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Dated 04January 2019

REQUEST FOR PROPOSAL

for

**Supply, Installation and Commissioning of Equipment
and Transfer of Technology**

for

**PolishingPrimary Mirror Segments of the Thirty Meter
Telescope**

2019January

Indian Institute of Astrophysics

II Block, Koramangala

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India

Introduction

The Thirty Meter Telescope (TMT) has a 30m diameter primary mirror (M1) composed of 492 hexagonal segments made of low expansion glass material. Each hexagonal segment has a nominal size of 1.44m across the corners. This announcement of opportunity is for transfer of technology and the supply and installation of mirror grinding and polishing equipment (2 Nos.), required metrology instruments and tools for the optics-polishing laboratory set up at the CREST campus of the Indian Institute of Astrophysics (IIA), on behalf of the India TMT Coordination Centre (ITCC). The scope of the proposal is (a) transfer of technology for grinding and polishing glass ceramic through training on polishing, that will enable achieving the required accuracies as mentioned in this document, and (b) supply of equipment for grinding and polishing full-scale (1.52m) roundels, which includes custom built / manufactured grinding and polishing machines, required tools and fixtures, metrology instruments, installation and commissioning. The TMT project prefers the use of the full tool Stressed Mirror Polishing (SMP) technique for grinding and polishing the M1 segments. The technical specifications are detailed in the Statement of Work in Section A, the Methodology of Submission of Proposal are detailed in Section B and Terms and Conditions are detailed in Section C.

The goal for the programme described by this RFP is for the Bidder to deliver to IIA all equipment required to set up a mirror grinding and polishing facility. The equipment will have been built and tested at the Bidder's works, with IIA/ITCC staff trained to operate, install and maintain the equipment, and having gained the experience by polishing actual TMT mirrors. Upon delivery, installation, and commissioning of all equipment, IIA/ITCC shall be able to begin Low Rate Initial Production, followed by a ramp-up to full production (approximately 2.5 mirrors per month, on average).

1. BACKGROUND INFORMATION

The Thirty Meter Telescope project, partnered by the California Institute of Technology, Universities of California, Canada, Japan, China and India proposes to build a 30m diameter optical–infra-red telescope at Mauna Kea in Hawaii, USA. The India-TMT group is led by the Indian Institute of Astrophysics (IIA), Bangalore, the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune and the Aryabhata Research Institute for Observational Sciences, (ARIES), Nainital. The activities of India-TMT are coordinated by the India TMT Coordination Centre (ITCC) hosted at IIA.

As part of India's contribution to the TMT project, ITCC, in consultation with the TMT Board, intends to deliver a portion of polished M1 segments. The TMT project prefers to utilize segment production methods used successfully on segmented mirror telescopes, such as that employed for the Keck telescope primary mirror segments. This process includes Stressed Mirror Polishing (SMP) of circular mirror blanks followed by hex-cutting, mounting onto a support system, and finally, Ion Beam Figuring (IBF). SMP method is preferred as (a) it uses full tool to control mid and high frequency requirements on the mirror surface (b) fast material removal rate to meet the rate of production of segments (c) has faster convergence towards the surface specifications needed for IBF

(d) gives the finish with no edge roll off. ITCC, through IIA, proposes to acquire the necessary technology for the Full Tool Polishing (FTP) technique and metrology (excluding IBF) for delivery of polished segments to the TMT Project. This is proposed through the process of training of IIA/ITCC personnel in the FTP technique by the Bidder, by jointly performed grinding and polishing of mirror blanks, and procurement of the grinding and polishing (G&P) equipment, tools and fixtures, metrology instruments, and associated controllers and software from a Bidder who has already demonstrated the technique for polishing mirrors of size 1.5m diameter or larger, using full tool. ITCC has built a centre in IIA's CREST campus about 40km from Bengaluru, wherein all the equipment required for India-TMT to polish, hex-cut and mount the M1 segments on respective support systems will be housed. The mirror polishing facility set up by IIA/ITCC in this process will be used to fulfill the requirements of the TMT project as well the requirements of any other Government of India funded / approved projects.

In pursuance of the above, the Director, Indian Institute of Astrophysics, Bangalore, on behalf of ITCC, invites proposal for custom build / manufacture and supply of proven, production-ready full tool polishing machines (2 Nos.), including all tools and accessories for grinding and polishing 1.52m circular mirror blanks (roundels), and all required metrology tools. The Bidder shall also assist in the installation and set-up of the delivered equipment at the IIA/ITCC polishing facility, and transfer the required technology related to the method of mirror grinding and polishing and metrology through necessary training.

