

Joint Liquid, Aerosol, and Gels Trial 2010

Final Report

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Table of Contents

| | | |
|-----|--|----|
| 1. | Summary | 5 |
| 2. | Background | 6 |
| 3. | Purpose | 6 |
| 4. | Screening Process..... | 6 |
| 5. | Data Collected | 7 |
| | 5.1. Number of Passengers Screened | 7 |
| | 5.2. LAGs Carriage Levels (LCL) | 8 |
| | 5.3. Category of LAG items | 8 |
| | 5.4. Container Type of LAG Items..... | 9 |
| | 5.5. False Alarm Rate (FAR) | 9 |
| | 5.6. Screening Process Timings..... | 9 |
| 6. | Equipment Performance | 9 |
| | 6.1. Advanced X-ray Observation Equipment | 9 |
| | 6.2. Bottled Liquid Scanning Equipment..... | 10 |
| 7. | Passenger Communication..... | 10 |
| 8. | Facilitation | 10 |
| 9. | Modelling | 11 |
| | 9.1. Distribution of Liquid Carriage Levels..... | 11 |
| | 9.2. Data and Assumptions | 12 |
| | 9.3. Outcomes..... | 13 |
| 10. | Current Status and Future Considerations | 13 |
| 11. | Recommendations..... | 14 |

Table of Figures

| | | |
|----------|--|----|
| Figure 1 | Equipment used in the Joint LAGs Trial 2010..... | 7 |
| Figure 2 | Number of LAGs carried by persons during the Joint LAGs Trial 2010..... | 8 |
| Figure 3 | Category of LAG items observed during the Joint LAGs Trial 2010..... | 8 |
| Figure 4 | Container material of oversize LAG items observed during the Joint LAGs Trial 2010..... | 9 |
| Figure 5 | Example of a CAST model simulation..... | 11 |
| Figure 6 | Distributions of the number of LAGs carried by passengers for high, medium and low LCLs..... | 12 |
| Figure 7 | Source of non-LAG related input data for trial processes | 12 |
| Figure 8 | Oversize LAG item screening timings and assumptions..... | 13 |

Acronyms

| | |
|------|---|
| AFP | Australian Federal Police |
| BLS | Bottled Liquid Scanner |
| CAST | Comprehensive Airport Simulation Technology |
| DfT | Department for Transport |
| Dstl | Defence Science and Technology Laboratory |
| ECAC | European Civil Aviation Conference |
| EU | European Union |
| FAR | False Alarm Rate |
| ICAO | International Civil Aviation Organization |
| LAG | Liquid, Aerosol and Gel |
| LCL | LAGs Carriage Levels |
| LEDS | Liquid Explosive Detection System |
| OTS | Office of Transport Security |
| STEB | Security Tamper-Evident Bag |
| TIPS | Threat Imaging Projection System |
| TSA | Transportation Security Administration |
| UK | United Kingdom |
| US | United States |

Definitions of LAGs screening equipment:

- Type A: Screens liquid containers singly with lids removed or loosened.
- Type B: Screens liquid containers singly without removing or loosening lids.
[alternatively referred to as Bottled Liquid Scanner (BLS) equipment in this report]
- Type C: Screens multiple liquid containers simultaneously but with containers removed from cabin baggage.
[alternatively referred to as advanced X-ray observation equipment in this report]
- Type D: Screens multiple liquid containers simultaneously but with containers remaining in cabin baggage.

Joint Liquid, Aerosol, and Gels Trial 2010

1. Summary

The Office of Transport Security (OTS) within the Department of Infrastructure and Transport conducted a trial of liquid-based explosive detection systems (LEDS) in collaboration with the United Kingdom (UK) Department for Transport (DfT) and the United States (US) Transportation Security Administration (TSA) in late November / early December 2010. The trial took place at Melbourne and Sydney airports and was undertaken as part of the Australian Government's Strengthening Aviation Security Initiative announced in February 2010.

