

Specifications of Thermography System for NDT of Composite Products

1) Introduction:

Vikram Sarabhai Space Centre (VSSC) is seeking potential sources for the supply of Infrared Thermography System for the Non- Destructive Testing (NDT) of Composites products. The Thermography System quoted shall be from the standard range of production of the firm.

2) Scope of Supply:

Scope of supply consists of supply of Infrared Thermography System with necessary accessories, delivery, installation, performance demonstration, commissioning and training of the supplied system at Composites Entity (CMSE), Vikram Sarabhai Space Centre (VSSC), Vattiyoorkavu, Trivandrum, Kerala, India. The party shall integrate the offered Thermography System to the existing 5-Axes CNC manipulator available at VSSC.

3) System Specifications:

The offer shall include the following deliverables:

- 1) Infrared (IR) camera (Cooled)
- 2) Necessary excitation systems to carry out Pulsed, Pulsed-Phase, Transient & Lock-In Thermography.
- 3) Necessary hardware & software for interfacing IR camera, control unit and excitation system and 5-axes manipulator.
- 4) Industrial PC with NDT Control Software Packages for Pulsed, Pulsed-Phase, Transient and Lock-In Thermography.
- 5) Rigid cabinet with wheels / rollers for storing all sub-systems.

Detailed specifications for each sub-system are given below.

3.1) IR Camera

Party shall supply a cooled IR camera with provisions for both internal & external triggering which can be utilised for pulsed thermography applications. The details of IR camera are given below.

Sl. No.	Parameter	Specifications
1	Detector type	Indium antimonide (InSb)
2	Spectral Range	3.0 – 5.0 μm or better
3	Resolution	640×512 or better
4	Detector Pitch	25 μm or better
5	Thermal Sensitivity / NETD	25 mK typical or better
6	Trigger modes	Trigger In, Record Start, Header Based
7	Minimum integration time	300 ns (nominal)
8	Frame rate (full window)	Adjustable; 0.0015 Hz to 1000 Hz
9	Dynamic Range	14 – bit or better
10	Camera in-built storage	• RAM (volatile): 16 GB RAM or better • SSD (non-volatile): 512 GB or more
11	Motorised Lenses	17 mm lens, with suitable lens interface

Sl. No.	Parameter	Specifications
12	Communication link / Camera Interface	Simultaneous Gigabit Ethernet (GigE Vision), Camera Link / CoaXPress®
13	Camera Weight	< 7 kg (without lens and handle)
14	Thermography Software	a) Camera Software should have in-depth thermal analysis on live and recorded data simultaneously. b) The software should be compatible with Windows 11 (64-bit) / later versions. c) SDK Support and MATLAB direct interface shall be available. d) The software should be with a license to be installed in at least 2 PCs simultaneously as required and should work with perpetual license.
15	Temperature Calibration	10°C to 350°C as in single range. Calibration should be traceable to NIST and OEM certificate has to be submitted with offer. OEM (Original Equipment Manufacturer) must have direct office in India with calibration checking facility. Camera must be repairable in India.
16	Service Facility	Office address along with contact details, Phone No, Fax No and Email id, should be provided. GST registration details of OEM should also be provided. Details of blackbodies available in India should also to be mentioned in the quotation.

3.2) Excitation Systems

Party shall supply excitation systems for Pulsed, Pulsed-Phase, Transient and Lock-In Thermography. The excitation system for pulsed thermography consists of a flash generator and flash hood with flash lamps. The flash generator shall generate high energy flashes of 9.6 kJ (nominal) within a very short time of only a few milliseconds. The flash triggering shall be controlled by the software via a synchronization unit. The details / features of flash generator and flash head are given below.

Sl. No.	Parameter	Specifications
1) Flash Generator		
1	Flash Power	6000 W or better
2	Flash Duration	0.3 ms (nominal)
3	Flash Cycle time (100 % energy)	4 s (nominal)
4	Flash Outlets	Minimum 2
5	Flash Controls & Flash Triggering	Shall have provision to control manually or through software
2) Flash Head		
1	Flash Power: 6000 W or better	
2	Solid full metal housing	
3	Swivel-tilt device for easy adjusting	
4	Focusing unit for focusing the flash energy on the part to be inspected	
5	Cable length: 20 m (min.)	
6	The flash lamps shall be provided with proper ventilations and provision for cooling.	

The excitation system for Transient and Lock-in Thermography consists of heat lamps (Halogen lamp modulated 2 kW @ 230 V [2 Nos.]) to create an appropriate, strong and fast response from defects. The lamps shall be provided with proper ventilations. The heat lamps shall be provided with proper reflectors for concentrating light intensity for spot-heating effect. The power output of the lamp shall be controlled from 0 % to 100 % either manually or through the control software. Cable length required for power cord and control cable shall be 20 m (min.)