2. Submission of Proposal

Proposals are invited from companies with proven technical expertise, track record and experience in polishing thin, aspheric low expansion glass / glass-ceramic mirrors (aspect ratio $\sim 1/30$) of size 1.5m (diameter), or larger, using the FTP technique. Proposals are to be submitted as specified below:

Submission of offer in two parts:

(a) Technical Bid

(b) Price Bid

Bidders are required to participate in Pre-Bid technical discussion(s) before the submission of their offer.

Guidelines for submission, including the details of documents required, are provided in Section B.

3. RFP Process Schedule:

Date of this Announcement	04 January 2019
Pre-Bid Technical Discussion	01 February 2019 (8:00am IST)
Deadline for receiving Proposals	08 March 2019(3:30 pm IST)
Opening of Technical Bids at IIA, Bangalore	08 March 2019(4:30 pm IST)
Opening of Price Bids at IIA, Bangalore (of Technically Qualified Bidders)	12 April 2019(3:30pmIST)
Award of Contract	17 May 2019
Delivery and installation	within 18 months from Award of Contract

Note: These dates may be revised by IIA by notification on its website.

The Bidders (or their authorized representatives) qualified through Technical Bid may be present at the opening of the Price Bid on the date mentioned above.

4. Contacts:

Technical Clarification:

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Section A: Scope of Work

A.1. Preamble

A brief overview of the TMT Optical Design and M1 Segmentation is provided here. Additional technical information related to M1 production process and specifications can be found on the TMT website [http:// www.tmt.org/documents](http://www.tmt.org/documents).

The TMT optical design is based on Ritchey Chrétien system. Both the primary (M1) and the secondary mirrors (M2) are hyperboloid. The focal length of the primary mirror is 30-m and the final f -ratio of telescope system is $f/15$. A flat tertiary mirror (M3) is used to fold and steer the light beam to any of the eight instruments that will be mounted on the two main Nasmyth platforms. The telescope has an unvignetted field of view of 15 arcmin. The M1 is a segmented hyperboloid (Paraxial ROC = -60.0m, $k=-1.000953$, sag = 1.8m, asphericity = 29.3mm) of an effective diameter 30-m. The secondary is a single piece convex hyperboloid (Paraxial ROC =-6.228m, $k=-1.31823$, sag = 196 mm, asphericity = 850 μm) with 3.1-m diameter. The diffraction limited resolution of TMT will be three times better than the existing 10m class telescopes and wavelength coverage would range from 310nm to 28 mm. To achieve the desired performance, the surface finish of each segment has to be $\lambda/20$ or better at the specified wavelength.

The TMT primary mirror is made of 492 hexagonal segments, each having a size of 1.44 m across corners. Figure 1 shows the top view of the M1 segmentation pattern. The entire M1 is divided into 6 identical sectors (A-F). There are 82 hexagonal segments in each sector. The segment arrangement pattern has six-fold symmetry about the vertical axis. That is, the entire M1 can be obtained by rotating any of the sectors in 60degree steps about the optical axes. Since an array of identical regular hexagonal cannot uniformly fill a curved surface, the shape and asphericity for each of 1-82 segments is uniquely defined. For example, the outermost segment (Type-82) has greatest aspheric departure $\sim 226 \mu\text{m}$ PV while the inner most (Type-2) has only $\sim 6 \mu\text{m}$ PV. The typical optical prescription of Type2 and Type 82 segments are given in Table A.1.

Table A.1 BORN & WOLF ZERNIKE COEFFICIENTS (in micron) for Type 2 and Type 82 segments

Segment Type	BORN & WOLF ZERNIKE COEFFICIENTS (micron)					
	C20	C22	C31	C33	C40	C42
2	2157.177	-2.821	-0.6232	0.0006	0.00007	0.0001
82	2044.354	-113.248	-3.544	0.1494	0.00353	0.0033

The TMT requires a total of 574 segments comprising 7 sets of the 82 unique segments. 492 of these segments will form M1 and remaining 82 extra segments are used to facilitate re-coating of the primary mirror and for use as spares. The segments are placed closely with nominal gaps of 2.5 mm to maximize the fill factor. Each Segment will be mounted on a Segment Support Assembly (SSA) that provides passive support to the mirror using three whiffletrees and a central diaphragm support. The SSA passively controls the three in-plane degrees of freedom of the segment while the overall shape of the M1 mirror is actively controlled (tip, tilt and piston) by the Primary Mirror Control System (MICS), which compensates continuously for the alignment errors caused by the wind disturbance, gravity loading, and structural deformations of the telescope resulting from temperature changes.