Five pieces of equipment capable of detecting liquid-based explosives were incorporated into a domestic screening lane at both Melbourne and Sydney airports. The trial screening process enabled information to be captured on the characteristics of liquid, aerosol and gel items >100ml (oversize LAG items) carried in an unrestricted environment. Information on discrete screening event times and operational performance of equipment was also recorded throughout the trial.

Two screening scenarios were trialled providing a comparison of 100% screening versus random and continuous screening, and screening utilising one technology versus screening using two complementary technologies.

The advanced X-ray observation (Type C) equipment and bottled liquid scanner (BLS) (Type B) equipment generally performed well. Operators were generally satisfied with the ease and speed with which the equipment could be used. Over 7000 people and approximately 4000 oversize LAG items were screened through trial lanes across both locations during the operational trial period. Passenger facilitation was minimally impacted with the screening process determined to be effective.

People screened as part of the trial were carrying an overall average of 0.72 oversize LAG items each. Only 7% of oversize LAG items screened fell within the duty free category.

Performance information will be provided to equipment suppliers to assist in the ongoing development of equipment capabilities and functionality.

The trial provided additional information regarding the impact of using liquid-based explosive detection technologies in an operational environment. This will inform future decisions relating to the restrictions on the carriage of liquid, aerosol and gel based products.

2. Background

On 9 February 2010 the Australian Government announced a package of measures to strengthen aviation security. This included funding for a joint trial of liquid explosive detection technologies. The trial was conducted at two Australian domestic screening lanes in collaboration with the US TSA and the UK DfT, both leading authorities in the evaluation of aviation security screening technologies.

The EU had intended to commence lifting restrictions on the carriage of LAGs subject to the identification of a suitable technological screening solution from 29 April 2011, with a view to lifting all LAGs restrictions by April 2013. This two phased approach would have initially allowed passengers transferring to an international flight to carry oversized LAG items, contained within an International Civil Aviation Organization (ICAO) standard security tamper-evident bag (STEB) with clearly displayed proof of purchase within the preceding 36 hours from airside at an airport or on board an aircraft, subject to being screened and cleared at transit and transfer points.

To achieve the first phase all airports within EU member states that screen international transfer traffic would have been required to have a minimum of one piece of equipment per screening / transfer point that is capable of detecting liquid-based explosives. The second phase, scheduled to commence in April 2013, would allow for oversized liquids to be carried by passengers on all flights subject to a technology based liquid screening regime.

On 29 April 2011, OTS was advised that the changes to EU LAGs restrictions were not going ahead and that they would remain in place across all EU member states with the first phase now unlikely to occur in EU member states in 2011 if at all. OTS understands that European aviation security regulators are still developing some of the process and policy positions relating to the resolutions of alarms produced by LEDs.

Key international partners are in agreement that a technological screening solution is an effective long term approach to mitigate the risk posed by liquid-based explosives.

Australia has supported the EU's proposal to remove LAGs restrictions subject to a technological solution for liquid screening.

3. Purpose

The purpose of the trial was to enable the collection of sufficient operational data to establish an understanding of the potential operational impact of introducing technological solutions to enable the lifting of LAGs restrictions on the carriage of oversized LAG items. LAG items within containers of $\leq 100\text{ml}$ were screened in accordance with normal domestic security screening procedures.

The following information was collected:

- carriage levels of oversized LAG items in an unrestricted environment;
- characteristics of oversized LAG items carried (size, shape, container material etc);
- operational performance of equipment; and
- process and facilitation implications.

This data was collected to supplement existing information on the performance of LEDs. The data was used to model the LAGs screening process (using discrete event simulation modelling) to allow the performance of multiple screening options and equipment configurations to be compared and identify methods to optimise both detection and the efficiency of the screening process.

