passengers may need to be transferred between airport buildings
- Baggage must be under strict security controls from the point of screening until transfer to the airport

Major Disadvantages

- Railway station/hotel check-in only covers a small proportion of passengers
- Not suitable for transfer baggage
- Loss of commercial revenue from meeters and greeters
- Risk of unauthorized tampering during transfer of baggage

5.2 Sterile Terminal

This consists of an entire passenger terminal building being declared a sterile zone. All baggage, goods and all persons, passengers, staff and visitors entering the building must be screened to the same level as the pre-boarding screening of passengers.

It involves the creation of a sterile area at the boundary of the passenger terminal building and can lead to prolonged queuing on terminal forecourt areas (public access roads).

Advantages

- Centralized screening maximizes utilization of equipment and personnel
- No interference with existing check-in processes or equipment
- Passengers see security as being high profile
- Probably easier to incorporate new technology as it becomes available, since equipment is not linked into baggage systems

Moderate Disadvantages

- All items entering the terminal are screened, although the majority of them may not be related to hold baggage or a threat to aircraft
- Complete sterility is very difficult to achieve unless all goods and consignments are subject to security controls; all personnel must also be screened
- Exits must be controlled to prevent unauthorized access
- Staff who do not need to go airside must also be screened or properly vetted creating additional burden for screeners and resentment among staff who do not appreciate the need for screening

Major Disadvantages

- Large screening areas are required at each entrance to the building and may have to be constructed in passenger drop-off zones, which will need to be relocated
- Disruption and capacity loss during construction
- Possibility of passengers queuing three times (terminal entrance/check-in/government inspection services)
- High profile passengers from ethnic groups or high-risk air carriers are at increased risk of terrorist attack during extended queuing at the entrance to terminal buildings
- Passengers arrive either earlier or spend less time in commercial facilities
- In order to maintain terminal service standards, additional screening points may need to be provided, thereby increasing capital and operating costs
- Can only be used for originating bags, but not transfer baggage
- A suspect bag cannot be moved after screening, and therefore requires terminal evacuation
- Loss of commercial revenue from non-passengers

5.3 Sterile Security Area Before Check-in

This involves the creation of a sterile area either at the boundary of the check-in area or in several smaller zones within the check-in hall. Passengers and their carry on bags should also be screened, or the hold bags wrapped or banded immediately after screening to prevent items being introduced after screening. Alternatively, the passenger and bag can be escorted to the check-in desk by air carrier or airport security personnel. Note: soft-sided zipper bags are difficult to secure adequately with banding machines.

Advantages

- Centralized screening offers better utilization of equipment and personnel
- Can be used for high security risk flights
- Other security procedures (profiling) can be carried out while passengers are queuing at the screening point
- Passengers see security as being high profile
- No interference with existing check-in processes or equipment
- No further hold baggage procedures for passengers required after check-in
- No interference with existing baggage handling system
- Probably easier to incorporate new technology as it becomes available, as equipment is not linked to baggage systems

Moderate Disadvantages

- Passenger and cabin bags must be screened simultaneously to prevent transfer of unscreened goods into hold baggage post screening
- Additional staff costs as exits from sterile zone must be controlled
- Possibility of passengers queuing three times (entry, check-in, carry on)
- May reduce attractiveness of commercial facilities to non-travellers

Major Disadvantages

- The large screening areas required at the entrance to check-in zones may reduce terminal capacity by up to 20 per cent
- Probable disruption and capacity loss during construction
- In order to maintain terminal service standards, additional screening posts may need to be provided, which could increase capital and operating costs
- When several check-in zones are in use, passenger queuing areas need to be controlled to ensure efficient passenger flows to designated check-in points
- Bag images can be seen by passengers and non-travelling members of the public
- Can only be used for originating bags, but not transfer baggage
- A suspect bag cannot be moved after screening, therefore requiring terminal evacuation
- If several check-in zones are used, it is harder to obtain economies of scale and efficiency is lost.

5.4 Screening In Front of Check-in

In this case, the screening area is located directly in front of the air carrier check-in counters. All check-in baggage and other objects which may not be permitted as hand baggage in the passenger cabin must be screened.

If this approach is adopted and the baggage is returned to the passenger after screening for transport to the check-in counter, stringent measures have to be taken to prevent passengers transferring unscreened items into screened bags and to ensure that any unscreened bags are not subsequently checked in as hold baggage.

Advantages

- Can be used for enhanced threat flights
- Passengers see security as being high profile
- No impact on non-travelling public
- No additional passenger queuing required
- Passengers and bags easily re-united if hand search is required

Moderate Disadvantages

- Careful surveillance required to avoid interference with screened baggage
- Passenger screening process can be conducted during queuing time

Major Disadvantages

- Dedicated additional space required for screening equipment and process, including a dedicated hand search area for a minimum of 10 per cent of hold bags
- Projected loss of capacity of up to 20 per cent, or a corresponding increase in pre-check-in space required
- Bag images can be seen by passengers and non-travelling members of the public
- Congestion at the screening point can lead to error, with the wrong bags being searched manually
- Cannot be used for transfer baggage
- A suspect bag cannot be moved after screening, and therefore requires terminal evacuation
- Passengers can easily spot the flaws in the system and terrorists can easily learn the system and exploit these flaws

5.5 Screening During Check-in

Baggage is screened during or immediately after the check-in process. Screening equipment can be integrated into each individual check-in desk, on the feeder bag tag belt or in a security zone located to the rear of the check-in desks. These installations typically have conventional X-ray equipment installed, requiring a manual search of a minimum of 10 per cent of bags, which can take place either adjacent to check-in or in a special screening area close to the check-in area.

Advantages

- Only hold baggage is screened
- Passengers see security as being high profile
- No effect on non-travelling public
- No additional passenger queuing required
- Although passenger processing times at check-in may increase, this process may not involve a loss of capacity at some airports
- Passengers and their bags are easily reunited if hand search is required

Moderate Disadvantages

- Major capital costs, as each check-in desk needs screening equipment to be installed
- Possible requirement for new check-in desks if existing desks cannot be retro-fitted
- Requires modification to the baggage handling equipment at the check-in desk may require changes to the check-in process to deal with baggage first so it can be screened while other passenger check-in processing is completed

Major Disadvantages

- Possible reduction in number of check-in desks per island or terminal (linear arrangement)
- Check-in transaction times may be increased
- Operators under pressure to screen bags quickly
- Cannot be used for transfer baggage
- Additional space required for manual search adjacent to or behind desks
- A suspect bag cannot be moved after screening, and therefore requires terminal evacuation

5.6 Manual Screening

Screening is carried out at dedicated locations, which can be either be located off the airport or alongside the departure check-in area.

Manual searching is a resource-intensive task and its most appropriate use is for operations with low volumes. It requires significant numbers of well-trained and motivated staff, often fully employed only for short periods of time, and the setting aside of dedicated areas for the search process.

It can be conducted in a mobile (dedicated screening vehicle) facility and used as the final arbitration for other techniques.

Advantages

- Centralized search areas may require less space for manual screening than a search area behind each desk
- Centralized search areas may require less personnel to be deployed on manual screening than a search area behind each desk
- Involves direct contact with baggage, and is considered very effective and reliable for most articles
- Bag screening takes place during check-in
- Screening can be conducted at the side of the aircraft in a dedicated screening vehicle
- It is the final arbitration for all other techniques

Moderate Disadvantages

- Baggage needs to be taken to the search area
- It is not as easy for search teams to communicate with check-in staff when they are in separate locations
- Requires training in concealment techniques
- Total reliance on human factors, and search must be thorough and efficient
- Not customer friendly. Repacking bags is difficult as in many cases bags have been very tightly packed. Also a lack of privacy for the passenger may be a problem if there is insufficient search facilities.

Major Disadvantages

- Space requirements for manual screening may dictate the need for new construction to replace lost capacity
- Not fully effective for complex articles with electronic components
- Only practical for small volumes/throughput
- Only possible with the passenger present
- Labour-intensive operation
- A suspect bag cannot be moved after screening, and therefore requires terminal evacuation

5.7 Screening Downstream in the Baggage System (Conventional X-ray Equipment)

Screening of hold baggage is carried out in the baggage sorting area or within the baggage handling system.