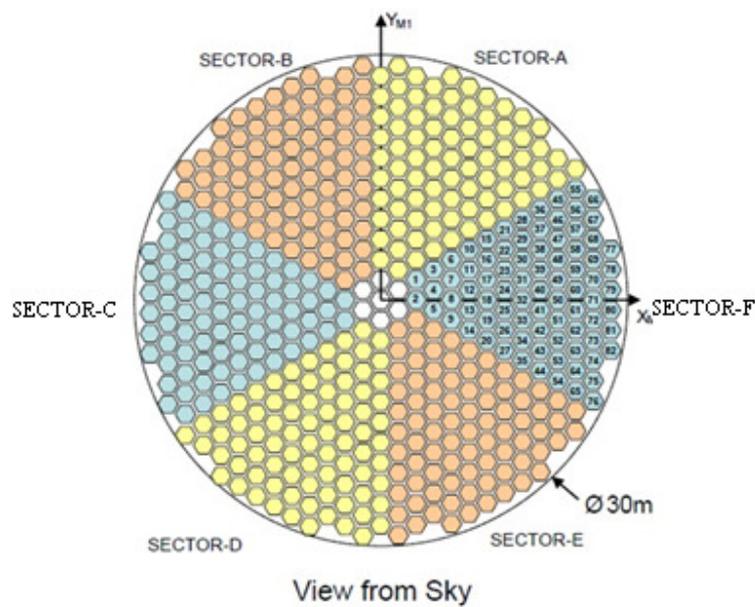


Figure 1: An illustration of M1 mirror array of 492 segments broken into six identical sectors, each having 82 unique segments

A.2 Statement of Work:

The polishing programme described herein includes, but is not limited to, the delivery and installation of production-ready FTP equipment, metrology instruments, ancillary tools, personnel training on operation, installation and maintenance, process knowledge, technical assistance, and the polishing of three Nos. TMT mirrors (blanks provided by ITCC).

A.2.1 Transfer of Technology to IIA/ITCC

A.2.1.1 Transfer of technology will be through hands on training. Bidder shall provide initial hands on training to IIA/ITCC Engineers/Technicians (hereinafter referred to as IIA-Personnel) on grinding, polishing and testing of a mirror blank using the proposed technology.

This training process shall be undertaken by the Bidder at their works, using existing equipment possessed by the Bidder.

Initial training shall commence within 30 days of from the date of signing the contract. In parallel with the initial training, Bidder shall be building the deliverable hardware described herein. During the fabrication and assembly of the delivered hardware, Bidder shall permit IIA/ITCC Personnel the opportunity to observe and assist in the work in a manner that will provide them a complete understanding of the operation and maintenance of the equipment.

A.2.1.2 Training shall include, but is not limited to

A.2.1.2.1 polishing of IIA/ITCC provided mirror blank to the prescriptions specified by IIA/ITCC (could be any of the 82 TMT prescription).

A.2.1.2.2 testing of the polished mirror to demonstrate which meets the requirements specified in the section A.2.4.

A.2.1.2.3 training in the best safe practices for handling TMT mirror blanks, including transport, lifting and flipping.

A.2.1.2.4 training on how to assemble, commission, and maintain the G&P and metrology equipment.

A.2.1.2.5 In case SMP technology is offered, demonstration of warping fixture performance by warping a mirror blank and then measuring the warped surface shape to verify that the fixture warping accuracy meets requirements stated herein. Warping demonstrations shall be performed for minimum 5 TMT prescriptions covering the full range of the 82 TMT segment Types.

A.2.1.2.6 Training Documentation shall include, but not limited to (a) process document that stipulates machine settings and durations to achieve required removals in grind and polish, (b) risk and severity matrix for safe handling procedure, etching and bonding/de-bonding procedure, draper operating procedure, G&P processing instructions, fixture operating procedure and processing instructions, etc.

A.2.2 Process equipment, metrology, and associated tooling

Bidder shall build and deliver operational mirror grinding and polishing equipment (2 Nos.) with custom built fixtures and tools for grinding and polishing Ø1.520m x 46mm thick OHARA Clearceram Z HS glass ceramic or similar glass using the FTP technique. Deliverables are defined in Section A.3.

A.2.2.1 Bidder shall deliver Full Tool Polishing fixtures (2 Nos.) that shall be capable of polishing any of the 82 TMT segment Types.

A.2.2.2 Bidder shall deliver G & P machines (2 Nos.) with slurry distribution / recycling and fully compatible with the offered technology that shall be capable of performing as per requirements of section A.4.5.