4. Screening Process

Advanced X-ray observation equipment and BLS equipment, both enabled to detect liquid-based explosives, were incorporated into an operational passenger security screening lane. The advanced X-ray observation equipment is classified by the EU as Type C equipments as multiple items can be screened simultaneously in sealed containers that have been

separated from other personal effects. The BLS equipment is classified as Type B equipment as it can be used to screen individual sealed containers.

Two screening scenarios were trialled:

1. Advanced X-ray observation equipment used as primary means of screening with alarm resolution performed by the BLS equipment; and
2. BLS equipment was used as a supplementary screening method, similar to explosive trace detection testing, in that bottles were selected on a random and continuous basis for screening.

| CEIA EMA-3 | THERMO FISHER SCIENTIFIC TRUSCREEN | RAPISCAN 620DV | SMITHS DETECTION HI-SCAN 6040aTiX | SMITHS DETECTION RESPONDER BLS |
|---|---|---|--|---|
|  |  |  |  |  |

Figure 1 Equipment used in the Joint LAGs Trial 2010

Persons presenting for screening were directed by a screening officer to undergo screening at the trial lane on a random and continuous basis. Screening through the trial lane was mandatory for those selected as facilitating this trial on a voluntary basis would have notably reduced the validity of the data collected and prevented it from being a representative sample. Operations at the trial lane were performed in accordance with a separate supplementary notice prescribing the methods, techniques and equipment to be used for screening at the trial lanes.

Measures to offset potential facilitation issues were put in place to ensure that any delays to passengers were minimised. It was anticipated that persons selected for the trial might experience slightly longer than usual screening times, due to the additional time required to explain the additional screening requirement, divest oversized LAG items from carry-on baggage and to undergo additional screening processes if required.

5. Data Collected

From the trial an extensive amount of data was collected from both of the two screening scenarios. Comparison data was also collected for a screening lane with no oversized LAG item screening equipment in use to give a baseline for a comparison to normal screening operations. Operational data collected included: the number and type of oversized LAG items carried by passengers; the operational performance of the equipment; and the timings for the screening processes and passenger facilitation.

The data collected during the trial was based on a scenario similar to that proposed by the EU to commence in April 2013. In this scenario all oversized liquids could be carried by passengers onto flights subject to screening using one or more pieces of liquid explosive detection technology.

5.1. Number of Passengers Screened

A total of 7430 passengers were screened through trial lanes during the three week operational trial. The following information is based on a sample of 5406 passengers across both Melbourne and Sydney airports and has been cleaned for incomplete and unreliable records. This is still considered to be a statistically significant sample size.

5.2. LAGs Carriage Levels (LCL)

People screened through the trial lane were required to divest all oversize LAG items from their personal effects and carry-on baggage. Data collection personnel characterised the divested oversize LAG items into seven categories and recorded the quantity carried by each person.