Advantages

- Current check-in procedures not affected
- No extension of public areas of building required
- Only hold baggage is screened
- Operators are under less pressure to screen bags quickly
- No effect on non-travelling public and commercial revenue
- Baggage is security controlled after check-in
- As any suspect bags have already been handled, they can be moved if necessary, thereby preventing the need for terminal evacuation
- Centralized screening within the baggage system maximizes machine utilization

- Can be used for both transfer and originating bags
- Check-in can be performed anywhere without worry of designing a screening system at the point of check-in

Moderate Disadvantages

- Passengers are not aware of security measures
- Could require extensions to baggage sorting areas to accommodate equipment/screening rooms

Major Disadvantages

- Problems could occur when reuniting passengers and their baggage for manual screening where required
- Difficulties in reuniting passengers and bags may cause delays to flights, especially near to departure time
- May require significant changes to the baggage sorting system with cost/capacity implications
- Screening equipment may require slower baggage belt speeds, which may reduce the capacity of the baggage system

5.8 Certified EDS Lobby Installations

Certified explosive detection equipment meeting the United States TSA Explosive Detection System (EDS) criteria, located in the check-in lobby area, can be operated either as a 'drop and go' screening point or for passengers referred from check-in. The equipment currently available is limited to computed tomography (CT) equipment designed originally for integration with baggage handling systems. CT systems can be operated in automatic mode, but have a moderate to low throughput when used in stand-alone configurations and are not practical in such configurations as single solutions for 100 per cent screening at moderate to large airports. They have a moderate false alarm rate (25 per cent +), which requires human analysis of complex CT images of uncleared bags.

Advantages

- Equipment meets United States federal requirements
- Only hold baggage is screened
- Can be used in automatic mode, thereby enabling operators to concentrate on rejected bags
- Passengers available if required to be reunited with their bags

Moderate Disadvantages

- High cost of equipment (not relevant in the United States, where it is Government funded)
- Moderate to low throughput
- Multiple detection configurations can lead to different detection standards
- Moderate to high false alarm rates

Major Disadvantages

- Large amounts of high-cost equipment required for moderate to large airports
- Additional lobby or check-in space required or corresponding loss of capacity, and therefore not practical for 100 per cent screening in moderate to large airports
- High reliance on human factors, and particularly the skill of operators in interpreting complex CT images
- A suspect bag cannot be moved after screening, and therefore requires terminal evacuation
- Cannot be used for transfer bags

5.9 Combined Technologies

In this case, the screening of hold baggage is carried out while it is transiting through the baggage handling system using a combination of automated technologies and image or data analysis by human operators. The technologies currently used in this process include high capacity advanced automated (AT) X-ray and certified EDS equipment. Moreover, the process can incorporate new technologies as they are proven and brought onto the market.

The most commonly used systems worldwide follow a generic model based on a total of five levels of screening, the first two of which are integrated into the operation of the baggage handling system. All bags for which the status remains uncertain after the screening process at a particular level are referred to the next level of screening. Levels 1, 2 and 3 of the comprehensive baggage screening system require the use of various types of specialized screening equipment,

The generic five-level model may be described as follows:

(a) Level 1

Level 1 screening is carried out by high-speed X-ray machines with automatic explosive detection capabilities. A proportion of all baggage passing through these machines is not cleared and requires the image to be reviewed by an operator through a remote workstation.

(b) Level 2

This level consists of a group of workstations each equipped with image enhancement/manipulation to allow diagnosis of the screened image by the operator. An operator decides whether the bag is cleared or not at this level. Bags referred to Level 3 from this level include:

- bags which cannot be allocated a unique security identity by the baggage handling system (regardless of the operator's decision);
- bags for which the operator could not make a decision within a defined period (known as 'timed out' bags); and
- bags that are positively rejected by the operator as uncleared.

(c) Level 3

All bags that are either uncleared by the Level 2 operator or are subject to errors in the tracking system are diverted to Level 3. Level 3 screening equipment typically consists of certified EDS CT units. This screening process is often carried out off-line from the main conveyor system to avoid delays to cleared bags. Any bag uncleared at Level 3 is referred to further levels of

screening not associated with the baggage handling system. Bags cleared at Level 3 are re-routed back into the main baggage handling process for delivery to their assigned sorting area.

(d) Level 4

This level is for bags not cleared at Level 3 and normally requires the bag and passenger to be reunited for a hand search of the contents. This can be conducted at a distance from the Level 3 process and is often carried out close to the departure gate, where the passenger can be quickly located. However, it is preferable that the passenger and bag be reunited in a more sensitive location away from other passengers. Bags cleared at this point are then loaded directly onto the aircraft. Bags not cleared by this process, or for which the passenger cannot be found, are re-categorized as Level 5 bags.

(e) Level 5

Level 5 bags are those which may be classified as suspect by the security screening staff at any point from Level 2 onwards. The appropriate authorities (police) and the airport management are notified by the security operator whenever uncleared baggage is referred to Level 5 and agreed emergency procedures are instigated, usually consisting of referral to the specialist EOD (bomb squad) teams

Variations on the generic model include:

- The Level 2 operator workstations are replaced by an integrated EDS CT unit. At airports where this solution has been adopted, the peak hourly baggage throughput is reduced to match the maximum capacity of the specific CT machine, which varies according to the type of equipment, but generally reduces the throughput on the Level 2 CT line to a sustained maximum of 450-500 bags per hour;
- The baggage handling system is modified to automatically deliver bags assigned prior to or during the check-in process for screening by a certified EDS machine. This can be achieved through the software tracking system or the use of appropriate baggage tags (typically RF).

The current maximum throughput capacity of certified EDS equipment negates its use as a primary screening system for moderate to high capacity baggage handling systems.

The following are examples of the two most commonly implemented global baggage screening solutions, with a third option being described for information purposes as this version is mandated by the German federal authorities for use in German airports.

5.9.1 Certified EDS - Profile Filter (C'EDS- PF)

At the first point of screening, which is typically immediately prior to check-in, the passenger's travel history (passport and air carrier booking/flight history) is profiled against the air carrier's database to clear passengers whose profile gives a degree of confidence that they and their hold baggage are low or no risk. This profiling can be carried out either through a series of questions or an automated check against the air carrier database of known travellers. The system is designed to project a clearance rate of 90-95 per cent, with the hold baggage of the remaining uncleared 5-10 per cent of passengers being referred to a certified EDS for the second level of screening. Experience

shows that the failed profile rate is lower than projected, resulting in fewer bags being screened by the EDS equipment.

The EDS equipment used for second stage screening is typically located immediately adjacent to the check-in area or in line on the check-in collector belt, where the baggage is screened by a certified EDS automated CTX scan, with moderate false alarm rates (25 per cent +), which requires human image analysis of complex CT images of uncleared bags

Advantages

- Only hold baggage is screened
- Operators can concentrate on rejected bags
- No effect on the non-travelling public and commercial revenue
- Only small numbers of passengers need to be reunited with their bags

Moderate Disadvantages

- Minimal extension of buildings required to public areas
- Baggage has to be under security control after check-in and screening

Major Disadvantages

- Profiling does not meet ICAO 100 per cent screening definition
- Profiling is an inconsistent art and subject to varying standards
- 90-95 per cent + of bags are not subject to screening, with only a small (failed profile) 5-10 per cent of hold bags being screened in accordance with ICAO standards
- A suspect bag cannot be moved after screening, and therefore requires terminal evacuation
- High reliance on human factors, especially the skill of operators in interpreting complex CT images
- High capital cost of buying new equipment
- Cannot be used for transfer bags

5.9.2 Certified EDS - Automated Filter (C'EDS-AF)

This is a multi-level positive (100 per cent) screening process, typically consisting of up to five separate processes (levels), the first three of which are carried out as the baggage is being transported on the baggage handling system. This requires the screening equipment to be integrated into the airport baggage handling system.