A.2.2.3 If SMP technology is offered, bidder shall deliver warping fixtures (2 Nos.) that shall be capable of performing as per requirements mentioned in section A.4.4.1.

A.2.2.4 Bidder shall deliver Metrology instruments of four types for testing the polished mirrors during processing and during acceptance testing. These instruments are:

A.2.2.4.1 One 2D area Profilometer or equivalent metrology tool and associated software. Profilometer system shall meet the requirements specified in Section A.4.6.3.

A.2.2.4.2 One high-resolution sub aperture interferometric Fizeau test station that can be used to measure 80mm (minimum) sub aperture across the entire mirror at a resolution of 0.25mm spatial periods.

A.2.2.4.3 One commercially available optical surface roughness measurement instrument that can measure the micro-roughness (with a resolution <0.2nm) anywhere across the mirror, including at the edge of the mirror.

A.2.2.4.4 One large three-ball spherometer that allows measurement of radius of curvature of the back surface and a Spherometer master.

A.2.2.5 Bidder shall deliver Grind and Polish (G&P) tools and accessories for both surfaces, G&P tools preparation accessories, bond pads, bond pad install/removal tools, tools/mirror handling equipment and required consumables set for minimum five rounds polishing.

A.2.3 Qualify the equipment (both numbers) built for IIA/ITCC

The equipment built for IIA/ITCC shall be qualified at the Bidder's works. Qualification of each equipment shall be through the means of IIA/ITCC Personnel grinding and polishing roundels as per specifications below:

A.2.3.1 Grind and polish two roundels of Type-number to be specified by ITCC, one on each of the IIA/ITCC equipment built.

A.2.3.2 The back surfaces (S2) to be processed to 62.5+/-3m radius of curvature (ROC). Polish level shall be free of sub-surface damage.

A.2.3.3 The front surfaces (S1) should be polished to paraxial radius of curvature (ROC) of M1, which is 60m.

A.2.3.4 Segment should be ~~off-axis~~ polished to meet the prescription corresponding to the TMT Type-number specified by ITCC.

A.2.3.5 Should demonstrate smoothness, convergence and low-order shape removal rates.

A.2.3.6 Low-order shape errors <1.7 µm PV.

A.2.3.7 Mid- High-spatial frequency errors as per Section A.2.4.2 of TMT Surface Specification Table A.2.4.2.1.

A.2.3.8 Roughness <0.5nm RMS

A.2.4 Acceptance Criteria

Acceptance of the equipment shall be based on the demonstration of the following:

A.2.4.1 S2 Surface:

A.2.4.1.1 Surface Scratch/Dig: 80-50

A.2.4.1.2 ROC measurement of 62.5+/-3m as measured using a calibrated spherometer

A.2.4.1.3 Surface shall be free of sub-surface damage (SSD) as described in Note 14 [OPTICAL SURFACE (S1) CLEAR APERTURE AND ENTIRE BACK SURFACE (S2) SHALL BE GROUND AND POLISHED TO REMOVE ALL SUBSURFACE DAMAGE] on TMT Polished Segment Drawing [Annexure A]. SSD removal shall be demonstrated on test piece of glass blank before applying over the actual glass blank.

A.2.4.2 S1 Surface:

A.2.4.2.1Surface Scratch/Dig 60-40

A.2.4.2.2Surface Specification(see Table below)

Table: A.2

S1 Surface prescription		Measured Surface Error Values
Low Order Zernikes (LOZ) (Noll Zernikes)		Z_M
NZ4	Focus (Z _{2,0})	RSS<1.7um PV
NZ5	Astigmatism (Z _{2,2} Sin)	
NZ6	Astigmatism (Z _{2,2} Cos)	
NZ7	Coma (Z _{3,1} Sin)	
NZ8	Coma (Z _{3,1} Cos)	
NZ9	Trefoil (Z _{3,3} Sin)	
NZ10	Trefoil (Z _{3,3} Cos)	
NZ11	Spherical (Z _{4,0})	
NZ12	Secondary astigmatism (Z _{4,2} Cos)	
NZ13	Secondary astigmatism (Z _{4,2} Sin)	
NZ14	Quadrafoil (Z _{4,4} Cos)	
NZ15	Quadrafoil (Z _{4,4} Sin)	
Mid frequency (rmsSRF _M)		
	Band 1 (> 200 mm)	<65 nmRMS
	Band 2 (200 - 120 mm)	<15 nmRMS
	Band 3 (120 - 80 mm)	<2.1 nmRMS
	Band 4 (80 - 60 mm)	<1.6 nmRMS
	Band 5 (60 - 50 mm)	<1.3 nmRMS
High frequency (rmsSRF _H)		
	Band 6 (50 - 0.8 mm)	<1.7nmRMS
Average Surface roughness (rmsSRF _{SR}) @ 20 random locations		
	Band 7 (0.8 - 0.02 mm)	<0.5 nmRMS

A.2.4.3 G&P Fixture performance:

A.2.4.3.1 Warping tool/ mirror blank and then measuring the warped surface shape to verify the fixture warping accuracy. Demonstration shall be performed for minimum 5 TMT prescriptions covering the full range of the 82 TMT segment types.

