IS : XXXX: 2025
Doc.No:. LITD 26 (22102)
February 2025

BUREAU OF INDIAN STANDARDS
DRAFT FOR COMMENTS ONLY

मसौदा भारतीय मानक
एक्स-रे सामान निरीक्षण प्रणाली (एक्स-बीआई एस)

Draft Indian Standard
X-Ray Baggage Inspection System (XBIS)

ICS 13.310

LITD 26 Alarms and Electronic Security Systems Sectional Committee	**Last Date for Comments:** 13 April 2025

LITD 26 Alarms and Electronic Security Systems Sectional Committee

NATIONAL FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on the recommendation of the Alarms and Electronic Security Systems Sectional Committee and approval of the Electronics and Information Technology Division Council.

1. SCOPE

This standard defines the requirement of X-Ray Baggage Inspection System (XBIS) for scanning of luggage without physically opening it. This Standard is applicable to 'Single View and Dual View XBIS with dual/multi energy detectors. XBIS enables security personnel / operator to analyze baggage for threat or suspicious objects. It shows scanned images comprising of four colors i.e. orange, green, blue and black. These four colors of scanned baggage are decided by effective atomic number of the object scanned. Orange, green, blue and black color signify organic, inorganic, thin metal and dense materials respectively. It is used by security personnel at airport, railway stations, metro stations, highly secured govt. offices, R&D labs, shopping mall and hotels etc.

This Standard is applicable to the following types of X-BIS with different tunnel sizes:

a.	Small Size	Parcel Scanner
b.	Medium Size	Baggage Scanner
c.	Large Size	Large Baggage Scanner

2. REFERENCES

The Standard given below contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All Standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the Standards indicated below:

IS No.	Title
IEC 61010-1:2010	Safety requirements for electrical equipment for measurement + control + and laboratory use - Part 1: General requirements

3. FUNCTIONAL DESCRIPTION OF X-BIS

3.1 X Ray Baggage Inspection System shall consist of X-ray machine, operator control console with suitable controls, stainless steel roller tables on entry side and exit side, LCD colour monitor, power cable, Combined Test Piece (CTP), Threat Image Projection (TIP) software, network supervisory workstation (optional) etc.

3.2 The X-ray baggage screening system required to function in network mode should be easily networkable using any standard software platform. The networked machines should be capable of allowing data and images to be accessed in real time by a centralized supervisory workstation. The system should enable the supervisor to perform key tasks for multiple units including second level screening of suspect objects, centralized monitoring of operators' performance using Threat Image Projection feature, and administration of all X-ray systems on the network.

3.3 The system should be capable of adapting to diverse operational requirements and evolving security challenges through easy customization of software-based controls and tools.

3.4 The X-ray baggage screening system shall be capable of bidirectional screening operation.

3.5

4. GENERAL REQUIREMENTS

4.1 The X-BIS shall have the ability for real time screening of baggage without stopping the conveyor belt. The aspect ratio of scanned image shall be equivalent to the real baggage and not be deforming from the original shape of the baggage.

4.2 The physical dimensions of X-BIS shall be compatible to security check points. It shall be easy to install, commission and service at the entrance/ exit of the user premises.

4.3 The X-BIS shall display scanned image comprised of at least four colours i.e. orange, green, blue and black signifying organic, inorganic, thin metal and dense materials respectively.

4.4 The conveyor movement shall be bidirectional for entry and exist gateway of the premises.

4.5 The real time scanned image shall be provided to enhance the image quality with the help of XBIS software but shall not allow the operator to alter/manipulate the scanned image.

4.6 Tunnel Size

The tunnel size of X-BIS denotes the size of entry and exit of the baggage. The X-BIS with different tunnel sizes are used in different applications. Based on the tunnel size other parameters of X-BIS are decided.

The minimum tunnel size of XBIS shall be as follows:

A. Small Size:	50 cm x 30 cm (WXH)
B. Medium Size:	60 cm x 40 cm (WXH)
C. Large Size:	100 cm x 100 cm (WXH)

4.7 Conveyor Speed

The conveyor speed decides the shape and image continuity of the scanned object.