Level 1, the first screening process, is by high capacity (up to 1200-1500 bags per hour) advanced technology X-ray equipment, which is integrated into the baggage handling system and screens every bag. Machine processing (materials analysis) is completed 'on the fly' and does not require the bag to be slowed or stopped during the screening process. The machine analysis differentiates materials through a complex computerized process and is affected by certain innocuous materials, the atomic signature and density of which falls within the band identified for certain explosive compounds. This results in varying Level 1 machine referrals for different groups of baggage. Business travellers' baggage tends to be

less affected than leisure or charter baggage. Level 1 referral rates typically range from 15 to 35 per cent, which are then referred to the second (Level 2) screening process.

The Level 2 process may be carried out different locations, either by:

- Option 1
  Remotely operated matrixed workstations (the most common process), consisting of a series of networked workstations which display an image for analysis by a skilled operator. These have minimal or no impact on the capacity of the system.
- Option 2
  Certified integrated (in line) explosive detection equipment, which has a lower throughput capacity and therefore reduces the capacity of the system.

Referral rates from either process are broadly similar and result in approximately 5 per cent of the total volume of baggage being sent to the tertiary screening (Level 3) process. The Level 3 process typically consists of a certified EDS located in the baggage sorting area. Bags referred to Level 3 are transported automatically by the baggage handling system for screening.

Bags which cannot be positively cleared during the first three process levels are referred to Level 4 or 5 respectively. The Level 4 process involves reuniting the passenger with the bag, and a physical search of the bag and its contents in her or his presence. This process is identical to the bag searches at the carry-on screening point. Most bags referred to the Level 4 process are cleared at this point. Bags which cannot be reconciled with the passenger or which have been identified as containing a suspect improvised explosive device are dealt with by the Level 5 process. These bags are normally taken to a remote safe storage place and referred to the police or EOD teams.

Advantages

- Current check-in procedures not affected
- No extension of buildings required to public areas
- Only hold baggage is screened
- Operators can concentrate on rejected bags (typically 30 per cent of total)
- Automation reduces human failures and minimizes human resource requirements
- No effect on non-travelling public and commercial revenue
- Baggage cannot be tampered with by passengers after check-in
- A suspect bag, having been already handled, can be moved if necessary, thereby preventing terminal evacuation
- Centralized screening maximizes machine utilization
- Can be used to screen transfer bags
- Only small numbers of passengers need to be reunited with their bags

Moderate Disadvantages

- Passengers are not aware of security measures
- Results in lower standards of service for the small number of passengers required to be reunited with their bags for manual search

- Reuniting passengers and their bags requires more time and could cause delays to flights, especially when close to departure time
- Some States require bags to be kept unlocked which may make them more vulnerable to pilferage – there is division on this point i.e. whether bags should be kept locked or unlocked
- Option 2 Level 2 EDS equipment requires slower or stopped baggage belts, which limits overall baggage system capacity

Major Disadvantages

- May require extension of baggage sorting areas to accommodate further equipment/screening rooms
- Requires changes to baggage sorting systems, with cost/capacity implications
- High capital cost of buying new equipment

5.9.3 German Option

The German government, the BMI (Bundesministerium des Innern – the Federal Ministry of the Interior - Civil Aviation Security Authority) has developed its own variation for 100 per cent HBS screening, based on special performance criteria adopted following a study by the BKA. The German Government originally mandated this for all German airports, but has recently relaxed restrictions for a selection of equipment and system designs.

The concept described above was first tested at Nuremberg airport. The Government has also mandated the manufacturer and the model to be deployed. Both are German companies, and as they are specified in this system for German airports, they are referred to in the explanation below. The Government has stated that it will be responsible for the selection and purchase of the screening equipment. Airports are required to modify their baggage handling system as required to integrate the equipment and the screening process.

The concept follows the typical AT system in that a HEIMANN EDS 100 65 (Government specified model) is used at Level 1. The baggage system then separates bags with opaque or density alerts (called dark alarms in the German option), with these bags being diverted to a special time-controlled conveyor belt. While the bag is being transported on the belt, the image (produced by the Level l unit) is checked by an operator at Level 2B. Bags at Level 1 which actuate an explosive alarm are diverted to a HEIMANN 10065 HDX-EDS at Level 2. Bags which cannot be cleared at Level 2 are transported to a YXLON XES 3000 for Level 3A screening.

If the operator is not able to clear the alarm, the bag is transported in a vertical elevator to Level 3B (passenger/bag reunification/manual search). Level 2B operators can also be used if the capacity of level 2A is limited. Before the passenger is asked to come to level 3B, the bag is first screened without the passenger and;

- the Level 1 image is (re-) produced

- a conventional X-ray-machine is used to produce one or more additional images.

This configuration makes it possible to screen the bag in two or more dimensions. The conventional X-ray machine allows the orientation of the bag to be changed and the different views compared with the Level l image. This procedure is claimed to reduce the number of passenger/bag reunifications required.

German law (as is the case in most States) requires the passenger to be present if the bag is opened for physical search. The SITA bag tag containing the passenger's name is used to identify the passenger if it is necessary to open the bag. The passenger is informed by information displays located:

- in the public area of the terminal
- in front of the security check point (passenger/cabin baggage screening)
- in the waiting rooms
- in the boarding gate desk

Advantages

- No capital equipment costs for screening equipment (Government funded for German airports)

Moderate Disadvantages

- No flexibility in equipment selection
- Vulnerable to vendor support maintenance service levels

Major Disadvantages

- No control over baggage system modifications
- Bureaucratically imposed design can affect system capacity
- Unable to adopt lessons learnt from peer airports
- Non-ECAC detection standards imposed, with an impact on alarm rate and capacity implications

5.10 Additional Considerations

As the characteristics of each airport are unique, it is essential to carry out a detailed study to assess the implications of hold baggage screening for the terminal capacity of each individual airport.

Screening using conventional X-ray technology will remain a necessity for many airports, either due to low throughput requirements or economic considerations.

Current evidence suggests that when this equipment is located in either a sterile security area in front of, at or immediately behind check-in, there is a loss of capacity in existing terminals of up to 20 per cent, based on a manual search rate of between 10 and 15 per cent. To maintain capacity, governments and airports may be faced with additional costs to replace the terminal capacity lost by the implementation of hold baggage screening.

Many moderate to large throughput airports, as well as others where the economics or traffic pattern require technologies with higher detection rates, need to consider the deployment of automated technologies integrated into the baggage handling system. The following chapters provide advice on some of the key planning and operational factors in this respect. This information has been developed by ECAC, an observer organization on which IATA are represented.

6. Planning HBS Facilities

6.1 General

This chapter deals with the key factors which need to be considered as part of the process of planning and developing HBS systems and facilities. As each airport has its own characteristics, there is no single solution that is suitable for all airports. Engineers and designers need to consider a range of options and develop solutions which address all of key issues and take into account the characteristics and constraints of the specific airport.

The fundamental aim is to ensure that the system that is developed can deal with current baggage throughput and future forecasts (i.e. the planning has to be demand-led) and delivers an effective and efficient screening process that meets the required standards at a viable cost. The key factors to be taken into consideration are summarized below:

Airport Characteristics and Constraints	HBS Facilities and Procedures
☑ Traffic characteristics: demand patterns, peak flows, type of traffic and baggage, etc.	☑ Capacity of HBS facilities/ equipment and baggage systems
☑ Architectural/structural issues	☑ Performance of equipment
☑ Customer facilitation/service and commercial issues	☑ HBS systems/physical characteristics
☑ Existing passenger and baggage handling facilities	☑ Space requirements for staff, equipment, facilities and operations
☑ Future airport expansion	

Three key considerations in the successful management of HBS systems with the introduction of an in-line integrated baggage handling system include:

- the requirement to synchronise the belt speed of conveying equipment to the processing speed and capacity of the explosive detection system (EDS) technology employed;

- the elimination of any potential 'bottle-necks' from hindering facilitation and the baggage transfer process by minimising inclines on the baggage sortation system and baggage handling systems; and
- the minimisation of inclines on the baggage sortation system, where any alterations are made to integrate with or accommodate the HBS solution in operation.
- It is generally accepted that the most critical issue in achieving an effective in-line HBS is the successful integration of the electronics of the BHS and the HBS.

