ANNEX N

PERFORMANCE AND ROUTINE TESTING FOR X-RAY SCREENING EQUIPMENT

1. Introduction

1.1 The performance requirements for x-ray equipment in terms of image quality parameters are laid down in this Annex. A Combined Test Piece (CTP) has been specially designed to ensure the requirements are met and maintained and should be available from the x-ray equipment suppliers.

2. Combined Test Piece

2.1. The combined test piece enables an operator to establish whether the performance of an x-ray system meets the requirements of the Office for Transportation Security, which are contained in Appendix 1 to this Annex. Regular use can help to ensure this performance is maintained.

2.2 The combined test piece incorporates organic and inorganic material samples, resolution and penetration tests mounted on Perspex sheet, which is a little larger than an A4 sheet of paper.

2.3 The combined test piece is used in conjunction with a log sheet to record the observations. Any degradation in performance of the x-ray equipment will be apparent by comparison with previous results.

3. Responsibility

3.1 Chartered Airports such as the Ninoy Aquino International Airport, Clark International Airport, Subic Bay International Airport and Mactan-Cebu International Airport shall be responsible for the regular maintenance and repair of security screening equipment installed in its respective airports.

3.2 In all airports, including airports that are privately managed, the conduct of daily routine operational testing of all security screening equipment installed will be a shared responsibility of the OTS Screening Supervisor on duty and the airport management.

Test Procedures:

3.3 The combined test piece is to be used as a quick routine test carried out daily to ensure that a satisfactory image is obtainable and the equipment is working correctly. This will involve operators recording their observations on the x-ray image using the sheet provided.

3.4 The combined test piece is to be placed on the belt and passed through the machine at least once a day, immediately after the x-ray equipment is

switch on, to ensure that the equipment is working correctly before commencing screening operations.

3.5 During the weekly test the combined test piece may be viewed using any image enhancement facility available on the x-ray machine and may be passed through the machine as many times as the operator decides. The data sheet prompts the operator to record what facilities were used and what could be seen. Either the black and white or colour displays can be used to view the test piece.

3.6 The optimum of the combined test piece on the belt depends on the x-ray source and detector arrangements. The aim should be to obtain the best picture possible. If there is any doubt about where to place the combined test piece, the maintenance engineers or manufacturers should be consulted. For some machines the lid of the combined test piece may need to be raised to trigger the x-ray beam as it passes through the machine so an image can be obtained.

4. Results

4.1 The best result taking both images (black & white and colour) into account should be recorded for the particular machine. The optimum position of the combined test should also be recorded.

4.2 Authorised persons should record that the daily test was carried out. A logbook will be maintained for this purpose. The results of the test should be recorded on the log sheet and should include the following information: date, time, type and serial number, settings and the name of the supervisor present. Comments for each test shall also be recorded. Recording of detailed results may be done more frequently if it is considered desirable.

4.3 The x-ray equipment being tested should meet all the requirements of the combined test piece. Failure of some or all of the tests may mean the video monitor, video signal or the x-ray apparatus could be at fault. If the results are still not satisfactory after the monitor has been cleaned, an engineer should be called. The equipment should not be used if the supervisor is not satisfied with the performance of the equipment. This must be recorded on the data sheet.

4.4 If the equipment appears to be giving poorer performance when compared to a previous test or there is doubt about whether a requirement is met, an engineer should be called. This fact must be recorded on the data sheet along with the steps taken to improve performance. The equipment may be used if the supervisor is satisfied with the equipment performance.

4.5 The operators should keep the records for at least two years after the final entry. The manufacturers or engineers may want them to be kept longer. Authorised officers, on behalf of the OTS Administrator, may request records.

5. Machine Automated Explosive Detection System (MAEDS)

5.1 For the make and model of the equipment that can be accepted for use under this Program, the operator is required to submit the details of the equipment for acceptance by the OTS Administrator before purchase. Three months should be allowed for assessment.

5.2 The supplier should be asked to confirm in writing whether a particular machine meets the requirements before purchase. Acceptance of the equipment should be dependent on the equipment meeting the requirement when installed.

APPENDIX 1 TO
ANNEX N

USER REQUIREMENTS FOR X-RAY SCREENING EQUIPMENT

1. Detection Requirements

1.1 X-ray screening equipment is required for use in detecting both metallic and non-metallic objects. These items may be concealed in any form of luggage carried or placed on board an aircraft. The list of items to be identified includes:

(a) firearms ï metallic and non-metallic

(b) firearms components

(c) ammunition ï all calibres

(d) grenades and other fragmentation/blast weapons

(e) knives, batons, swords, etc.

(f) explosive ï military, commercial

(g) detonators and timing devices

(h) electrical and electronic items

(i) power sources

2. Performance Requirements

2.1 An x-ray screening machine which offers the greatest probability of detecting all the items mentioned in the previous section will meet the following requirements:

2.2 Combined Test Piece Requirements

2.2.1 These tests determine whether an x-ray machine meets the requirements of the OTS:

(a) Single wire resolution (Test 1) defines the ability of the system to display a single thin wire. The combined test piece uses a 33 SWG, (standard wire gauge, 0.254mm), un-insulated tinned copper wire. Wires of 25 SWG (0.508mm), 33 (0.254mm), 36 (0.193mm) and 40 (0.122mm) are included to show if the machine has better single wire resolution than required, or that the performance has deteriorated with time. The wires are laid

out in ñSò shaped curves; the requirement is to display the 33 gauge wire not covered by the step wedge. A tick should be used on the log sheet to indicate visible wires.