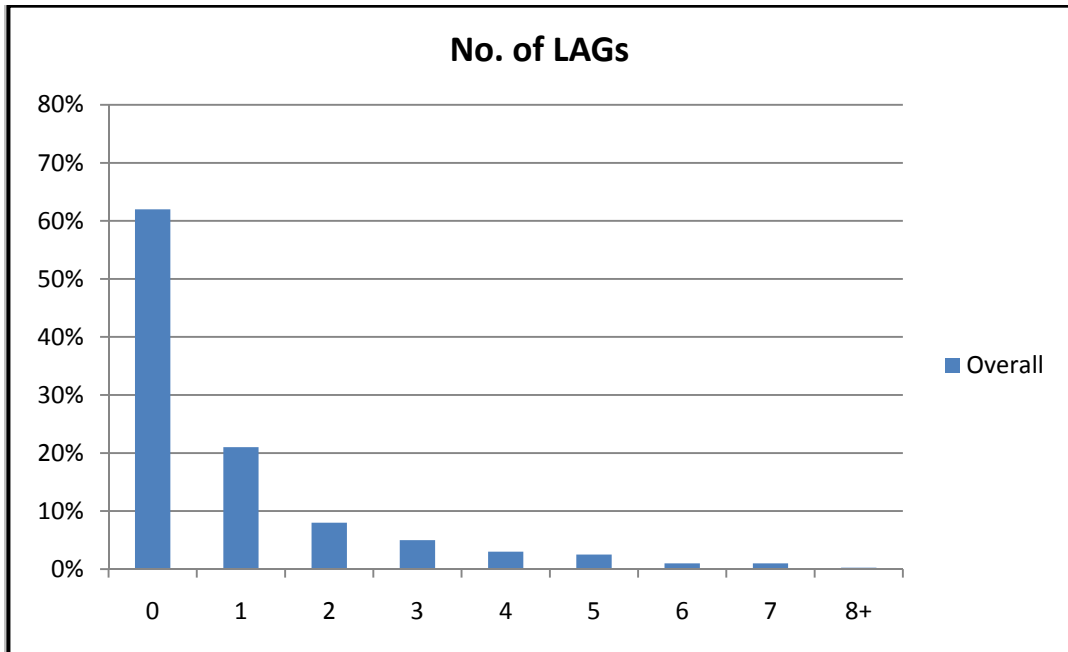


Figure 2 Number of LAGs carried by persons during the Joint LAGs Trial 2010

The majority of people screened were carrying no oversize LAG items with them. Where people were carrying an oversize LAG item it was predominantly only one or two.

5.3. Category of LAG items

Oversize LAG items were recorded six different categories. An additional “other” category was added to account for unexpected oversize LAG items that appeared during the trial (e.g. lava lamp).

| LAG Categories | Overall |
|-------------------|---------|
| Alcohol / Perfume | 7% |
| Drinks | 37% |
| Foods | 2% |
| Household | 0% |
| Medicines | 1% |
| Toiletries | 53% |
| Other | 0% |

Figure 3 Category of LAG items observed during the Joint LAGs Trial 2010

The majority of the oversize LAG items screened during the trial were classified as toiletries or drinks. The medicines category refers to naturopathic oversize LAG items that were not exempted from screening as prescription medications (e.g. fish oil capsules). The alcohol / perfume category represents oversize LAG items which are available in duty free stores.

5.4. Container Type of LAG Items

Container material type is a significant factor in identifying a technological solution to allow the relaxation of LAGs restrictions. This is due to the inherent limitations of some technologies such as laser-based equipment that require a container to be transparent or translucent in order to analyse its contents. Over 70% of the oversized LAG item containers observed were plastic with an average of 40% being transparent or translucent.

| LAG Categories | Overall |
|----------------|---------|
| Glass-Opaque | 1% |
| Glass-Other | 10% |
| Metal | 16% |
| Paper | 1% |
| Plastic-Opaque | 32% |
| Plastic-Other | 40% |

Figure 4 Container material of oversized LAG items observed during the Joint LAGs Trial 2010
("Other" refers to transparent and translucent containers)

5.5. False Alarm Rate (FAR)

It is important to acknowledge that the detection sensitivity settings on the equipment can have an impact on the observed alarm rate. In many instances alarms observed for oversized LAG items were a result of the equipment identifying characteristics that are similar to materials of interest.

5.6. Screening Process Timings

The screening process timings captured have been analysed to take advantage of the limited number of observations collected during the trial for some of the screening processes.

A significant increase in throughput was observed at both locations as screening officers became more familiar and experienced in applying the procedures and using the equipment.

Further analysis and throughput information is included in the modelling section of this report.

6. Equipment Performance

Only equipment deemed effective in testing undertaken by OTS and our international transport security partners was used to ensure the trial lane met the security outcomes required by the Australian Government.

Both the advanced X-ray observation equipment and BLS equipment performed adequately during the trial. The range of oversized LAG items that could be screened during the trial was enhanced by having multiple complementary technologies available for use in the screening process. Screening configurations that utilised complementary technology types were observed to optimise the performance of the screening process as a whole.