It is strongly recommended that security equipment with the best performance in terms of the detection of explosives and explosive devices is selected. At the same time, careful consideration must be given to the potential false alarm rates of the equipment, which may have significant operational consequences. In selecting equipment, the aim is therefore to seek the best balance in maximizing the probability of detection with an acceptable false alarm rate.

The choice of HBS system also needs to take into account international and national security standards/recommendations and threat information.

It is essential that hold baggage security facilities and procedures are able to operate effectively within the overall airport environment. The introduction of hold baggage screening will have some impact on other parts of the airport's operations. It is recommended that the planning process include careful consideration and analysis of a number of different solutions, which should be assessed on the basis of their feasibility, their potential consequences on airport operations, issues relating to the layout, structure and architecture of the building, etc. It is important to involve all the relevant organizations in the development and discussion of the options with a view to identifying all the issues and establishing an agreed, practical solution.

These organizations normally include:

- airport authorities
- air carriers and handling agents
- state security authorities (including regulators, the civil aviation administration, etc., as appropriate)
- police authorities
- representatives of the staff who are involved in, or will be directly affected by, the HBS operation
- relevant specialists, such as forecasters, engineers, system designers, etc.

6.2 Testing Phase

An appropriate testing phase must be planned when implementing HBS systems. In this respect, the phasing-in of a proposed 100% HBS solution within a testing period well in advance of the deadline date will be critical to iron-out anomalies and fine-tune the system. This is to ensure that each airport will be in a position to comply with the 100% HBS requirement by the set deadline date, using the most appropriate, effective and efficient solution, with adequate redundancy built into the system to address potential delays, disruptions, and peak passenger flows.

6.3 Traffic Characteristics

HBS facilities can involve high investment costs. Inevitably, the capacity of HBS facilities is not unlimited. Unless these facilities are designed to be compatible with future traffic demand, the modification or expansion of the system may involve significant cost and disruption. For these reasons, it is essential to develop robust forecasts of future traffic patterns and plans for the expansion of the airport or terminal. Future traffic patterns are often difficult to forecast. As well as the "most likely" forecast scenario, planners should consider, and take into account, the consequences of other scenarios involving greater and lower growth rates to ensure that the proposed solution is sufficiently flexible and robust to deal with reasonable unplanned changes in traffic without major modifications.

6.4 Passenger Traffic Flows

Information and forecasts of passenger flows are the first and most fundamental element to be established in the planning process for a HBS facility.

They should include:

- annual traffic, including departure and transfer traffic
- traffic patterns and variations within a year (including seasonal fluctuations)
- traffic patterns and variations within a day (including patterns of check-in operations, desk/belt allocations, check-in opening and closing times for the flight schedule, etc.)
- traffic types (domestic and international flights, scheduled and charter operations)
- aircraft types, including passenger capacity and load factors (occupied seats)
- destination regulators minimum standards for HBS

These parameters are necessary to identify the baseline pattern of demand, and particularly peak demand (by hour and quarter of an hour). Peak demand is a critical parameter in planning capacity, since peak demand for just 15 minutes can generate significant problems if there is insufficient capacity to deal with the throughput and the effects can continue for some time after the peak has passed. The importance of peak demand cannot therefore be underestimated and must be a key dimension in the planning and development of the HBS system.

6.5 Baggage Types

The number of items of hold baggage to be processed is a critical parameter in the planning and development of a HBS facility. In this respect, the following factors should be taken into consideration:

- number of items of baggage per passenger (this varies for different types of passengers and flights)
- scheduled flights (including the proportion of business passengers on the flight)
- charter flights
- short/long haul flights
- amount (throughput) of out-of-gauge baggage[1]

[1] Out-of-gauge baggage is commonly defined by IATA standards as baggage the dimensions of which exceed:

maximum sizes :	length 0.90 metres	width 0.70 metres	height 0.50 metres
minimum sizes :	length 0.30 metres	width 0.20 meters	height 0.10 metres

- amount (throughput) of transfer baggage

6.6 Demand Forecasts

The throughput requirements for the system can be determined by combining the information on passenger flows with baggage parameters, and particularly peak demand, which is critical in determining the design capacity of the total system. It should be noted in this respect that it is important to consider the volume of demand, not only at the first stage of the screening process, but also at each subsequent level. A capacity shortfall at any level may have a serious effect on the operation of preceding stages of the process. In extreme cases, this may lead to die back in the system, which may bring the line and the check-in desks associated with it to a standstill. In addition to the quantitative parameters outlined above, it is also necessary to take into consideration more qualitative issues that may affect capacity assessments.

In particular, the proportion of bags that are rejected at each level and the time that an operator requires to assess the image of a bag effectively (which, in turn, may affect the reject rate and/or the throughput of bags) are strongly influenced by the size, nature and density[2] of the bag's contents. For example, a densely packed bag containing many electrical items and articles that are difficult to assess inevitably takes longer to examine. The incidence and pattern of such bags should be included in consideration of the capacity requirements for the HBS process.

Once the total capacity of the system has been determined, a more detailed assessment of the system to be adopted can begin. At this stage, a range of options should be considered at the different levels in the process. This should include consideration of the performance of the various types of screening equipment, the reject rates of the screening options,[3] space and resource requirements, and facilitation and service issues. The proportion of bags that are referred for manual search and baggage reconciliation can have significant operational implications for facilitation and service. This proportion is largely determined by the reject rates and effectiveness of the baggage analysis and assessment capabilities at the preceding levels.

6.7 General Constraints

After analysing the traffic and baggage flows, designers need to consider baggage facilities and HBS systems within the context of the overall airport/terminal design. Baggage facilities and screening systems require considerable space. Keeping these systems as simple as possible also minimizes costs and operational/maintenance difficulties. It is important to ensure compatibility with the key structural elements, architectural design and facilitation.

Some machines used for HBS (explosive detection systems in particular) have limited inspection tunnel sizes, which can result in operating problems in handling systems. As a consequence, specific equipment and procedures may be required for out-of-gauge baggage .

[2] In terms of reject rates, two types of alarms are possible:
- threat alarms, when the system believes it has detected potential explosive material. However, some innocent items generate alarms by EDS/EDDS machines, such as food, plastic materials and electronic components;
-dark alarms: some items are opaque to X-ray transmission or diffraction in conventional X-ray machines or EDS, and operators cannot clear baggage because they cannot assess the items in question effectively.

[3] The reject rate is defined as the proportion of bags passing through a level or stage in the process which need to be examined at the next level of the process.

6.8 Space Requirements and Location

HBS facilities often require the allocation of considerable space for the equipment itself, screening operators, manual search facilities, sterile areas (where appropriate) and operational and maintenance access. The location of the required space depends in part on the positioning of the screening equipment. Where screening facilities are located at or before check-in, the space required includes areas where passengers may need to queue before the screening point(s). In such cases, the spaces required for the screening process are located primarily in areas normally occupied by public and commercial functions.

Where screening facilities are located beyond check-in, the space required for the HBS operation is located primarily in areas normally allocated for baggage processing and loading.

The allocation of space is relatively straightforward where a new terminal or extension is being planned. However where HBS is introduced into an existing terminal operation, it is recommended that the impacts on existing space, operations, architecture and structures are given careful consideration with a view to achieving an effective and coordinated solution.

6.9 Airport Structures

Where HBS is to be introduced into an existing terminal operation, it is important in the planning phase to take into account all existing structural elements so as to ensure that the baggage conveyors and screening systems can be developed without unnecessary conflicts or constraints, which may adversely affect their performance. Where there are structural elements that are very difficult/expensive to move or replace (such as lifts and service cores), the baggage systems should be designed in such a way that these structural elements do not inhibit operational, maintenance or security performance.

Where a new facility is being developed, it may be useful to develop a plan for the baggage systems as a priority item at the beginning of the planning phase, with other (more flexible) facilities and structures being located around them.

6.10 Check-in Islands and Zones

An important decision at the outset of the planning process is to determine the relationship between the configuration of check-in facilities and the HBS system. Depending on the baggage flows to be screened, a number of different solutions are possible:

- a single HBS facility can be installed serving all check-in islands
- each check-in island can have its own HBS facility
- there can be more than one HBS system, each serving different check-in zones, but linked to provide support for each other in the event of overload or breakdown of one of the systems

Some HBS systems may require certain modifications of check-in desks or the zone around the check-in facilities. It is important to consider carefully the impact of such changes on check-in and other operational activities. It may, for example, be necessary to provide more space for check-in desks (either to accommodate X-ray equipment in check-in desks and/or additional

desks because of increased processing times at check-in), equipment or passenger queuing/processing areas.