A.2.4.3.2 Shall be able to grind and polish a surface of asphericity upto 400µm PV. Bidder shall provide the theoretical analysis of warping fixture for warping the required surface asphericity

A.2.5 Installation and Commissioning at site

A.2.5.1 Provide domain expertise and support to IIA/ITCC-Personnel in installation and setting up the mirror grinding and polishing facility at IIA.

A.2.5.2 Demonstrate the warping fixture performance.

A.2.5.3 Demonstrations shall be performed for minimum 5 TMT prescriptions covering the full range of the 82 TMT segment Types.

A.2.5.4 Continued support for at least 3 years post-installation through electronic modes of communication.

A.2.6 The mirror blanks shall be provided by ITCC conforming to TMT Specification [Annexure A].

A.3 Deliverables

A.3.1 Transfer of Polishing technology to IIA/ITCC, includes hands-on training as well as documentation.

A.3.2 Three full-scale polished roundels as per specifications in Section A.2 and subsections within.

A.3.2.1 One roundel is polished during training phase at Bidder's works on Bidder's existing polishing setup (Section A.2.1).

A.3.2.2 Two roundels, polished at the Bidder's works, one on each of the two deliverable G&P equipment (Section A.2.2).

A.3.3 Supply, installation and commissioning of the following deliverables, meeting the requirements of Section A.4:

A.3.3.1 Custom built integrated Grinding, Polishing, and Metrology system for producing polished aspheric round mirror blanks

A.3.3.1.1 Two numbers Polishing Fixture, with two sets of necessary spare parts

A.3.3.1.2 Necessary spare parts for Polishing fixture

A.3.3.1.3 Three sets of Invar bond pads

A.3.3.1.4 One bond-pad installation station with bond proof load fixtures

A.3.3.1.5 One bond-pad removal station with tools for removing bond pads

A.3.3.1.6 Two numbers G&P polishing machines with slurry distribution/recycling system and associated grinding and polishing laps.

A.3.3.1.6.1 Two pitch polishing laps for convex surface

A.3.3.1.6.2 Two grinding lap for convex surface

A.3.3.1.6.3 Convex-up part holding tool for convex surface G&P of mirrors

A.3.3.1.6.4 Two pitch polishing laps for concave surface

A.3.3.1.6.5 Two Grinding tool for concave surface

A.3.3.1.6.6 Pressing tool for S1 and S2

A.3.3.1.7 One multi-probe LVDT based 2-D Profilometer (or equivalent) system.

A.3.3.1.8 One high-resolution sub-aperture interferometric optical test station capable of measuring 80mm min diameter sub apertures anywhere across the mirror surface.

A.3.3.1.9 One optical surface roughness measurement instrument capable of measuring micro-roughness with a resolution $<0.2\text{nm}$ anywhere across the mirror, including at the edge of the mirror.

A.3.3.1.10 One large three-ball spherometer and a spherometer master

A.3.3.1.11 S2 serialization tool that shall allow S2 side to be serialized with fiducials to be used/referenced in mirror metrology.

A.3.3.1.12 Metrology frame suitable for Reference Sphere (calibration tool for 2D Area Profilometer) and 2D Area Profilometer.

A.3.3.1.13 Bead Blasting Equipment

A.3.3.1.14 Software modules for Polishing fixture and data analysis

A.3.3.2 Equipment for lifting and handling of the mirrors

A.3.3.2.1 One Vacuum lifter

A.3.3.2.2 One mirror flipping box and spreader bar for flipping box and Polishing Fixture

A.3.3.2.3 One spreader bar /straps for polishing tools

A.3.3.2.4 Surfacing tool Lifting Device

A.3.3.3 Any Other equipment/ tools/ Fixtures required for the complete process

Note: The list of deliverables will indicate whether “necessary” or “optional” against each item.