6.1. Advanced X-ray Observation Equipment

The two pieces of advanced X-ray observation equipment were able to screen all oversized LAG items presented to them as part of primary screening.

6.2. Bottled Liquid Scanner Equipment

The choice between which piece of BLS equipment was to be used in each of the scenarios was governed by standard operating procedures designed to optimise the equipment's performance. The BLS equipment trialled was only capable of screening one oversized LAG item at a time and the dimensions and space allocated by the equipment for analysis did not always match those of the oversized LAG item.

The use of laser-based technologies also requires operators to understand and use the equipment in a way that promotes laser safety and prevents eye injuries.

Overall the equipment used for the trial was able to effectively and consistently screen the majority of oversized LAG items. Complementary technology configurations significantly reduced the number of oversized LAG items that required an escalated resolution.

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7. Passenger Communication

The trial was supported by a communications strategy which included the provision of a media release including video footage, signage and information material at the screening point and website information.

For the duration of the trial an OTS staff member was available at each location at all times whilst the trial lanes were in operation. The trial process was supported by trial assistants (contracted staff from a labour hire company) to help persons that were selected to participate in the trial, provide further information and answer questions. In addition, the TSA and DfT contributed to the trial through the provision of expert staff and data collection equipment.

In general, those that participated in the trial were impartial about the trial and did not provide any feedback, either positive or negative, on the TravelSECURE website, or on comments cards available at the trial screening lanes.

8. Facilitation

Facilitation rates during the trial increased over time as communication and procedures improved and as screeners became more experienced with the technology and procedures. Concise instructions and visual aids were the most significant factors in improving the compliance of people divesting oversized LAG items prior to screening. This reduced the need for rescreening and reduced the average screening time required per person.

Screening officers' familiarity with the screening process and confidence with the equipment also reduced the overall screening time and improved passenger facilitation. Towards the end of the trial passenger facilitation for both scenarios was observed to reach an average of 200 people per hour.

A model to simulate the security screening process and this has been validated using existing data and trial data. The model allows results of the trial to be applied to other screening locations and screening objectives. Data collected during the trial has been used to explore optimal screening point configurations and processes for screening LAG items to minimise the impact on facilitation.

The key factors in achieving high facilitation rates are likely to remain communication, screening officer experience and equipment configuration as it is unlikely that screening times for equipment will change dramatically. Screening point design and queue management will also contribute to possible and actual screening and facilitation rates necessary for maintaining adequate passenger flows.

9. Modelling

The purpose of the trial, as described in section 4 of this report, was to collect characteristic information on oversized LAG items in an unrestricted environment. This information was essential to enable the development of a realistic modelling tool for investigating the impact of various oversized LAG item screening scenarios.

The modelling tool was built using both data collected during the trial and data collected previously by international counterparts. The aim of this work was to model the oversized LAG item screening process and to consider the impact of different technology configuration options on screening point throughput. The model used for this was developed using Comprehensive Airport Simulation Technology (CAST) and was validated against an existing CAST model.



Figure 5 Example of a CAST model simulation
http://www.airport-consultants.com/index.php?option=com_content&task=view&id=26&Itemid=51

The trial data used was complemented by quantitative and qualitative information collected internationally.

The model was used to produce throughput information for the Australian conditions using the trial data. This incorporates a limited number of screening options. The models developed in CAST all incorporate the LAG screening process data from the trial data set as this is a unique data set.

The analysis is based on a phase two 2013 scenario, where oversized LAGs are expected to be allowed to be carried subject to being cleared following screening. The analysis does not extend to the specific situation of phase one for transit and transfer passengers.

9.1. Distribution of Liquid Carriage Levels

There was a significant difference between the LCL obtained from the trial for the Australian domestic travelling public compared to that projected by other international regulators.

It is acknowledged that factors such as the LCL will impact on the achievable throughputs and this was confirmed by the model. The model developers have recommended that should substantially different information become available, including a significantly different LCL, the modelling work should be repeated.