6.11 Existing Handling Facilities and Modes of Operation

Where HBS is introduced into an existing terminal, its location at or before check-in or as free-standing equipment in the baggage hall is unlikely to affect baggage handling systems that are already in place. However, where HBS is to be integrated into existing mechanized baggage systems, significant modifications, or even replacement of the baggage system, may be required.

Where existing baggage handling facilities are incorporated with a sorting operation and HBS facilities, it may be possible to re-use systems (conveyor belt systems, checking islands, etc.) in order to limit investment costs and operational inconvenience.

To minimize potential disruption and costs, it is important for the design of HBS systems to take into account future developments of the airport/terminal. As far as possible, the HBS system should be compatible with future development plans so that it can be extended (where necessary) with the minimum of disruption and modification to existing systems.

6.12 Operational Issues

In the planning process for the selection and development of HBS facilities, it is important to take into consideration all operational issues which may affect, or be affected by, the HBS operation. Full discussion and cooperation with all relevant organizations is essential in developing an effective and efficient solution.

The potential operational issues to be considered include the effects that HBS systems may have on:

- circulation or processing space, and other operational, service or commercial facilities which may be inhibited or displaced
- overall processing times at check-in
- passenger reporting times for check-in
- passenger dwell time in the airport
- total processing time for baggage, for example from check-in to sorting
- flight check-in close out times (allowing for reconciliation and hand search of bags where required)
- supervision and monitoring procedures

6.13 HBS Issues

The performance and characteristics of the HBS equipment and associated systems are central to the planning and selection of the appropriate solution for a specific location. As noted above, there are a range of different approaches to achieving the appropriate security standards. Each process – manual searching, conventional X-ray, smart X-ray (AT) and certified screening equipment – has its own performance and operating characteristics. These processes can be used individually or can be linked in a multi-level screening process. Some of the key issues to be considered are set out below.

6.14 Detection Performance

As a general principle, it is recommended that security equipment with the best performance in terms of the detection of explosives or explosive devices should be selected. At the same time, careful consideration must be given to the potential false alarm rates which may be generated by the equipment, as they may have significant operational consequences. The aim in selecting equipment should therefore be to achieve the best balance that maximizes the probability of detection with an acceptable false alarm rate.

6.15 Throughput and Reject Rates

The forecast demand in terms of baggage volumes to be processed is a major factor significantly influencing the choice of HBS equipment and the overall configuration of the system. However, the choice is not simple. As noted above, the use of conventional X-ray equipment and/or hand searching may be considered for facilities which are only required to process low volumes of baggage. Planners of HBS facilities that are expected to have to handle a high baggage throughput usually seek equipment which can process and analyse large volumes of bags at the first stage, often in automatic analysis mode to maximize throughput. However, it is equally important to consider the likely reject rates from the first and subsequent levels and their consequences in terms of the equipment and resources needed to examine uncleared bags. In some cases, equipment that has a high throughput rate but generates a high rate of uncleared bags may not be cost-effective, with the result that machines with a lower throughput but a higher detection/lower false alarm rate may be the preferred alternative. A number of options for the overall system should be examined and verified.

Where the check-in facilities are dispersed, it may well be concluded that the optimum solution is to use several machines with a relatively low throughput located near the various check-in/sorting systems. In other cases, it may be concluded that security, operational and financial performance is optimised by developing a single centralized system using high throughput equipment at the first level. Local circumstances and requirements have a significant influence on the choice of the best solution.

At the planning stage, it is essential to establish accurate and realistic performance data for the equipment that is being considered, and particularly the throughput and reject rates that are achieved in practice.

A range of options for the HBS system should be developed and their operation tested against throughput demand forecasts using realistic processing/reject rates to assess the performance of the overall system at all levels. It is useful to subject the system to a range of demand forecasts and throughput/reject rates to test its ability to cope with future changes. A simulation model should be used, with practical testing of key elements of the process where possible.

6.16 ‘False Alarm’ Rates

Much depends on the setting at which the screening equipment is calibrated. Much of the available information indicates that a small variation in the alarm detection rate can have significant resource implications for ‘downstream’ processing. Consequently facilitation rates could potentially be affected. The alarm detection rate assumed in much of the available documentation is based on a fairly conservative rating - 25%. In reality and particularly given locations which have peculiarities in the kinds of baggage typically seen, there is likely to be a

higher alarm rate which could have a considerable affect on facilitation and demands on manual inspections tying up resources at Level Three, depending on the solution(s) employed.

6.17 Consistency with Passenger and Cabin Baggage Screening

The integrity of the entire hold baggage screening process could be compromised unless there is consistency and logical integration with other aviation security measures. The considerable attention devoted to equipment types and specifications for hold baggage screening specifications could be undermined by the failure to consider employing the same robust standards with regard to other security aspects of carriage, including passenger screening and screening of carry-on luggage.

While it is perhaps more likely that terrorists intent on attacking a passenger aircraft would seek to introduce a harmful item such as an improvised explosive device (IED) through the hold baggage system (given the opportunity to 'no show' the flight and the possibility that the item(s) of luggage might inadvertently be processed for onward carriage), the advent of the suicide bomber would suggest that modern terrorists are prepared to attempt to conceal IEDs with the specific intent of detonating the device at a time and location of their choosing, deliberately taking their own life in the process to inflict maximum harm and achieve significant publicity and impact.

While the choice of technology or a combination of multi-level solutions may be sufficient to comply with the 100% HBS requirement at each airport, there are clear consequences for the type of technology or solution selected to comply with the ICAO requirement. The limitations of conventional X-ray, usually requires that a minimum of 10% of baggage is manually inspected in the continuous random screening method to meet the screening requirement standards. For this reason, the use of conventional X-ray equipment in the baggage make-up area is discouraged, because of the need in many States to reconcile passengers with any items of baggage that are deemed to be 'risks'.

Applying the logic of this rationale, the possibility that conventional X-ray equipment might continue to be used for screening passenger carry-on luggage would threaten to undermine the integrity of the entire screening process, since it is acknowledged that conventional X-ray equipment does not detect all explosive types to the same robust standard as advanced technology (AT) or certified EDS equipment.

6.18 Space Requirements

The space requirements for HBS systems must be carefully identified and included in the design at an early stage in the planning process. Typically, space is required for the following components:

- screening equipment
- baggage handling facilities (e.g. motorized conveyor belt systems, roller tables, baggage diversion equipment, etc.)
- screening workstations, printers, computers, servers, etc.
- screening operators (screening operators' rooms should provide a conducive working environment, with good noise levels, lighting and temperature, and sufficient working space for the effective performance of their work)

- space and facilities for the reconciliation and searching of bags in a suitable environment which respects the privacy of the passenger and the need to maintain a secure and sterile environment: appropriate equipment, search facilities, lighting and circulation/work space should be provided to facilitate an effective search process
- access to install, move and (if necessary) replace machines or major components

6.19 Integration with Layered Security Architectures

Efficiencies and flows in the HBS process are likely to be more effectively managed if 100% HBS is undertaken in conjunction with other security counter-measures such as advance passenger risk assessments, airline travel history reviews, and biometric checks. Any effective passenger risk assessment (previously known as profiling) techniques need to rely on advanced interrogation of available records concerning the passenger, their travel history, and their biographical details where this is permitted by law. Otherwise facilitation is potentially affected.

Legislation might need to be introduced to facilitate random screening of passengers and their hold baggage. The present system of continuous random processing to achieve a minimum acceptable level of screening is an inexact science and provides a somewhat haphazard counter-measure which is likely to provide only limited deterrence to extremists. It is recommended that if random continuous screening is maintained as part of any screening solution, that additional screening be carried out on the basis of more specific passenger risk assessment criteria, and/or in conjunction with a 'trusted traveller' program.

