

**INDUSTRIAL 3D CT SCANNER**

SI. No	Nomenclature & Specification	A/U	Qty
(a)	(b)	(c)	(d)
	<b>Industrial 3D CT Scanner with all standard and additional accessories as per specification below:</b>	Nos	01
<b>1.</b>	<b>Specification of the Machine :</b>		
	<b>a. X-RAY UNIT</b>		
	(1) Voltage Range : 20KV-450 KV continuously variable in steps of 1 KV or to be mentioned.		
	(2) Focal Spot (Bifocal) : Fine 0.3 ~ 0.5 mm and Coarse 0.8 ~ 1.00 mm as per EN 12543		
	(3) Tube Power : minimum 450 W for the Fine Focus and minimum 1000 W for Coarse Focus or to be mentioned		
	(4) The x-ray tube must be bipolar, constant potential and high power metal ceramic type and it must be demountable		
	(5) Tube Current : To be mentioned		
	<b>b. DETECTOR</b> : Dual Detector-Linear Detector Array (Optional) (Fan Beam CT) and Flat Panel Detector (cone beam CT) with the following specification:		
	<b>(1) Linear Detector Array (Fan Beam CT) (Optional)</b>		
	(a) 16 bit linear detector array		
	(b) Scintillator : CdWO4 or to be mentioned		
	(c) Pixel size : 194 Microns or to be Mentioned		
	(d) Active Area Length : Minimum 600 mm		
	(e) Adjustable collimator slot		
	(f) Possibility of diode exchanges on place		
	<b>(2) Flat Panel Detector (Cone Beam CT)</b>		
	(a) 16 bit flat panel detector		
	(b) Scintillator : Csl/DRZ+ or to be mentioned		
	(c) Pixel size : 194 microns or to be mentioned, as per ASTM E2597		
	(d) Active area : 400x400 mm minimum or to be mentioned		
	(e) Dynamic Range : Greater than or equal to 10,000:1		
	(f) Frame Rate : 15 fps to 30 fps or to be mentioned		
	(g) Active pixel : 2048 x 4028 pixels minimum or to be mentioned		
	(h) Voxel resolution : 100 Microns or Better		
	<b>(3) Detectability</b> : To be mentioned		
	<b>(4) Spatial Resolutions and Contrast:</b> To be mentioned		
	<b>(5) Detector must be ensured with:</b>		
	(a) Distortion free imaging system.		
	(b) Homogeneous detection quantum efficiency over the whole area		
	(c) Free from pixel or line defects and ring artifact		
	(d) System must have provision for image correction to get Sharp and Contrast image which will improve the X-ray quality and hence boost the signal to noise rotation and the same must be demonstrated satisfactorily.		
	<b>(6) Price of Linear Detector Array (optional item) must be to quoted separately</b>		

	<b>c. MANIPULATOR FOR OBJECT HANDLING:</b> A High Precision granite-based Manipulator must be provided with the following specification for precise rotation and translation of the objects:		
	(1) Stable & Vibration free granite Manipulator		
	(2) Axis : Seven Independent Axes (Vertical movement of source and detector, Focus Detector Distance, Horizontal movement of Flat Panel Detector, Geometrical Magnification, Offset-CT and Object Rotation)		
	(3) True running of rotation axis : > 5 Microns or to be mentioned.		
	(4) Manipulator travel–Magnification axis: 600 mm min or to be mentioned.		
	(5) High Precision rotation stage diameter: 300 with 360- degree rotation		
	(6) Typical part weight : Minimum 100 kg.		
	(7) Size of the job to be inspected : Diameter 300 mm, Height up to 1500 mm or to be mentioned.		
	(8) Geometric Magnification : 1.35-2.0x or to be mentioned.		
	(9) Focus detector distance : Minimum 500-600 mm and Maximum 1500- 2000 mm or to be mentioned.		
	<b>d. SYSTEM PARAMETERS</b>		
	<b>(1) CT Measurement Accuracy:</b> CT Measurement Accuracy MPE-SD: Approx. 15 microns +L/75 or to be mentioned		
	<b>(2) Mechanics Accuracy for Linear Axes:</b> <25 microns or to be mentioned		
	<b>(3) Depth of Penetration of X-rays :</b> In steel minimum 70 mm or more and for other materials penetration thickness is to be provided.		
	<b>(4) Material/ Parts to be inspected :</b> Made of Cast Iron, Plain Carbon Steel Alloy Steel, Brass, Aluminum, Titanium and Polymer.		
	<b>e. SAMPLE/JOB'S LOADING AND UNLOADING SYSTEM (Price has to be quoted separately)</b>		
	(1) The machine must have a conveyor/crane-type semi-automatic and unloading system of jobs for continuous inspection. Drawing/video of Sample Handling System must be provided with the offer.		
	(2) There must be a batch modus for the inspection of several samples at the same time.		
	(3) The machine must be capable of identifying chemical and metal items separately and must be non-reactive to any chemical.		
	<b>f. SOFTWARE AND HARDWARE.</b> Complete software solution for CT data analysis (to find Porosity, Void, inclusions etc ), Metrological measurement, Volume Graphics Cast & Mould Software Package for Color viewing of 3D image, 3D data conversion software for generation of CNC Machine codes (G-CODEs) must be provided.		
	(1) Interactive user friendly software must be provided for CT acquisition, reconstruction, Metrological analysis, Wall thickness measurement, CAD data comparison, Porosity analysis etc		
	(a) Full featured 3D volume viewing and analysis package		
	(b) Clipping and object positioning.		
	(c) Segmentation and classification of voxels based on grey level.		
	(d) Region of interests must be defined and utilized for analysis.		
	(e) Data import and export.		
	(f) Data analysis and measuring functions.		
	(g) Animation		
	(h) Filtering of the volume data.		
	(i) Surface extraction		
	(j) Documentation of results.		
	(k) Automation.		

