



INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

MATERIALS MANAGEMENT DIVISION

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Technical Specifications for Ceramic 3D printing system and accessories

RFx No. 6100000782 (Reference No. 1000016870)

Technology:

Static mask exposure (DLP) system along with suitable system for ceramic colloid layer preparation.

Machine parameters:

- Processable ceramic slurry viscosity range between 0.1 - 100 Pa.s
- Intensity of light exposure > or equal to 44mW/cm² (Faster process times for higher productivity) selectable with parameter access for customer materials including sluggish slurries
- Utilizes DLP technology to provide homogeneous green parts, to limit the amount of material involved in the process and reduce the amount of cleaning after printing to minimum
- The process should expose layers from the bottom to ensure highly reliable printed layers (thus avoiding contact between printed parts and blade)
- Wavelength of light source between 450-460 nm
- Automatic slurry feeding system
- Lateral resolution(x and y): better than or equal to 60 μm
- Slice thickness: 10-100 μm user selectable option required
- Component Building Range (XYZ): more than 110mm, 60mm, 200 mm in X Y Z respectively.
- Highly-efficient material usage: initial material requirement < 10 ml to start
- Data format: .STL or any other specify.
- Printed component top surface typical surface roughness: top surface better than 0.1 μm side surface better than 1 μm
- Starter kit with all necessary tools to be provided
- Time for changeover of material: < 3 mins
- Ultra-high contrast system for enhancement of resolution
- Range of available standard materials - Al₂O₃, ZrO₂, Si₃N₄, with comparable mechanical properties to conventionally manufactured components.
Proof: scientific publications (peer reviewed) or test certificates from accredited laboratories. Components must be sintered without pressure and built standing up (for testing of the adhesion of the layers)
 - σ Al₂O₃ > 400 MPa (4PB) for alumina (according to ISO 843-1); tested in layer boundaries
 - σ Si₃N₄ > 700 MPa (4PB)

- $\sigma \text{ZrO}_2 > 900 \text{ MPa}$ (4PB)
- Ability to print parts with minimal feature size $< 70 \mu\text{m}$
- Ability to print parts with minimum channel diameter $< 200 \mu\text{m}$ (at an aspect ratio of > 10)
- UPS to be provided

Materials:

- The wide range of standard materials should be provided (two cartridge each at least 200g) along with the printer along with their parameter specification for use with the proposed ceramic 3D printing system software. The standard slurries/catridges with the following materials: alumina, zirconia, silicon nitride, β tricalciumphosphate, hydroxyapatite must be provided and any additional can be specified.
- To be provided along with Full package of printing process parameters to enable immediate production of parts. Guidelines for post-processing (thermal treatment) tuned to every material need to be specified.
- 3 empty cartridges should be provided to fill our own material. Procedure to fill the cartridge should be provided.
- Shelf life of each of the materials and their solid loading % should be specified.

Software:

- Should have facility to check (suitability for printing) and correct .STL files if need be.
- Should have facility to provide supports for overhanging structures.
- Should print component automatically without need of intervention after giving the print command.
- Need to have all safety features to protect the system in several possible usage cases (say for example power failure etc.): Please provide list of all such cases.
- Software additional features required: Open advanced parameter access specifically developed for R&D. Should give access to all printing parameters enabling the development of new materials and study and optimization of printing parameters. They should include exposure control, geometry correction, and others. Please provide list of parameters for which access would be given. Parameters should be changeable for every layer independently.

Installation and Basic Training:

- Installation and Training of basic operation tailored to suit different possibilities of printing (2 days). Should also include training on use of advance open access parameter (online training is ok).

Warranty + 1 year AMC:

- Include 12 month warranty after installation and annual maintenance contract (AMC) for 1 year beyond the warranty period.

Test components printed in the SAME system (for which quotation is given) to be provided:

All components to be provided in sintered state as well as green state (with scaling factor). Sintered parts need to be crack free and without need of reworking

- **Fine resolution:** Al_2O_3 lattice cube with channels in all axes. Ridges $<100\ \mu\text{m}$ in all axes, Channel diameter $<200\ \mu\text{m}$ in all axes. Edge length of the lattice cube has to be at least 7 mm. An outer frame of the grid with a thickness up to $700\ \mu\text{m}$ can be added to increase stability of green body for shipment
- **Continuous channel:** Al_2O_3 cylinder with 3 mm diameter and >14 mm height, has a helix channel with at least 3 rotations and maximum diameter of $400\ \mu\text{m}$
- **Precision:** ZrO_2 part with internal metric ISO-thread M2
- **Non-oxide ceramics:** Turbine impeller made of Si_3N_4