The conveyor speed shall preferably range from 0.18m/s to 0.3 m/s.

4.8 Throughput

The throughput of the machine shall be minimum 200 bags/hour.

4.9 Conveyor Load Capacity

The load capacity (evenly distributed) of the Conveyor shall be as below:

a. Small Size X-BIS: Maximum 60 Kg

b. Medium Size XBIS: Maximum 165 Kg
c. Large Size XBIS: Maximum 200 Kg

4.10 Cooling

Electron striking to anode contributes to heat which increases the temperature of X-Ray tube. To compensate this heat cooling mechanism shall be provided.

4.11 Detector Type

Dual energy/Multi energy detectors shall be provided to display scanned images in different colour as per effective atomic number.

4.12 Power Supply Input

The power supply input shall be 230± 10 % VAC, 50 Hz.

4.13 Operating Temperature

The operating temperature range shall be -10 °C to 50 °C.

4.14 Storage Temperature

The storage temperature range shall be -20 °C to 50 °C.

4.15 Humidity

The humidity shall be up to 90% non-condensing.

4.16 Zoom

Continuous electronic zoom with a minimum value of 16X.

4.17 Connectivity (Optional)

The Computer system used along with XBIS should have Ethernet connectivity. A client server configuration can be established to network with other of XBIS and its display can be monitored in a central monitoring station.

4.18 Film Safety

The machines should be film safe for high speed films up to ISO 1600. The photographic films shall not be damaged due to X-Ray examinations.

4.19 Food Safety

The machine should be food safe.

4.20 Video Display

The XBIS machine shall have the following Video Display specifications:

a. CPU: Should be able to deliver the output to meet the XBIS specifications.

b. Monitor: Minimum 21” monitor with LED back panel. Should be able to display scanned images without corner cut.
c. Hard Disk: Minimum 1 TB ,7200 rpm SATA HDD

d. Mouse & Keyboard: optical

e. Ports: 6 USB port, HDMI, Display port, RJ-45 port.

f. CD-R/RW Drive: DVD Writer

g. Networking: 10/100/1000 on board integrated network port.

4.21 Credential for XBIS software:

The XBIS software shall provide the following three levels of credentials:

a Operator credentials: with limited access.

b Supervisor credentials: with complete access.

c Service Engineer credentials: for maintenance.

The software should be able to recall minimum 15 last scanned images in all level of credentials.

4.22 Threat Image Projection

4.22.1 TIP software facility shall be incorporated in the offered X-ray machines to assist supervisors in testing the operator alertness and training X-ray screeners to improve their ability in identifying specific threat object. The system will create a threat object and the same will be superimposed on monitor screen while a bag is being screened. To acknowledge that the operator has seen the false object, operator must press the control panel key that will cause the computer-generated threat object to disappear from x-rayed bag image on the VDU screen. Each operator's action shall be recorded in the hard disc of the computer for the auditing purpose by the supervisor or other authorized person.

4.22.2 ***Design of the system***

4.22.2.1 TIP software should be compatible with other X-ray technologies such as automatic reject unit, Dual X-ray screen technologies, automatic threat recognition system etc.
All X-ray image function must be available at the same time along with the TIP.

4.22.3 ***Image library***

4.22.3.1 The TIP facility should have an image library. The system shall have facility to expand the library to incorporate additional images by user without assistance of the manufactures as and when required.

4.22.3.2 The image library should contain images of threats at different orientations – both plane and end-on orientations should be used. Although these will be assigned different file names and references. It must be possible to cross reference these as the same threat. All threat Image Projection images must be realistic. Representative and non-distinguishable from real threat items.

4.22.4. ***Time interval***

4.22.4.1 Programming facility shall be available to project threat images in different intervals. The time period for threat image as well as image mix in percentage shall be user programmable e.g. software shall select 40% images of explosive devices, 35% of fire arms & 25% knives or random etc.

4.22.4.2 Once the screener has responded to identity of the computer-generated threat image, it should remain on the screen for a predefined user programmable time for analysis. The image should be highlighted, upon identification, and feedback message shall be visible to the screener.