	<b>(2) Co-ordinate measurement</b>		
	(a) Advanced surface determination.		
	(b) Enhanced alignment techniques.		
	(c) Measurement of objects and between objects.		
	(d) Geometric Dimensioning and tolerance analysis software must be provided (as per DIN EN ISO 1101)		
	(e) Automation of measurements through measurement templates.		
	(f) Measurement taken directly on volume data. Reduction of uncertainties by using thousands of automatically generated fit points to define the objects.		
	(g) Reporting tools to output the measured data report in various formats (CSV, HTML, RTF, PDF etc.)		
	<b>(3) Porosity/ Inclusion / Creak analysis</b>		
	i. Automatic and fast detection, analysis and visualization of voids, pores, inclusions and crack etc. in the material.		
	ii. Volume, position, size and surface area estimation for every individual pore/void/crack analysis.		
	iii. Color-coding of pores, inclusions or crack according to volume.		
	iv. Possibility to specify the minimum defect size as radius, diameter or volume.		
	v. Statistical defect size analysis, overall percentage of porosity and defect volume histogram.		
	vi. In-place data filtering for noise reduction		
	<b>(4) Wall thickness</b>		
	i. Automatic and quick analysis of wall thicknesses (no CAD model required)		
	ii. Color-code visualization of wall thickness variations.		
	iii. Ability to tolerance the wall thickness analysis with various parameter e.g. thickness (MAX, MIN, mean, deviation).		
	iv. Analysis of entire object or of a user defined "Region of interest".		
	<b>(5) Actual/nominal comparison</b>		
	i. Automatic and fast comparison of a scanned object with a reference object.		
	ii. Comparison of volume Data with CAD model (nominal/Actual comparison).		
	iii. Direct comparison of volume data sets.		
	iv. Ability to tolerance the nominal/actual comparison with various parameter e.g. deviations (max, min, cumulated).		
	<b>(6) Statistical evaluation of all metrological defect features with color coded visualization of analysis results of the entire object or region of interest.</b>		
	<b>(7) Generation of user defined reports for both Metrology inspection and defect analysis.</b>		
	<b>(8) Manufacture must provide all the necessary and suitable software for functions mentioned in SI. No. f (1) to f (5) and hardware for data acquisition, processing, cross sectional image reconstruction, measurement of features from images and general image processing.</b>		
	<b>(9) Dedicated 2D visualization software independent of the 3D visualization software.</b>		
	<b>(10) Beam hardening and Ring artifacts correction.</b>		
	<b>(11) Dual helical scan modus.</b>		
	<b>(12) Virtual rotation axis capability.</b>		
	<b>g. COMPUTER CONTROL ANALYSIS SYSTEM:</b>		
	(1) The control including joysticks and twin control monitors as well as the Radiation tolerant monitors must be mounted close to the cabinet but outside of the cabinet. One control monitor is meant for viewing the X-ray image and other is meant for display of the inspection control data.		
	(2) Monitors must be 24" (min) Flat Screen Display, with keyboard and mouse. Memory must be min 4GB.		