The graph shown in figure 6 below illustrates that the LCL distribution can vary greatly. The majority of passengers screened through the trial lane, approximately 68 per cent, were not carrying any oversized LAG items in comparison to an expected 30 per cent in a high carriage level scenario.

The midpoint referred to in figure 6 relates to a validation number calculated using the CAST modelling tool to illustrate a possible LCL between the significantly different high and low LCL.

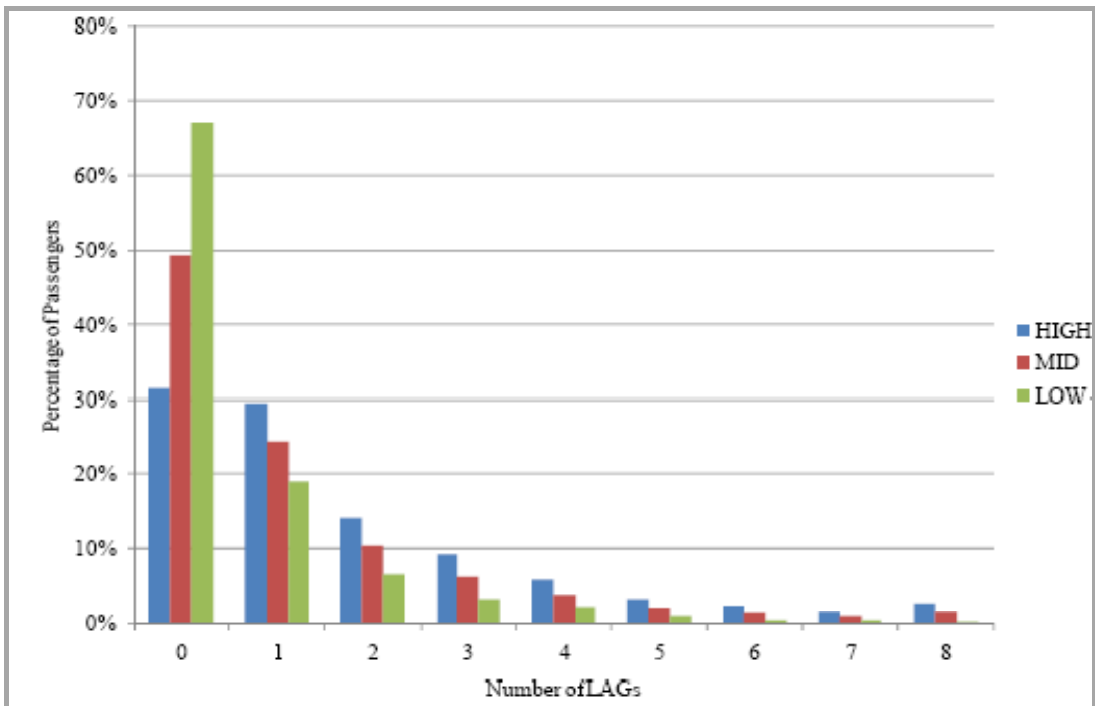


Figure 6 Distributions of the number of LAGs carried by passengers for high, medium and low LCLs

9.2. Data and Assumptions

There was a need to make certain assumptions and use certain timing averages to develop both the CAST models. The table in figure 7 below shows some of the assumptions that have been made for non-LAG related input data when modelling the trial processes.

| Data | Australian Process |
|--|--|
| X-ray screening time | International times used (trial data not suitable) |
| Number of items (not including LAGs trays) | 1.64 items per person |
| Non-LAGs divest/recompose | Trial distribution used |

Figure 7 Source of non-LAG related input data for trial processes

International data for X-ray screening time was used for the CAST model in place of trial data as there was insufficient, statistically significant, timing data collected on this process during the trial.