A.3.3.4 Materials and consumables sufficient to polish 5 mirrors shall be delivered, including:

A.3.3.4.1 Cerium oxide polishing medium

A.3.3.4.2 Grinding materials

A.3.3.4.3 Polishing Pitch

A.3.3.4.4 Adhesives for bond pads

A.3.3.4.5 Lubricants (if any)

A.3.3.4.6 Other consumables

A.3.3.4.7 Specifications of the consumables and source

A.3.3.5 Documentation, Manuals, and procedures (hard and soft copies):

A.3.3.5.1 Risk and severity matrix documentation, Safe part handling procedure

A.3.3.5.2 Cylinder etching and bonding/debonding procedure

A.3.3.5.3 Draper operating procedure and S2 G&P processing instructions

A.3.3.5.4 Fixture operating procedure and processing instructions document

A.3.3.5.5 Material removal schedule for grind and pad polish of S1 and S2

A.3.3.5.6 Tool preparation procedure

A.3.3.5.7 Roundel serialization procedure

A.3.3.5.8 Fixture and Draper machine setup and startup procedure

A.3.3.5.9 2D Area Profilometer operating procedure and measurement and analysis procedures

A.3.3.5.10 Metrology instrumentation procedure

A.3.3.5.11 Fixture load/unload procedure

A.3.3.5.12 Polishing data set for three roundels

A.3.3.5.13 Necessary Operations, Instructions and User Manuals

A.3.3.6 List of critical spares required for operation and maintenance of the delivered equipment for at least a period of 5 years of trouble free operation shall be provided.

A.4 Requirements for Delivered Hardware, Training and Procedures

A.4.1 Environment, Health and Safety:

A.4.1.1 All delivered hardware shall be designed and manufactured to meet environment, health and safety standards for the Bidders local jurisdiction, as well as the standards for the IIA/ITCC polishing facility site jurisdiction.

A.4.1.2 In particular, pinch hazards, hazards associated with large reciprocating and rotating equipment shall be considered.

A.4.1.3 Mirror handling equipment and processes shall be based on best industrial practices. Training shall include “Dos and Dont’s” associated with handling large optics.

A.4.2 Electrical Power:

A.4.2.1 All hardware shall be capable of operating at 50+/-0.5Hz and 60+/-0.5 Hz. The fabrication facility at CREST campus will have 430+/-10 V three phase and 230 +/-10 V single phase AC power supply.

A.4.3 System Process Performance

A.4.3.1 The two delivered polishing equipment, metrology instruments and ancillary tools and components shall together be capable of polishing 2.5 mirrors per month (on average) to TMT figure requirements defined in Table: A.2.4.2.1 during production (after all learning curve improvements are established), assuming two 8 hour shifts per day, 5 days per week.

A.4.4 Fixture Requirements & Performance

A.4.4.1 For Stress Mirror Polishing (SMP) technology

Stressing fixtures shall meet the following requirements as a minimum:

A.4.4.1.1 Fixture shall be capable of polishing the TMT segment blanks to any of the 82 TMT prescriptions (0-293 microns PV) as a minimum, and capable of polishing roundel of asphericity maximum 400 microns PV.

A.4.4.1.2 The expected warping convergence shall be within 25 minutes after initiation using normal care and effort.

A.4.4.1.3 Fixture shall permit rapid (5 minutes) release of warping forces in order to facilitate in-process testing of mirror, using normal care and effort.

A.4.4.1.4 Warped shape accuracy shall be 150nm RMS or better of commanded shape

A.4.4.1.5 Warping repeatability shall be 100nm RMS or better

A.4.4.1.6 Warping fixture shall have a hydraulic axial support

A.4.4.1.6.1 Hydraulic support shall have 37 hydraulic bellowfram pads as a minimum. Hydraulic pads shall be plumbed into three zones, making 3 whiffletrees. When hydraulic valves are open, the mirror shall float on 3 whiffletrees.

A.4.4.1.6.2 Each hydraulic pad shall include a hydraulic ball valve in direct proximity to the pad such that the whiffletree can be rigidized (valves closed) and floated (valves unlocked) within 1 minute.

A.4.4.1.6.3 Hydraulic support shall be designed and constructed such that it can be easily bled to remove air from pads during servicing.

A.4.4.1.6.4 Stiffness of all hydraulic pads shall not vary by more than 10% (to be demonstrated at the time of installation at IIA).

A.4.4.1.6.5 Hydraulic system shall include device to permit raising and lowering of mirror to facilitate loading and unloading of mirror during processing.

A.4.4.1.6.6 Hydraulic pads shall not include any sliding friction features or components.

A.4.4.1.6.7 Hydraulic pads shall not constrain the lateral motion of the mirror during polishing.

A.4.4.1.6.8 The warping fixture shall have a lateral restraint system for the mirror.