6.20 Passenger Reconciliation

One of the issues central to the processing and handling of hold baggage in an automated screening system integrated with the baggage handling system concerns the requirement to reconcile a suspect bag identified as being a risk item in the baggage screening process with the passenger.

Experience at some airports has shown that attempts to integrate the two have met with complications which have hindered facilitation. Consequently, one solution is to design the baggage tag identification system to assign a 'pseudo-identification' only to bags that alarm in the automated screening process, separate from the baggage sortation system. This would potentially avoid the complicating and unnecessary situations where the bag tag reader has to distinguish between the screening system scanned baggage tags and the air carrier generated passenger baggage identification tags.

6.21 Transfer and Transit Baggage

Many of the screening solutions possible prior to check-in or at the point of check-in will not permit adequate time or opportunity to enable solutions beyond Level 1 or Level 2 to be implemented in the presence of the passenger, since in order to reconcile the passenger with their baggage if it alarms, the air carrier and airport authorities will not be guaranteed to be able to locate the passenger after they have checked in their bags at the point of the originating flight.

6.22 Pre-Screening Prior to Check-In

This method might achieve the ICAO standard but functionally compromises the integrity of assuring safety and security in that the entire process is open to surveillance by extremists, privacy is compromised, space is sacrificed, and unless designated personnel are assigned to escort the passenger once screening is completed, there is no guarantee that risk items will not be introduced into the baggage handling process, particularly in a congested terminal area. Bag items can also be seen by passengers and non-travelling members of the public.

Additionally, potentially vulnerable passengers (such as certain high-profile nationalities at greater risk of targeting) are exposed and highly visible and identifiable to potential extremists when awaiting processing. The regularity and timing of such processing could afford terrorists the opportunity to gather valuable planning information to plan and execute an attack landside at the terminal.

6.23 Size and Weight of Security Equipment

It is important at an early stage to give careful consideration to the size, weight and load distribution of the HBS equipment under consideration. In some cases, structural alterations may be required. In extreme cases, it may not be practical to install a particular machine in the preferred location.

6.24 Operating Environment for Equipment

The requirements for an appropriate operating environment for the equipment that is being considered should be established at an early stage. Issues such as sensitivity to ambient temperature, moisture and the presence of air pollution should be considered, as appropriate. These requirements should be incorporated into the design to minimize potential problems with the serviceability of equipment or deteriorations in detection performance.

6.25 Redundancy of Equipment

Whatever the type of equipment chosen, provision must be made for regular maintenance and occasional failure. Equipment suppliers will provide data in failure rates (Mean Time Between Failures – MTBF). If 100% of baggage is to be cleared at all times, arrangements must be made for alternative methods to clear bags during primary equipment downtime. This may involve rerouting baggage to a secondary belt with back up X-ray, use of trace equipment, or a combination of methods that includes some screening in the presence of the passenger at check-in, and some screening downstream.

6.26 Operational Specifications of Equipment

The technical and operating characteristics and the technical requirements should be established as soon as possible when assessing the choice of equipment. This includes issues relating to the integration of software and controls for HBS equipment and other parts of the baggage system, power supply requirements, performance and processing the data/information available from the equipment.

6.27 Staff Issues

Consideration of various screening options should include an appraisal of the numbers of staff required for the various security functions, with the implications for training, management, cost, etc., including the staff required to undertake:

- X-ray image assessment, reconciliation, trace detection and hand searches
- training, supervision and management
- loading/offloading bags for the HBS equipment
- transferring bags between different levels of the screening process
- maintenance and checks.

It is recommended that a careful financial appraisal be made of *both* the capital and operating costs of a range of HBS solutions before any final decision is made. It should be noted that, in certain circumstances, a system based on low-cost equipment could prove more expensive over the operational lifetime of the equipment than a system using more expensive equipment because of the differences in the operating costs of the systems.

The influence of human factors is an important consideration in achieving effective security standards. Good performance depends not only on training, motivation and supervision, but also on working conditions and environment.

It is important that staff have a safe and appropriate working environment to carry out their tasks effectively. This should be addressed as a priority issue in the planning phase and should be discussed and developed in close consultation with the staff involved in the work.

6.28 Legislative Changes

In many States, there will need to be legislative changes to accommodate effective 100% HBS. This is required, for example, to ensure facilitation is maintained to an acceptable level, and that bags can be manually inspected in the absence of a passenger, to cater for instances where passengers cannot be located when an inspection of their bag is necessary.

7. Key Factors in the Screening Process

7.1 General Principles

All relevant baggage must be searched/screened by a means accepted by the relevant regulatory body. For most airports this may mean one or more host States, such as the United Kingdom, the United States and the ECAC States.

It is recommended that security staff should adopt the principle that, before security controls are carried out, the status of each bag presented for examination is assumed to be “uncleared”. Each bag must be subjected to critical examination, whether by technical means, hand search or a combination of both, to determine whether the bag is clear of prohibited articles. A bag can be designated as “clear” only when it is determined that the bag and its contents do not contain any prohibited articles.

Where a bag screened by X-ray has not been “cleared”, further examination procedures must be applied in an attempt to resolve the cause of the concern. The bag cannot be allowed to proceed for carriage until such concerns are resolved fully and effectively. Where X-ray equipment is deployed (whether conventional, EDS or “certified technology”), this may require a variable number of levels or stages of examination (a multi-level search process).

Where a multi-level search process is adopted, the following general principles should be applied:

- the number of search levels should be kept to a minimum
- relevant information must be passed from one level to the next
- each successive search level must provide added security value
- the search process should always be “fail safe”.

Each search level is also a decision level which inherently involves some risk. Minimizing the number of levels in turn minimizes the risk of an incorrect decision.

Any screening process should be based on the principle of developing a more informed evaluation at each stage, building on the information obtained from previous levels.

If each stage in the process does not provide better and more complete information about the bag and its contents, the process will be inefficient and ineffective.

Information that is important for the evaluation of a bag and its contents must not be lost in the system. If the reasons for concerns identified at one level are not carried forward, additional time may be required while the operator fully reassesses the image, with the risk that the original reasons for the referral may then be overlooked. Where EDS equipment is used and the bag is rejected purely on the basis of threat or density alerts, these will be obvious to the operator at the next level. However, where concerns are not immediately obvious, they should be passed on to the operator at the next level for consideration.

Each successive level in the screening process should provide clear additional security value to enable the operator to make a more informed and reliable decision, which means that the amount and quality of information about the bag and its contents should be significantly better than at the preceding stage. The additional security value is derived from the increased depth, quality and/or detail of the examination.

This can, for example, be achieved by:

- examining the bag using screening technology with more powerful/accurate detection and diagnostic capabilities
- presenting an improved image of the bag
- using all appropriate enhancement facilities offered by the equipment where these were not used at the earlier stage in the process
- subjecting the bag and its contents to a different and more effective search technique, such as a hand search supported by trace detection analysis

However, despite the obvious advantages of such a system, there is also a danger that the operator will merely look at the potential threat item(s) highlighted and miss out on other threat items

which may have been missed at the previous level(s). Perhaps technology will eventually be developed to match up highlighted areas by the two different levels of screening.

It should be noted that the provision of additional time for the operator to make an assessment does not in itself result in additional security value unless the time is used for a positive purpose. Typically, this may involve making significant additional use of the analytical and image enhancement functions of the equipment (for example, if screening at the previous level was time-limited and these facilities were not used fully).

To ensure a reliable and effective approach, it is important that equipment and procedures always "fail safe". Where there is an equipment malfunction or failure, the system must ensure that the relevant baggage is not allowed to proceed for loading until the full screening process has been applied.

Where the status of a bag is ambiguous, the bag should be treated as "uncleared" and subjected to the appropriate screening procedures. It is essential to ensure that no assumptions about the clearance status of a bag are allowed, as these seriously undermine the integrity of the system. For example:

X-ray operators must not clear a bag unless they are satisfied that no prohibited article is present, or in other words they must reject any bag about which they have any reservations or doubts.

The system should automatically reject bags where:

- the operator fails to make a decision
- the bag mistracks within the HBS system
- the screening equipment fails to make a decision, for example because
- insufficient information was obtained

(Note: the system at the next level should ideally provide an automatic indication of the reasons for the rejection of the bag).