4.22.5. ***System Administration***

4.22.5.1 The threat image projection facility shall have details of user data-base such as airport name, screener name, organization, user ID number.

4.22.5.2 Access to start up menu should be restricted only to the authorized individuals. A log-in procedure by means of 'password' or 'security key', could achieve restricted access to each of the comment. The log-in procedure should not take longer than 20 second. The system should have facility to by-pass the TIP facility, if programmed so by the system administrator. It is to be ensured that the TIP software shall not be hindrance to normal functioning of X-ray Machines.

4.22.5.3 When the operator logs-in or log-out, message should be displayed on X-ray BIS VDU Screen to confirm that he/she has been correctly logged-in or logged-out.

4.22.6. ***Feed Back Report***

4.22.6.1 The threat image Projection should be capable of giving feedback HIT, MISS or FALSE ALARM message. No message will be presented if a screener correctly passed as clear bag.

4.22.6.2 A 'HIT' message to be presented when a screener has correctly identified a Threat Image Projection image. A'MISS' message shall be presented when screener fails to identify the TIP image A 'False Alarm' message shall be given when screener incorrectly indicate TIP image when in fact no threat image projection is present. The feedback should clearly indicate in a screen that a TIP object has been correctly identified / TIP object has been missed / no TIP object was present. Information should be recorded in the database.

4.22.6.3 Different colour coding shall be used for feedback to the screener. It is recommended that colour code 'Red for MISS', Green for 'HIT' and 'yellow to False Alarm or Interrupt' be used.

4.22.6.4 The system shell automatically prepares the daily log of events for each shift and for each screener performance. TIP log shall include particulars of

4.22.6.5 Airport, XBIS, Name of Screener, Time & data of threat image, weather threat image was successfully identified or missed etc.

4.22.6.6 The report on Threat Image Projection system may have date and time (FromTo) as per requirement, Screener particulars, and decision /outcome i.e. MISS, HIT or False Alarm in percentage as well in absolute numbers, number of bags screened, categories such as explosive devices knife or weapon etc.

4.22.6.7 As a standard practice, daily/ weekly/monthly report shall be retrieved. Report shall be for any given time and period, as per command.

4.22.6.8 All data should be stored on the system for a minimum of two months after it has been down loaded. No individual, regardless of access rights to the Threat Image Projection components would delete or amend any of threat Image Projection data or time i.e. Threat Image Projection data on the actual X-ray machine will be read only file.

4.22.6.9 Automatic tray retrieval system with reject lane and recheck station with multiple divestment stations may be installed by airport operators to increase throughput, wherever required.

4.22.6.10 X-BIS shall have automated online framing of suspicious martial (e.g. Explosives, high density material, narcotics etc.) for operator. This feature should be in real time requiring no operator involvement.

4.22.6.11 All the system should be maintained by the OEMs or entities certified by them, by whatever arrangements airport operators opt for.

4.22.6.12 The system should not be connected or accessed through internet by the OEM for any purpose including remote diagnosis.

4.22.6.13 A non-disclosure agreement (NDA) is to be signed by the airport operators (Buyer) with OEM (Supplier) to affect the confidentiality of the information pertaining to the system.

4.22.6.14 Service Engineer of Indian origin will only be deputed by the OEM or entities authorized by them to maintain the system. Non-Indian Engineers may be deputed for major breakdowns under supervision.

BIS Comments: Following Image parameters may be incorporated:

a. Machine should be capable for recalling 15 or more previous images,

b. It should have the capability of archiving 50,000 or more images with date & time stamp.

c. Facility of image enhancement should be available,

d. Facility for variable contrast must be incorporated to allow enhancement lighter and darker portion of the image,

e. Machine should have online recording facility and images can be recorded on a mass storage device and should be able to view images so recorded on a stand-alone PC,

f. The machine should have features of Multi-energy X-ray imaging facility where materials of different atomic number will be displayed in different colours to distinguish between organic and inorganic materials.

g. Continuous Electronic Zoom facility should be available to magnify the chosen area of an image eight times (8X) or more. Image features shall be keyboard controllable.