A.4.4.1.6.8.1 The lateral restraint system shall be capable of reaching the transverse surface tractions introduced into the mirror by the grinding/polishing tools.

A.4.4.1.6.8.2 The lateral restraint system shall be sufficiently athermal so as not to cause damage to the mirror or fixture when the temperature of the fixture changes by +/-10 deg C.

A.4.4.1.7 The warping fixture shall have a system (either automated or passive gravity based) for applying the requisite warping forces and moments to the perimeter of the mirror via a set of Invar-36 bond-pads/blocks.

A.4.4.1.8 The warping system shall be designed such that the warping forces are introduced into the mirror at a minimum of 24 equally spaced locations around the perimeter.

A.4.4.1.9 The warping-force setting accuracy of an individual “actuator” (whether gravity based or automated) shall be sufficient to meet stated accuracy and repeatability requirements for the fixture as a whole.

A.4.4.1.10 If automated, actuators shall be easily removable for calibration and service.

A.4.4.1.11 If automated, actuator force settings shall be stable overall operating conditions.

A.4.4.1.12 Actuators force setting shall be continuously adjustable over the required load range.

A.4.4.1.13 If automated, actuators shall have features that prevent overloading of the mirror that could cause damage.

A.4.4.1.14 Actuator mechanisms shall have low friction, as required to assure polishing convergence.

A.4.4.1.15 Bidder shall provide the theoretical analysis of warping fixture for warping the required surface asphericity

A.4.4.2 For other full tool polishing technology (if applicable)

A.4.4.2.1 Deformable/Other Full Tool to obtain a minimum asphericity of 0 – 293 microns PV (TMT segments) and maximum of 400 microns PV for similar segments. Bidder shall provide the theoretical analysis of Deformable/Other Full Tool for generating required surface asphericity

A.4.4.2.2 All accessories associated with the Full Tool

A.4.4.2.3 Documentation, Manual and procedure for Full Tool

A.4.4.2.4 Complete Process Control Software for Full Tool

A.4.5 Polishing Machine Requirements

A.4.5.1 Polishing machines shall be based on a classical Center over Center large tool polishing machine design.

A.4.5.2 Polishing machines shall have sufficient precision, stability, and drive axis power to meet the requirements for polishing performance and throughput stated elsewhere within this document.

A.4.5.3 Polishing machines shall have a slurry distribution and management system as required to process the mirrors to meet the requirements for polishing performance and throughput stated elsewhere within this document.

A.4.5.4 Polishing machines shall be fully compatible with the Warping Fixture that shall be capable of performing as per requirement.

A.4.6 Metrology System Requirements

A.4.6.1 The Metrology System shall include four instruments:

A.4.6.1.1 2D area Profilometer (or equivalent) for measuring low- mid-spatial frequency shape.

A.4.6.1.2 High-resolution sub-aperture optical measurement system for measuring mid- high-frequency errors.

A.4.6.1.3 Optical surface roughness measurement instrument

A.4.6.1.4 Three-ball spherometer to measure the RoC of 62.5m with an accuracy of $\pm 3\mu\text{m}$ over full aperture with off loading mechanism including necessary fixtures.

A.4.6.2 Together the delivered metrology tools shall be able to measure the S2 surface ROC and S1 surface errors over the spatial frequency range from full aperture to micro-roughness, such that a PSD can be directly constructed from the data.

A.4.6.3 2D Area Profilometer

A.4.6.3.1 2D area profilometer shall have an absolute accuracy of 100nm RMS

A.4.6.3.2 2D area profilometer shall have a repeatability of 50nm RMS

A.4.6.3.3 2D area profilometer shall have 61 LVDT probes as a minimum to enable measurement of lower order Zernikes as indicated in Table A.2

A.4.6.3.4 The 2D profilometer shall be portable and be able to be brought to the mirror being polished for testing.

A.4.6.3.5 2D profilometer shall also be designed to permit three set-downs (0, 120, 240 degree rotations) to increase the sampling of the mirror surface.

A.4.6.3.6 Probe arrangement shall give equal weight to each probe (same swept tributary area).

A.4.6.3.7 Probe arrangement shall be such that 0, 120, 240 deg set-downs do not measure the same points on the mirror.

A.4.6.3.8 2D profilometer system shall include mechanical and software capability for performing calibration against a Ø1.520m x 0.300m zero-expansion polished and tested reference sphere (ITCC provided).

A.4.6.3.9 2D profilometer system shall include software and electronics that collects probe readings, and then processes the measured data, reporting Zernike coefficients, PV, RMS, and a graphical surface map.