(b) Useful penetration (Test 1) defines what level of detail should be seen behind a thickness of a known material. The combined test piece has different gauges of wire behind varying thickness of aluminium. This is similar to the American Society for Testing & Materials (ASTM) wedge that which has wires behind the steps. The requirement for this test is that the 25 SWG is seen under the second step of the wedge (5/16ò). This is the equivalent of the United States FAA/TSA requirement. Ticks on the log sheet indicate what wires are visible.

(c) Multi-energy X-rays (Test 2) With multi-energy X-rays, it is possible to distinguish between materials of different average atomic number. This means that organic and inorganic substances can be differentiated. (ómulti-energyô ódual energyô and ómaterials differentiationô are considered synonymous in the present context.) The use of sugar and salt samples encapsulated on the test piece as well as the various materials used in the construction of the combined test piece, will check the material discrimination facility. The requirement is that different colours are allocated to the two samples. The optimum colours for this task are the subject of further research. A tick will indicate that the two samples are shown in the colours.

(d) Simple penetration (Test 3) defines what thickness of steel the machine should be able to penetrate. The steel step wedge on the combined test piece has steps of 2mm to 12 to 24mm with a lead strip underneath. The requirement is that the lead is visible beneath 14mm of steel. A tick will indicate where a difference between the lead strip and the step wedge is visible.

(e) Spatial resolution (Test 4) defines the ability of the system to distinguish and display objects, which are close together. The combined test piece tests this aspect of performance by using 18 copper sheet gratings at right angles to each other. The requirement for this test is that a vertical and horizontal grating can be seen. A tick on the log sheet will indicate that gaps in the grating are visible.

(f) The ability to image thin metal is tested using steel shim (test 5). The requirement is to image steel 0.1mm thick. A tick on the log sheet indicates the steel shims are visible. Together, these tests will also demonstrate the machineôs dynamic range.

2.3 Display Requirements

2.3.1 The machines should incorporate the following features:

(a) Detector Positioning-The arrangement of the detector should be such that both a ótopô and ósideô view of the object are displayed. Such an arrangement is commonly known as a ófolded arrayô.

(b) Black and white image- Objects are distinguished by differing shades of Grey. Such shades are caused by variations in the amount of x-rays penetrating the target bag. The image should be reversible. The DGCA considers that any equipment that uses a black & white display only does not meet its requirements.

(c) Colour coded image. Different colours should be assigned to metallic and organic material in multi-energy x-ray image. Also a third colour should be assigned to objects through which the x-rays cannot penetrate. The following colours can be used; orange for materials of low average atomic number (e.g., organic materials), blue for metals and red for areas where the x-rays cannot penetrate. With this method of imaging, it should be possible to distinguish high-density organic material such as explosive.

The colours are given as examples and are those used on one type of commercially available equipment. Further research is being undertaken to determine the optimum selection of colours.

(d) Organic colours only. It should be possible to display a single colour image representing just the organic component. This simplified image should make it easier to identify explosive.

(e) Image enlargement. The operator should be able to select a section of the image and expand it. There should be at least nine enlargement sections in the complete image.

(f) Brightness scanning. The human eye cannot distinguish between more than about a dozen variations in brightness, but computers have no such limitation. There should be at least 256 shades in the x-ray image. These 256 shades should be displayable in one turn as one group of adjacent shades, by scanning across the complete range of shades. Each level in the displayed group is to be assigned a visually discernible shade. In this way, more detail can be displayed.

(g) Edge Enhancement. This feature modifies the periphery of the image of the object so as to make it more visible on the display.

(h) Display time. Every part of the item being examined should be displayed (statically) for not less than five seconds. When not in use the image of the last bag should be removed or a screen saver used to prevent image ôburn-inô.

(i) Operator identification. It should be possible for the displayed image to show an operator identification number and the time and date.

(j) Automatic detection. There is x-ray equipment available that can detect the presence of explosive material or components of an improvised explosive device automatically. Such equipment does not need to provide an image if it is being used in a fully automatic mode. If such equipment is used

in a way that requires an operator to make a decision based on an image (indicative mode), this image should be the same standard as a conventional x-ray machine. Operator intending to use such equipment should discuss the application with the DGCA.

2.4 Hardware and Software

2.4.1 The machine should incorporate the following features:

(a) Expandability. New techniques will become available, particularly in image processing and pattern recognition. The machine should be designed so that software enhancements can easily implemented, or a separate ôblack boxô can be added. It should be possible to program the machine via an output port. The protocol for this should be documented and available.

(b) Software. The image processing and control software should be written to allow ease of updating.

(c) Speed of operation. Any display mode should be available within one second of detection or selection. This time limit may not apply to future image processing techniques such as pattern recognition. However, the maximum allowable delay is six seconds.

(d) Video connection. It should be possible to record easily the image seen by the operator. Outports should be provided to permit the connection of a video recorder or an external ôblack boxô. Such outports should provide both composite video and RGB signals compatible with video recorders (PAL 625 lines/50 fields, CCIR system I). It should be possible to input test images via a video input.

2.5 Health and Safety

2.5.1 The machine must comply with the requirements of current health and safety legislation and be approved and licensed for use by the Radiation Monitoring Board, Department of Health (DOH) of the Republic of the Philippines.