	(3) Windows based system to control the operation of the machine as well as data backup for analysis must be quoted.		
	(a) Latest/high end workstation details/ Specification compatible with the equipment and latest software to provide the best performance must be provide		
	(b) Microprocessor based control for manual control with joystick operation.		
	(c) Must be possible to program the machine through "TEACH MODE" Manual operation		
	(d) All necessary provisions to be provided for "OFF LINE" programming like separate identical Computer with the same measurement software, license (if required) etc. must be provided.		
	<b>h. RADIATION SAFETY CABINET SYSTEM:</b>		
	(1) The CT system must be supplied with a self-shielded and radiation proof lead cabinet. The leakage radiation must be less than 1mSv/H (0.25mR/h) measured at a distance of 100 mm when operating at the highest power. The cabinet must be constructed with steel lead-steel sandwich construction. The cabinet must be in compliance fully with international Radiation Regulations and the Local Bangladesh Atomic Energy Commission and supplied with independent safety switches to protect the operator when the doors are open. Cabinet side service doors must house the generators, safety system, power distribution and pneumatics.		
	(2) An in cabinet color CCTV system with external viewing monitor (Desk mounted) must be provided to aid in the safe manipulation of the sample in the cabinet.		
	<b>j. ELECTRIC POWER SUPPLY AND ENVIRONMENTAL CONDITION:</b>		
	(1) 3 Phase with Neutral and Earth 400 VAC +- 10% and 50 HZ Frequency.		
	(2) Operating temperature: 23° ±2° C.		
	<b>k. SYSTEM MUST CONSISTS OF THE FOLLOWING:</b>		
	(1) Manual image analysis measurement tool.		
	(2) Image processing features such as noise suppression, structure attenuation, extraction of edges and structures and image combination		
	(3) Visualization of image and volume data.		
	(4) Generation of volume data as an image sequence.		
	(5) Real time manipulation of displayed volume.		
	(6) 2D cross sectional image generation and measurement		
	(7) 3D display.		
	(8) Image subtraction system.		
	(9) Absence of foggy structure for homogeneous materials		
	(10) Automatic rotation center determination with an included calibration tool for best measurement result.		
	(11) System must be supplied with suitable software for scatter correction and beam hardening.		
	<b>l. The control console must display the following:</b>		
	(1) Tube voltage set and achieved.		
	(2) Tube current set and achieved.		
	(3) Error messages.		
	(4) The control unit must have provisions for door interlock, and operating though system table.		
	(5) The HT generator must be suitably interfaced with the tube head through at HT cable		
	(6) HT and other cables must be of appropriate length as required in the system.		

	(7) A suitable cooling unit must be provide and interfaced for cooling the target.																
	(8) Work holders for flat, rectangular and cylindrical objects must be quoted.																
	(9) The entire manipulator must be computer controlled and it must be possible to access the individual axis through remote control																
	(10) It must be possible to align the tube and the detector.																
	(11) Company must supply Calibration standards/ Phantoms as per International Standards for Line Detector Array, Flay Panel Detector and Metrology Measurement functions.																
	<b>m. SPARES AND CONSUMABLES:</b>																
	(1) Essential spares like Silicon paste, Lamps, fuses, Coolants for tube & detector must be quoted. Other essential and optional spares if any must also be quoted separately.																
	(2) List of spares, accessories and consumables (including price) recommended for 10 years period (Mechanical/ Electrical & Electronic) required for smooth operation of the machine after the expiry of warranty period must be provided.																
	(3) Any additional items require for routine maintenance.																
2.	<b>Terms &amp; Conditions:</b>																
	a. Performance test and accuracy demonstration for Metrology and defect analysis of the Computed Tomography System must be carried out at the supplier's site in presence of BOF representatives. The machine has to be fully assembled and erected for this purpose.																
	<b>b. Foreign Training :</b> Machine operation with maintenance training for 03 BOF Persons for 05 working days (excluding journey period) to be provided at machine manufacturer site. Air ticket, & pocket money, food, accommodation & medical (if needed) cost will be provided by BOF.																
	<b>c. Pre-Shipment (PSI):</b>																
	(i) PSI of the machine will be carried out by 02 BOF Persons for 04 working days (excluding journey period). All cost of the PSI to be borne by BOF.																
	(ii) Supplier must submit details plan of PSI (Modus Operandi)																
	(iii) Supplier must also mention PSI cost to be borne by them at their end.																
	<b>d. POST INSTALLATION REQUIREMENT AT BOF:</b>																
	(1) It is the responsibility of supplier to fully integrate, erect and commission the machine at our selected site/room.																
	(2) Performance and accuracies are to be demonstrated as per ISO Standards on supplied samples by us and on Calibration Standards supplied by the supplier.																
	(3) <b>Local Training :</b> Machine installation, trial run and operational with maintenance, training is to be provided by the certified engineers' of machine manufacturer at BOF site. Number of trainer must be at least 01 (one), duration of training should be at least 15 working days. The training must cover complete operation, application software installation and usage in all aspects of measurement and data analysis, part programming, calibration, basic & preventive maintenance and trouble shooting.																
	<b>Following information must be as under for local training :</b>																
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	(4) Supplier must bring all necessary calibration standards, calibration equipment for proving the machine accuracies with valid traceability certificates at our site.																
	(5) Must submit local training plan along with the offer.																
	<b>e. DOCUMENTATION:</b> The following documents (hard copy 2 sets & soft copy in CD/Flash Drive/HDD) must be provided;																