5. PERFORMANCE REQUIREMENTS

The CTP (Combined Test Piece) shall be used to ensure that the performance requirements for XBIS set out are met and maintained. The CTP shall contain samples of organic and inorganic material; materials for resolution and penetration tests. See Fig.1.

Fig 1. Combined Test Piece

The X-Ray Baggage Inspection machine shall comply with the following requirements:

5.1 Single Wire Resolution

Wire resolution defines the minimum gauge of the wire detected using XBIS. Wire resolution depends on applied kilo volt to the X-Ray tube of XBIS.

A set of un-insulated tinned copper wires of size 26, 30, 35, 38, 40 and 42 SWG or corresponding AWG wires are placed on Perspex sheet. The wires are laid out in 'S" shaped curves. The wires are placed behind varying thickness of aluminium. A quarter of the length of each wire is uncovered whilst the remaining 3 quarters are covered by 3 wedges of aluminium of 4.8mm (3/16"), 7.9mm (5/16") and 11.1mm (7/16") thickness. Metallic marker is provided using high-density material, so that SWG/AWG numbers are clearly visible on the display. The X-BIS machine shall be able to display single un-insulated tinned copper wire of 40 SWG or 36 AWG.

5.2 Useful Penetration

This test defines what level of detail can be seen behind a thickness of known material. The CTP should have different gauges of wire behind varying thickness of aluminium. The requirement of this test is that the 26 SWG wire should be seen under second step wedge (5/16”).

5.3 Multi Energy X-Ray

The machine should have features of multi energy X-ray imaging facility where materials of different atomic number will be displayed in different colours to distinguish between organic and inorganic materials. The use of sugar and salt samples encapsulated on the test piece of CTP will check the material discrimination facility. The sugar shall be displayed in orange color and salt in green color.

5.4 Steel Penetration

Steel penetration defines thickness of steel which the X-Ray from XBIS is able to penetrate. The penetration shall be minimum 35 mm thickness of steel.

5.5 Spatial Resolution

Spatial Resolution defines the ability of the system to distinguish and display objects which are close together. The minimum spatial resolution that the XBIS shall be able to distinguish is 1mm.
The CTP has copper plate with two sets of gratings (1.0mm and 1.5mm). Each set consists of a horizontal group and a vertical group. The requirement is that a vertical and horizontal grating can be seen.

6 SAFETY REQUIREMENTS

The machine must comply with requirements of health and safety regulations with regard to mechanical electrical and radiation hazards. Before installation of the machine, the supplier/manufacture should furnish relevant certificate from Atomic Energy Regulatory Board of India regarding radiation safety.

6.1 EMI/EMC Requirements:

The EMI/EMC requirement for various test parameters shall be as given in below table;

Sr.No.	Name of the test	Standard
1.	Conducted Emissions	IS 6873 (Part 4) : 2019/ CISPR 11
2.	Radiated Emissions	IS 6873 (Part 4) : 2019/ CISPR 11
3.	Radiated RF EM field Immunity	IS 14700 (Part 4/Sec 3) : 2023/ IEC 61000-4-3:2020
4.	Electrical Fast Transient / Burst immunity	IS 14700 (Part 4/Sec 4):2018/ IEC 61000-4-4:2012
5.	Surge Immunity	IS 14700 (Part 4/Sec 5):2019/ IEC 61000-4-5:2017
6.	Conducted disturbance, induced by RF Field	IS 14700 (Part 4/Sec 6):2016/ IEC 61000-4-6:2013
7.	Power Frequency Magnetic Field Immunity	IS 14700 (Part 4/Sec 8):2018/ IEC 61000-4-8:2009
8.	Voltage Dips, Short Interruptions & Voltage Variations Immunity	IS 14700 (Part 4/Sec 11):2021/ IEC 61000-4-11:2020

9.	Electrostatic Discharge Immunity	IS 14700 (Part 4/Sec 2):2018/ IEC 61000-4-2:2008

6.2 The XBIS may also have the following:

a. Fuses for over load protection

b. Lock & Key switch for power supply to restrict unauthorized operation

c. Safeties inter locks for Array Box and side panels

d. X-Ray On indication and Emergency Stop on front panel, rear panel & control desk.: provision for Emergency Stop should be there to switch off the power in case of emergency condition. X-Rays ON warning indication located at the entrance and exit of the inspection tunnel and control panel to indicate that the X-ray generator is switched ON.