The party shall integrate the excitation systems with IR Camera to the existing 5-Axes CNC manipulator available at VSSC.

3.3) Hardware & Software Interface

Party shall supply necessary hardware & software for interfacing IR camera, control software and excitation systems to carry out Pulsed, Pulsed-Phase, Transient and Lock-in Thermography. The hardware interface shall be based on standard components. So that, any expansion of the hardware functions or any adaption to special requirements can be performed in future.

3.4) Industrial PC with NDT Control software

Party shall supply an Industrial PC with NDT Control Software Packages for Pulsed, Pulsed-Phase, Transient and Lock-In Thermography. The industrial PC shall be mounted on the rigid case with rollers. The details of the industrial PC are given below.

- 1) Processor: Intel i9 (13th or latest generation) / Xeon Gold Series Processor / equivalent.
- 2) RAM: 64 GB or better.
- 3) Hard disk (SSD): 1 TB or better.
- 4) Graphics Card: 32 GB Nvidia / better.
- 5) OS: Windows 11, 64-bit / later versions.
- 6) Display: FHD screen with 32" nominal or better.
- 7) 2 TB Hard Disk.
- 8) MS office 2021 or above.

The supplied NDT control & analysis software package shall have perpetual licenses and shall have following modules or capability for:

- a) Non-Destructive Inspection (NDI) by Infrared Image Analysis.
- b) **Measurement Techniques:** Supports Lock-in, Pulsed, Pulsed-Phase and Transient Thermography.
- c) **Excitation Sources:** Compatible with optical excitation (lamps), optical pulse excitation (flash lamps).
- d) **Image Handling:** Functions for loading and storing image sequences and single images.
- e) **Temperature Plots:** Display of temperature plots for measurements.
- f) **Camera and Excitation Control:** Various settings for controlling the camera and excitation sources, and for recording and pre-processing infrared image sequences.
- g) **Data Management:** Storage of all measurement parameters and settings in workspace files.
- h) **Pulsed, Pulsed-phase and Transient Thermography:**
 - i. **Evaluation Methods:** Supports advanced methods such as Max. contrast method, e-function approximation method, sqrt approximation method, and pulsed-phase analysis.
 - ii. **Measurement Arrangements:** Supports reflection and transmission arrangements.
 - iii. **Phase and Amplitude Calculation:** Calculates phase and amplitude, displaying results as images for easy defect identification.

- iv. **Result Views:** Allows display of an unlimited number of result views for direct comparison of results achieved with different algorithms and parameters.
- v. **Result Toggling:** Easy toggling between different result images.
- vi. **Export Functions:** Export to MATLAB, Excel, ASCII, and various image formats (bmp, jpg etc.).
- i) **Lock-In Thermography**
 - i. **Evaluation Methods:** Supports advanced methods such as Single frequency Fourier transformation, harmonic approximation, and harmonic approximation with an analytic approach.
 - ii. **Measurement Arrangements:** Supports reflection and transmission arrangements.
 - iii. **Online Measurements:** Functions for Online Lock-in measurements with harmonic and burst excitation using heat sources, ultrasound, and eddy current.
 - iv. **FFT/Lock-In Thermography:** Functions for FFT/Lock-in Thermography with excitation by heat sources.
 - v. **Phase and Amplitude Calculation:** Calculates phase and amplitude, displaying results as images for easy defect identification.
 - vi. **Result Views:** Allows display of an unlimited number of result views for direct comparison of results achieved with different algorithms and parameters.
 - vii. **Result Toggling:** Easy toggling between different result images.
 - viii. **Export Functions:** Export to MATLAB, Excel, ASCII, and various image formats (bmp, jpg etc.).
- j) Party shall provide an additional perpetual software license for offline assessment of thermography data.
- k) Party shall also supply a rugged laptop for post processing of the thermography data. Offered laptop shall be rated for dust, vibration, shock etc. as per appropriate standards. Certificates for the same shall be supplied along with the system. The specifications of the laptop are given below.
 - i. Processor: Intel i9 (13th or latest generation) Processor / Xeon Gold Series Processor / equivalent.
 - ii. RAM: 64 GB or better.
 - iii. Hard disk (SSD): 1 TB or better.
 - iv. Graphics Card: 32 GB Nvidia / better.
 - v. OS: Windows 11, 64-bit / later versions.
 - vi. Display: FHD screen with 14" nominal or better.
 - vii. MS office 2021 or above.

3.5) Rigid Cabinet with wheels / Rollers

Party shall supply a rigid cabinet with wheels / rollers for storing all sub-systems. Cabinet case shall be of aluminium construction. It shall have space for mounting industrial PC with monitor, flash generator, hardware interface etc.

4) Delivery Schedule:

The offer shall clearly indicate the delivery schedule for the offered items. Items shall be delivered within 10 months from the receipt / acceptance of Purchase Order by party. Pre-Delivery Inspection (PDI) either through online / offline mode will be carried out by VSSC at OEM factory before shipment. The system capability in compliance with the technical specifications shall be demonstrated during PDI.