RESTRICTED

	(1) All the data and results of testing and calibration of the Computed Tomography at supplier's site must be properly documented and supplied to BOF. Calibration Certificates (traceable to National/ International Standard) of all the artifacts/ reference standards used for the same must be provided.		
	(2) Operations, Calibration & Application software Manual - This document must explain all the measurement options, Calibration, application of the system with sketches and detailed expiation.		
	(3) System administration & maintenance manual - This document must explain the detailed system configuration and administration including controller, probe head with the help of sketches. System manual must explain known possible errors and solution for the same. User manual and service manual (for both mechanical and electrical hardware/circuit) in English language must also be provided.		
	<b>f. AFTER SALES SERVICE/SUPPORT:</b>		
	(1) Supplier must guarantee the availability of spares, software/firmware updates and additional add-on modules for at-least 10 years from date of expiry of warranty.		
	(2) Customer support facility must be made available for at least 05 (five) years after expiry of the guarantee period.		
	(3) Online remote diagnostic till the machine life/ online help for maintenance application.		
	(4) Online help support for system Queries/ Application support.		
	(5) Service facilities and personnel availability.		
	(6) Service Personnel to attend any fault within 3 days after receipt of the information, whenever called for.		
	<b>g. WARRANTY</b>		
	(1) The machine must have warranty for minimum period of 12 months after commissioning for defect free operation and specified accuracies at our site.		
	(2) Any defect observed during the warranty period must be Repaired/ replaced free of cost with minimum down time. All the software updates during the warranty period must be supplied, installed and our personnel must be trained on real time basis at free of cost.		
3.	<b>Country of Origin : Group 'B' countries (Name of country to be mentioned)</b>		
4.	<b>Country of Assemble : Group 'B' countries (Name of country to be mentioned)</b>		
5.	<b>Port of shipment : Group 'B' countries (Name of country to be mentioned)</b>		

**Terms & Conditions**

Supplier must mention their compliance on the following mentioned points :

1. A principal/manufacture can submit **only one offer through one local agent** for any individual item. Offers through multiple local agents by same principle/manufacture will be **treated as rejected**.
2. To ensure unhindered LC handling the principal must provide a certificate to confirm that their LC operating bank has RMA (Relationship Management Agreement) with the local Banks of Bangladesh
3. Supplier must **clearly mention** (in the technical offer) that as principal/manufacture they poses necessary **export permit** from the concern ministry or any other authority of their country. They must also submit a certificate in this regards as per the attached specimen format at Annex F.
4. Before signing the contract, Performance Guarantee @ 10% of total LC value is to be submitted by the Principal in favour of Commandant, Bangladesh Ordnance Factories, Gazipur Cantonment, Gazipur through any scheduled Bank located in Bangladesh (As per the format at Annex D).
5. A separate **certificate should be provided** by the principal **originally signed** (Computerized or digitally edited signature will not be accepted) stating that they are aware of the requirement of the PG and if the contract is awarded they will be bound to provide the PG as per the format at Annex E, otherwise administrative action will be taken against the principal and local agent.

6. The stores should be supplied to BOF at **supplier's cost**.
7. On arrival of the stores at BOF, the supplier must complete installation, commissioning, trial run & trial production within 01( one) month (from the date of entry at BOF). Otherwise, penalty will be imposed at the rate of 2% but not less than 1% and will not exceed 10% of the total CFR/LC vale (As applicable).
8. If the supplier fails to deliver the stores within the stipulated period, the followings will be applicable:
  - a. Cancel the contract and/or,
  - b. Decision at the discretion of BOF.
9. Inspectorate is the authority in all matters pertaining to Inspection. Any verdict by the inspectors regarding rejection, acceptance, and /or deviation of machine involving price reduction will be treated as final and will not be subject to arbitration.
10. The Supplier must submit the following **attested documents** with the schedule :
  - a. **Trade License**
  - b. **Tin Certificate**
  - c. **Up to date VAT Registration certificate.**