e. Lead impregnated curtains at the entrance and exit of the XBIS to reduce leakage radiation less than 1µSv/hr

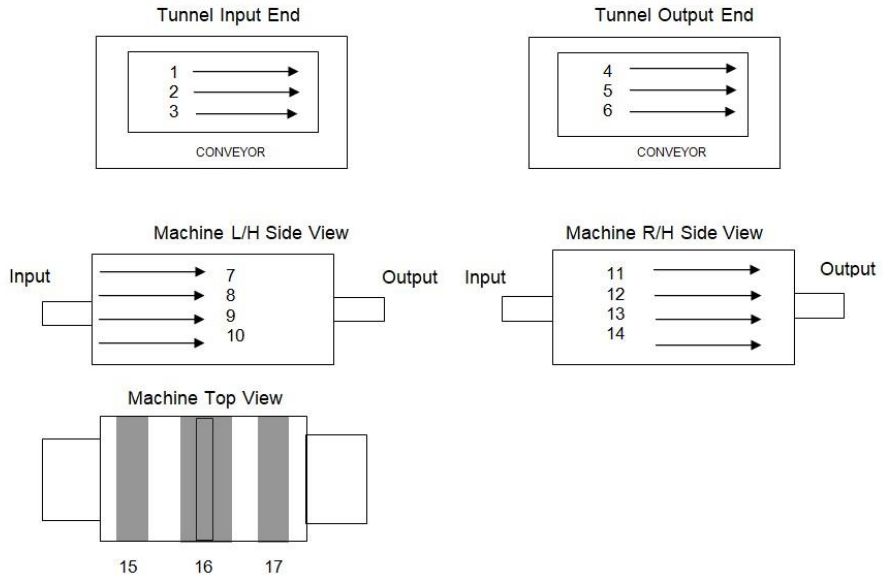
f. Lead shielding material on cabinet

g. Warning Signs: Permanently affixed warning sign at entry and exit of the tunnel of XBIS.

7 OTHER IMPORTANT TESTS

7.1 Radiation Emission Check:

Leakage Radiation measurement shall be measured at the various points of the XBIS when X-Rays being generated. A calibrated pressurized ion chamber radiation survey meter is used for the measuring leakage radiation. Leakage measurement has to be done as per the following points.



The leakage radiation must be less than 1µSv/hr at 5cm from all surfaces of XBIS.

7.2 High Temperature Test

The XBIS system shall be kept in a high temperature oven at 42ºC for 4 hrs. After the test the XBIS should work as per its specifications.

7.3 Humidity Test

The XBIS system shall be kept at 40ºC @ 93% RH for 48 hrs. After the test, the XBIS shall work as per its intended specifications.

7.4 Durability of Marking Test

All system markings shall remain clear and legible under conditions of normal use and shall resist the effects of the cleaning agent. The markings are rubbed by hand, without undue pressure, for 30s with a cloth soaked with 70% of isopropyl alcohol.

7.5 Temperature Monitoring Test

The XBIS shall be subjected to temperature monitoring test in accordance with Cl. 10.1 of IEC 61010-1:2012. This test is conducted to monitor temperature at different points of XBIS Surface for protection against burns.

7.6 Conveyor Belt Load Test:

The XBIS shall be subjected to conveyor belt load test in accordance with IEC 610101:2017. The load shall be placed on the conveyor belt. Conveyor belt should withstand and be able to scan optimum load in reverse and forward direction.

8 MARKING

8.1 Each XBIS shall be legibly and indelibly marked with the following information:

a) Manufacturer’s name or trade-mark (if any);

b) Model designation and serial no.;

c) Month and Year of manufacturing

d) Country of manufacture;

e) Input supply voltage and frequency;

f) Power consumption;

8.2 BIS Certification Marking:

The XBIS may also be marked with standard mark.

8.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulation made thereunder. The details of conditions under which a license for the use of the Standard Mark may be granted to manufacturers and/or producers may be obtained from the Bureau of Indian Standards.