5) Installation, Commissioning & Training:

Installation and commissioning of the system shall be carried out by the party at VSSC. All features and functional requirements shall be demonstrated in compliance with purchase order specifications in full. The system will be accepted based on the successful demonstration of all stated features / capabilities of the system. The components to be tested will be provided by VSSC.

The party shall integrate the offered Thermography System to the existing 5-Axes CNC manipulator available at VSSC. The details of CNC manipulator will be provided at a later stage.

Minimum 5 days training on all the features of the system including operation and maintenance aspects shall be imparted to VSSC personnel at CMSE, VSSC, Vattiyoorkavu, Trivandrum, Kerala, India

6) General Requirements:

- a) Offer shall be from Original Equipment Manufacturer (OEM) or by authorised Indian agent only. Authorisation letter shall be attached along with the offer.
- b) The party should have supplied and successfully commissioned at least 3 similar systems. Please attach the testimonials for the same with customer contact details, phone number and email id. This list shall be produced during the bid stage itself. Otherwise, the party has to demonstrate the capability of the system on VSSC specimens with built-in defects, free of charge during technical bid evaluation stage. During test, no surface modification or spray paint, etc. is permitted on the surface of the test specimens. During demonstration, party shall demonstrate the detectability of 10 mm x 10 mm debond & delamination in sandwich construction of 3 mm thick face skins and 5 mm x 5 mm delamination in laminated construction of 3 mm thick. The defects in both constructions will be implanted at varying depths. Minimum 2 specimens each of both constructions shall be tested. The test results will be reviewed by VSSC for approval.
- c) Warranty shall be provided for minimum period of two years from the date of commissioning and acceptance at VSSC, Vattiyoorkavu, Trivandrum, Kerala, India for the items under the scope of supply. Warranty shall be provided by OEM only.
- d) Detailed manuals, instructions and data sheets pertaining to the offered items are to be provided in the form of hard copy or soft copy in English language.
- e) The offered equipment should be fully compatible with Indian power supply and meet the electrical safety standards. Power Supply: 240 \pm 10% V AC, single phase, 50Hz.
- f) The parties participating in the tender have to submit their offers in two-parts i.e., Technical Bid (including price bid with prices masked) and Price Bid separately in E-Procurement portal of VSSC.
- g) During part 1 technical bid, the party has to fill the compliance matrix for all the specification in the format given. Descriptive statements to be provided, as applicable, in the compliance check list. Relevant proof/supplementary document for the compliances are to be furnished and shall be referenced to the technical bid.
- h) If required, the party has to demonstrate the capability of the system on VSSC specimens with built-in defects during technical bid evaluation, free of charge. During test, no surface modification or spray paint, etc. is permitted on the surface of the test specimens. During demonstration, party shall demonstrate the detectability of 10 mm x 10 mm debond & delamination in sandwich construction of 3 mm thick face skins and 5 mm x 5 mm delamination in laminated construction of 3 mm thick. The defects in both constructions will be implanted at varying depths.

Minimum 2 specimens each of both constructions shall be tested. The test results will be reviewed by VSSC for approval.

- i) Technical justifications for deviations/variations/modifications proposed are to be clearly spelt out.
- j) Technical leaflet/ brochure (in English) and write-up (in English) of the proposed model of the system must be furnished by the party along with the quotation.
- k) Detailed system cost break-up should be given in Part 2 which is the Price Bid. The price bid format is given in table 1 below. Separate price details for AMC, Essential Spares & accessories etc. are also to be provided. Essential spares & accessories, AMC charges will not be considered for arriving L1 party.

Table 1: Price Bid Format

Sl. No.	Item Description	Cost
1	IR camera (Cooled)	
2	Excitation system for Pulsed Thermography	
3	Excitation system for Transient & Lock-in Thermography	
4	Hardware & Software Interfaces	
5	Industrial PC for Acquisition & Analysis of Thermography Data	
6	Laptop for Post Processing of the Thermography Data	
7	NDT Control & Analysis Software Packages for Pulsed, Pulsed-Phase, Transient and Lock-In Thermography with perpetual license	
8	Rigid Cabinet with wheels / rollers for storing all sub-systems	
9	Installation, Commissioning and Training	
10	Post-Warranty Non-Comprehensive AMC for 3 years	
11	Essential Spares & accessories	

- l) Post-warranty Non-Comprehensive AMC (including two Preventive Maintenance visits per year and unlimited break-down calls) shall be quoted for at least three years after warranty period of two years.
- m) Software updates, if any, shall be provided free of cost during warranty and post- warranty AMC periods.
- n) Party from abroad shall have a local representative in India. Trained Engineers shall be available in India to attend after sales service.
- o) All other terms and conditions as per VSSC norms.