Where the operator is presented with an incomplete or flawed image, the bag should in all cases be referred for further screening/examination.

The process should ensure that all bags which have not been positively cleared are identified and referred to the next level of screening or examination accurately and reliably. Where cleared and uncleared bags are separated and diverted onto different tracks, the process should be checked regularly for accuracy.

Where a bag remains "uncleared", the final stage in the resolution process may involve a "threat assessment" of the bag to determine whether it is to be treated as suspect. Even if the assessment is that the bag is not suspect and that no escalation in action or response is required, the bag must not be passed for carriage on a flight until the specific concerns about the bag and its contents which caused its referral are fully resolved by the accepted screening/searching procedures.

It is recommended that the procedures for the process of reuniting bags and passengers and hand searching bags are practised on a regular basis, where possible so that each security operative who exercises this responsibility can practise the procedure at least once a month.

It is also recommended that the procedures for the next level of screening are practised at least once every six months. This should help to familiarize all relevant personnel with the procedures and enable any necessary improvements to be identified and implemented

Upgrades in hardware or software should be adopted as soon as practicable.

7.2 Screening Principles

7.2.1 General

When items of hold baggage are screened by X-ray, the X-ray operator must:

- examine the entire X-ray image for prohibited articles, or components of prohibited articles, where appropriate making full and effective use of the equipment's image enhancement features. In particular (but not exclusively), the operator should look for components of improvised explosive devices, including detonators, wires, batteries and electronic or mechanical timing devices. The operator should pay particular attention where the image shows dense or opaque areas that might conceal prohibited articles and areas which are highlighted as containing a potential threat item;
- check that the shading of the bag's image is consistent throughout, since lighter edges may indicate the presence of a sheet explosive that does not completely line the top or bottom of the case;
- pay as much attention to the framework and appendages as to the contents;
- examine any metallic or channelled part of a case for apparent bulges or protrusions which could partially conceal a component of an explosive device.

Where an operator cannot fully satisfy her or himself that the bag and its contents do not contain any prohibited articles or components of prohibited articles, she or he must refer the bag for further examination. The operator should not feel under pressure to "clear" the bag, or in other words where the operator has any doubts or reservations, the bag must be referred for further investigation at the next level.

7.2.2 Dense/Opaque Objects

Where the degree of absorption of an X-ray beam is significant, the relevant area of the X-ray image will indicate this, either by allocating a specific colour to the area in the case of a conventional X-ray machine, or by generating an automatic alarm and highlighting the area(s) in question (a 'density alert').

A density alert displays areas within a bag that are too dense to be penetrated sufficiently for accurate analysis. In particular, the equipment cannot complete the analysis of the areas highlighted with sufficient accuracy to be able to determine whether explosive material is present. The areas are not necessarily X-ray opaque (although they may be) but, due to the degree of absorption of the dual energy X-rays, for example with the low energy beam being completely blocked, the information provided to the X-ray operator is limited, and often significantly so.

X-ray operators should therefore note that, although there may be occasions when the use of certain image enhancement functions may elicit more information, for example by using contrast adjustment, such information cannot be relied on to provide sufficiently meaningful information about the area(s) under examination. Operators must clearly understand the value and limitations of the enhancement functions of the equipment they are using in respect of dense areas and opaque objects. As such, X-ray operators must exercise caution when forming a judgement about areas highlighted by a density alert. The following considerations should be noted in this respect:

- The X-ray operator should assess the size of the area/item highlighted by the alert and then consider whether it could house/shield a prohibited article, in particular an improvised explosive device. (N.B. it must be understood that an opaque area not only prevents information on articles behind the area from being presented to the operator, but also information about articles in front of it. This is because the absorption of the X-ray beam is such that the information on the bag's contents for the entire line of the beam is affected). Where small areas of alert overlap an organic mass, the X-ray operator should consider whether such dense areas might shield the components of an improvised explosive device.
- The item can be examined from different angles (e.g. at 90 degrees from the angle of the original presentation of the bag), which may enable the X-ray operator to establish the size and shape of the item more clearly. In certain circumstances, a different orientation may improve the penetration of X-rays through some or all of the item and allow an effective assessment of the item. If the area or item is considered insufficient to house/shield a prohibited article, the area may be deemed to be cleared. However, it is important that the entire image is fully and carefully assessed before a decision is reached.
- X-ray operators should adopt a cautious approach to assessing areas covered by a density alert. Where *any* doubt exists, the bag should be referred to an examination level that is capable of reliably resolving the doubt, which usually means by hand search.

In most cases, the best practice to resolve concerns about a dense area or opaque object effectively is to subject the bag to further X-ray examination using higher penetration X-rays, or to search the bag and its contents by hand (supplemented by explosive trace detection analysis where available).

7.3 The Hand Search Process

Wherever possible, hand searchers should have ready access to X-ray facilities and explosive trace detection equipment to support the hand search of individual items. The aircraft operator should ensure that hand searches of hold baggage are carried out at the location specified in the approved Hold Baggage Searching Operating Protocol and that each hand search is conducted as follows:

- items of hold baggage should normally be searched in the presence of the relevant passenger;
- baggage should be opened by the passenger (when present);
- baggage should be examined to ensure that there is no false bottom, using a straight-edge gauge-rule, rod or other device where necessary to establish whether there is a significant discrepancy between external and internal measurements;

- particular attention should be paid to linings, trim, seams, rims, studs, zip fasteners, locks, hinges, wheels and handles to identify signs of tampering or repair which may indicate the concealment of a prohibited article, and where suspicion is aroused, the area(s) should be subjected to explosive trace detection equipment;
- the contents should be removed layer by layer, each being examined until the bag is empty. The empty bag should be lifted by hand and assessed for balance and empty weight. If either give rise to suspicion that the bag is not of uniform weight, or of a weight consistent with being empty, the bag itself should be examined for concealment. If necessary, it should be screened by X-ray (ensuring that an X-ray image of the bag is presented to an operator for assessment and decision);
- electrical items which might conceal a weapon or explosive device (e.g. shavers, calculators, radios, clocks, cameras, personal stereos and their cassettes, etc.) should be examined to ensure they have not been tampered with, are of the expected weight, are balanced and have no additional batteries. If necessary, an item should be screened by X-ray to ensure that it has no additional power source or that there is no organic material within what should be an inorganic shell (ensuring that an X-ray image of the item is presented to an operator for assessment and decision) and subjected to explosive trace detection equipment;
- articles such as vacuum flasks, books, umbrellas, crutches, etc., should be examined in sufficient depth, by X-ray if necessary, to establish their bona fides;
- attention should be given to the contents of containers and bottles capable of holding volatile liquids;
- liquids must be rejected when there are grounds for suspecting that they may be used to commit an unlawful act;
- searchers should look for greasy stains and small holes in the exterior of the case and for the smell of almonds, nail polish, glue, perfume or other masking vapours which might indicate the presence of explosives; and
- bags should be closed and fastened on completion of the search.

Upon completion of the search, hold baggage should not under normal circumstances be returned to the passenger.

7.4 Process for Out-of-Gauge (OOG) and Super-Out-of Gauge (SOOG) Baggage

OOG and SOOG items are those which cannot be processed through the standard baggage system because of their size, shape or weight. Many of these items can be subjected to X-ray screening using an X-ray with a larger tunnel aperture. Items which cannot be X-rayed should be searched by hand, in accordance with the principles set out above.

Some items do not readily lend themselves to a conventional hand search (such as bicycles and skis). Such items should be subjected to a thorough physical and visual examination. Items which can be detached or removed (such as bicycle panniers) should be subjected to X-ray examination, where possible. It is useful to support this process with analysis using explosive trace detection equipment applied particularly to areas where explosives may be concealed or inserted.

7.5 Explosive Trace Detection Equipment (ETD)

Trials and tests of explosive trace detection (ETD) equipment confirm that it is highly effective in detecting minute traces of explosive material where they are present.