The timings and assumptions used in figure 8 were used for both the CAST model for LAGs related processes.

| System | Time | Assumption |
|----------------|-------------------|---|
| X-ray (Type C) | 5s per tray | System "in-line" with X-ray system |
| BLS (Type B) | 39s per passenger | Covers discussion time with passenger regardless of number of LAGs being screened |
| | 32s per LAG | Covers time to physically screen a single LAG container |

Figure 8 Oversize LAG item screening timings and assumptions

The above timing for the X-ray is based on information from international airports and the BLS information is based on trial data.

Several screening scenarios were modelled that represent the trial screening method. The security screening processes, used throughout the trial, that enable the data capture used to create this model are those described in section 4 of this report. The operational and business related outputs from the modelling work will be provided to relevant industry participants.

9.3. Outcomes

Based on the outputs of the CAST modelling, several conclusions can be drawn relating to LCL.

The LCL for both Type C and B screening options will have a significant impact on throughput. The overall output of the modelling demonstrated that the throughputs for Type B equipment, where used as the primary means of screening, were less than those for the Type C equipment used as a primary screening mechanism. It remains important that screening processes are robust to changes in the LCL distribution as this parameter cannot be mitigated by the security screening process.

In general there was an inverse relationship between screening level and throughput. This relationship was more pronounced with the Type B primary screening configuration. Increasing the screening level, where Type B equipment is operating in a primary capacity, has a significant negative impact on the predicted throughputs.

10. Current Status and Future Considerations

The current status and issues for further consideration identified as a result of the trial:

- The trial provided key information on the possible implementation effects of the EU proposed April 2013 screening regime. The trial did not look specifically at the proposed EU phase one LAGs screening regime as the April 2013 scenario was considered to provide sufficiently detailed information to model other scenarios.
- The EU had legislated that the initial phase of reduced restrictions will apply to oversize LAG items presented in STEBs that meet ICAO standards and contain visible proof of purchase within the previous 36 hours from an airport or onboard an aircraft. STEBs may need to be made available at transit and transfer screening points.
- Liquid explosive detection capable equipment will also need to be compatible with other incoming screening technologies. This will require considerable thought to be put into the practical requirements such as power, floor loading, access etc. to maintain the security outcome and individual airports' facilitation requirements.
- Technology will continue to contribute to the Australian Government's risk based, layered approach to aviation security. Training and procedures are key factors in any change to policies associated with the implementation of new technologies.

- The use of advanced X-ray observation equipment for primary screening improves the detection of other prohibited items.
- The Department's policy and regulatory amendments need to be in place in advance of any relaxation of current LAGs restrictions. This will inform development of future methods, techniques and equipment specific to screening of oversize LAG items which will be issued to industry through the Aviation Screening Notice.
- Any future changes to Australian restrictions should be commensurate to the risk posed to the aviation sector and include consultation with industry members to minimise the impact of implementation.
- The Australian Government has indicated support for the gradual relaxation of LAGs restrictions, subject to an appropriate technological screening solution supported by effective procedures.

11. Recommendations

The trial achieved its intended purpose which was to establish an understanding of the potential operational impact of introducing technological solutions to enable the lifting of restrictions on the carriage of oversize LAG items.

The following recommendations are based on trial outcomes and current information.

- LAGs restrictions remain in place at international, transit and transfer screening points until airports have implemented equipment capable of screening oversize LAG items and a process has been determined to support this screening.
- Make relevant equipment lists available to screening authorities to ensure they are aware of which equipment is capable and certified/qualified or approved for use in screening for liquid-based explosives.
- Continue to engage in regular and comprehensive communication with international aviation security counterparts and key industry groups on LAGs policies and LEDS technologies.
- Consider funding research and development into technologies capable of performing liquid-based explosive detection.
- Further develop and maintain an understanding of the current international equipment certification/qualification or approval processes and future objectives.
- Engage with industry on the efficacy with which equipment, capable of performing liquid-based explosive detection, can be implemented into existed security screening processes.
- Collaborate with last port of call countries to ensure consistency of procedures, passenger experience and security outcomes.