As with all advanced technology, it is essential that operators follow the correct and appropriate procedures for the application of ETD to ensure that the equipment is used effectively. It has been clearly established that precautions taken by bomb-makers affect the likelihood of traces of explosive material being present on the outside of a bag containing an improvised explosive device and an item of hold baggage *cannot* therefore be cleared for carriage on an aircraft on the basis of ETD indicating that there is no trace of explosives on the outside of the baggage. ETD can provide significant added value to the searching process, particularly for the examination of specific items and areas within a bag in support of the hand search process, including for:

- individual items *in* bags that are difficult to search effectively by hand and those that are difficult to screen effectively using X-rays, such as laptop computers, electrical/battery-operated items;
- items specifically referred for hand search (by the X-ray screen operator or highlighted by an automatic alarm), including most items which appear opaque to X-ray operators;
- the inner lining of bags, paying special attention to the seams, joins and closure points;
- appropriate areas or parts of OOG and SOOG items.

7.6 Time on Task for X-ray Operators

The issue of how long a security agent should undertake hold baggage X-ray assessment duties without having a break is a complex issue. There is no simple answer, as a person's performance over a period of time is strongly dependent on factors such as:

- the time of day
- the time in the shift
- the level of cumulative sleep loss
- the shifts worked previously
- the type of task and
- the workload.

X-ray assessment is a complex task and can therefore be mentally demanding. In one study, it has been observed that security staff reject more items in their first 15 minutes of monitoring. It is therefore a key principle that X-ray operators should have regular breaks.

X-ray operators should not undertake X-ray assessment duties for periods exceeding 45 minutes (Optimal assignment time being 20 minutes). A period of at least 15 minutes should then elapse before a security agent is required to resume responsibility for an X-ray monitor. (A period of duty in this context is defined as a continuous period of time during which a person has formal responsibility for X-ray assessment).

7.7 Minimum/Preferred Time for the Viewing of Images

An X-ray operator should be allowed sufficient time to make a reliable assessment of the image. The time allocated for this task is influenced by the nature and depth of the examination required at that stage of the process. For example, a key element in the added value of a specific screening level may be that no limit is placed on the time available to the operator to examine the X-ray image of a bag. This is often the case, for example, for a free-standing X-ray machine at Level 3. However, where the X-ray process is an integrated part of a continuous flow of bags (for example, at Level 2), the time available may be more limited if the baggage system is not to be

disrupted significantly. In this context, the volume of bags running through a screening line may also influence the time available. The size of the bag and the complexity of its contents also affect the time required by the operator to assess the image effectively.

Nevertheless, current information suggests that operators should ideally have an average of between 10 and 15 seconds to make a reasoned and reliable decision. As a minimum, the image of every part of the item being searched should be capable of being displayed on the screen for no more than 5 seconds. Where the examination of the image takes place while the bag is continuing to move along the baggage system, the time available to an operator to make a decision is determined primarily by the distance between the X-ray machine and the divert/reject point and the speed of the conveyor system.

It is also important to take into account the time that the X-ray equipment takes firstly to analyse the data and then, where a bag is rejected, to present an image while the bag continues to travel along the conveyor. In addition, where one or more further bags are rejected in quick succession, this can reduce the time available for the presentation to the operator of the image of the second and subsequent bags**.**

An X-ray operator must not be made responsible for controlling more than one monitor in cases where the X-ray images presented on the monitors are time-limited. Even where the images are not time-limited, the general principle is that operators should only ever have responsibility for one monitor at any one time.

7.8 Operator Proficiency Testing

There is a need for ongoing proficiency testing of operators to ensure that they are performing their tasks at an appropriate level of competence. This testing can be undertaken in various ways including technological methods such as Threat Image Projection Systems (TIPS) which test operators by inserting images of threat items into the images of actual bags that are being processed and measure the ability of operators to spot these items automatically. Other non-technological methods such as the actual insertion of tests pieces simulating threat items inserted into actual passenger bags (with passenger permissions) or test bags again assessing the operators ability to spot such items can also be used.

No matter which method is chosen the test results must be used as a performance enhancement tool and must be shared with the operators and should also be shared with the air carriers serving the airport.

7.9 Procedures for Dealing with Firearms, Other Non-IED Prohibited Articles, Contraband and Dangerous Goods

Operators should ensure that clear procedures are published for dealing with firearms, other prohibited articles, contraband and dangerous goods identified in hold baggage, and that all relevant staff are familiar with them. These procedures should identify the organization/person to be contacted initially, the contact procedures and the relevant contact numbers. This information should be readily available at the points at which baggage is examined. Where such items are not encountered regularly, it is recommended that the procedures are practised as contingency exercises to ensure that staff are familiar with them and can act promptly and correctly when required to do so.

7.10 Communication

As noted above, information that is important for the evaluation of the bag and its contents should be carried forward through the security process until the bag is cleared. Appropriate arrangements should be made to ensure that the reasons for the concerns identified at one level are communicated effectively to succeeding levels of the process.

It is essential for the communication process to support efficient and effective responses to a range of urgent situations which may arise. These may include, for example, the detection of firearms, dangerous goods or contraband, cases in which an operator believes that she or he has positively identified an improvised explosive device at any stage in the process, or a breakdown or failure affecting the HBS system.

Relevant staff should be familiar with the required procedures for dealing with such incidents and should have immediate access to the appropriate communication system. The relevant telephone numbers, radio channel call signs, etc., should be immediately and conveniently available. These procedures should be practiced on a regular basis.

7.11 Record and System Information

Records should be maintained for the following:

- routine equipment checks and maintenance operations
- routine compliance test results
- daily bag volumes processed at each level
- specific individual records of each bag referred for a hand search, including:
    - date, time and location of search
    - name of searcher
    - name and flight number of passenger
    - reason for referral
    - details of items found and results of the search

7.12 Control and Management of the System (Software and Hardware Management and Operating Protocols)

After the initial installation has been completed successfully, there should be strict controls to ensure that no unauthorized changes are made to the security equipment, both for hardware and software (including settings). The procedures should ensure that control and approval of any changes are confined to specific persons who are authorized to do so and any changes are formally cleared with the appropriate authority before implementation.

Staff should be fully familiar with the role and responsibilities to which they are assigned. Detailed procedures should be developed and provided to all relevant staff. Before commencing duties, staff must have effective training and familiarization for their specific role and responsibilities, together with an overview of the whole system, to ensure that they are familiar with the context in which they are operating. There should be strict controls in place to ensure that no changes are made to the established procedures unless approved by specific persons authorized to do so.

Operators may wish to consider whether the controls indicated above are to be applied through an operating protocol for each location. Such a protocol could include the equipment (software settings, etc.), maintenance and breakdown arrangements, training requirements, detailed screening/searching and resolution procedures at each level, the records to be kept, contingency plans, etc. Once established, there should be a defined process for approving changes to any element of the protocol.

8. Contingency Plans

There must be effective contingency plans in place so that, in the event of a breakdown or failure affecting the HBS system (or the baggage system that serves the HBS process), all relevant bags can continue to be searched/screened to the required standards. States should have the option, at their discretion, to employ hold baggage screening mitigation techniques, on a temporary basis, to ensure operational continuity.

The baggage system and hold baggage screening facilities should include sufficient redundancy (i.e. spare capacity/flexibility) so that the screening of all relevant hold baggage can continue in the event that the HBS facility becomes unserviceable or for any other reason is unable to operate to its intended capacity.

It is essential that full use is made of all available screening facilities and resources. Where necessary, additional hand search facilities or screening equipment should be made available.

Examples of contingency options include:

- diverting bags (automatically or manually) to other available HBS facilities that are (including transfer and OOG facilities)
- moving passengers to other check-in desks that are linked to operational HBS facilities, or asking some passengers to take their baggage to central search facilities
- setting up additional hand search facilities
- bringing in mobile X-ray equipment, etc.
- utilizing State approved emergency baggage screening mitigation techniques

It may be necessary to establish specific dedicated facilities as contingency capacity where there is insufficient capacity in the main system, or where other operational facilities cannot be readily used.

Every effort must be made to maintain effective searching/screening of all relevant baggage, and all available equipment and resources should be fully utilized insofar as practicable. It is essential that contingency plans include operational procedures addressing these issues practically and effectively and which can be implemented without delay. The plans should be practised at regular intervals to ensure that staff are familiar with the procedures and that any practical difficulties are identified and addressed.