A.4.6.3.10 Kinematical mount interface shall be provided to capture the data on the reference sphere as well under in situ conditions on the G&P machine.

A.4.6.4 High Resolution Sub-aperture System

A.4.6.4.1 The high resolution sub-aperture system shall be based on a COTS Fizeau interferometer.

A.4.6.4.2 The high resolution sub-aperture system shall have an aperture of 80mm minimum, and a resolution of at least 0.25mm.

A.4.6.4.3 The high resolution sub-aperture system shall be designed to receive a polished mirror for testing.

A.4.6.4.4 The high resolution sub-aperture system shall be able to take sub-aperture data anywhere on the mirror surface.

A.4.6.4.5 The high resolution sub-aperture system shall be able to measure right to the edge of the mirror.

A.4.6.5 Optical surface roughness measurement instrument

A.4.6.5.1 The surface roughness measurement instrument shall be a COTS instrument with adequate objectives to measure the required spatial frequencies.

A.4.6.5.2 The instrument shall be able to measure the micro-roughness anywhere across the mirror, including at the edge of the mirror.

A.4.6.5.3 The instrument shall have a resolution <0.2nm.

A.4.7 Requirements on Training (Two-IIA/ITCC personnel at a given time at Bidders work)

- A.4.7.1 Training and process walk through on Risk and severity matrix
- A.4.7.2 On Job Training on Safe part handling
- A.4.7.3 On Job Training on Cylinder etching and bonding/debonding
- A.4.7.4 On Job Training on Draper operation and S2 grind and polish
- A.4.7.5 On Job Training on Polishing Fixture operation and S1 grind and polish
- A.4.7.6 On Job Training on Tool preparation
- A.4.7.7 On Job Training on Roundel serialization
- A.4.7.8 On Job Training on Polishing Fixture and Draper machine setup and startup procedure
- A.4.7.9 Training on 2-D profilometer operating procedure and, measurement and analysis procedures
- A.4.7.10 Use of other Metrology instruments for the polishing process (Spherometer, Sub aperture station, and Micro-roughness metrology equipment).
- A.4.7.11 On Job Training on Polishing Fixture load/unload
- A.4.7.12 Training on Software control of Polishing fixture
- A.4.7.13 Necessary Documentation

Section B: Methodology of Submission and Qualification

B.1 Submission of Technical and Price Bids: General Terms

B.1.1 The original Bid shall be signed by the Bidder or a person or persons duly authorized by the Bidder. The latter's authorization shall be indicated by written Power of Attorney accompanying the Bid.

B.1.2 The bid must be submitted in an organized and structured manner. No brochures/leaflets etc. should be submitted in loose form. Please indicate page nos. on your quotations. For e.g., if the quotation is containing 25 pages, please indicate as 1/25, 2/25, 3/25, ..., 25/25.

B.1.3 The contents must be clearly typed without any cancellation/corrections or overwriting. Each page of the bid and cutting/corrections (if any) shall be duly signed and stamped by the bidder. Failure to comply with this requirement may result in the bid being rejected.

B.1.4 All pages of the Bid (except for un-amended printed literature) shall be initialed by the person or persons signing the Bid. The Bidder's name stated on the proposal shall be the exact legal name of the firm.

B.1.5 The 'Technical Bid' shall contain, in addition to the Bid, supporting documents that would help in the technical evaluation of the Bid such as (but not limited to).

B.1.5.1 The profile of the Company.

B.1.5.2 Details of past experience of the company in executing grinding and polishing work on thin, aspheric low expansion glass / glass-ceramic optics (aspect ratio $\sim 1/30$) of size 1.5m (dia), or larger, using the FTP technique.

B.1.5.3 Details of past experience of the company in executing projects involving optics related to astronomical or other sciences if any.

B.1.5.4 Appreciation/Reward Letters and other supporting documents with reference to B.1.5.2 and B.1.5.3 above.

B.1.5.5 The management structure and brief bio-data of top technical personnel.

B.1.5.6 Technical staff strength related to the Bid.

B.1.5.7 Manufacturing plants and equipment of the company.

B.1.5.8 Financial position of the Company supported by Audited balance sheets for the last three years.

B.1.5.9 Solvency certificates (not older than 12 months) issued by scheduled/nationalized/multi-national bank with which the bidder holds the current account, or a Government Agency.

B.1.5.10 Copy of Registration Documents of the Company.

B.1.6 The Technical and Price Bids (both original and copy) shall be sealed in separate envelopes. The envelopes shall bear the following “Supply, Installation and Commissioning of Equipment and transfer of technology for Polishing Primary Mirror Segments of the Thirty Meter Telescope”, and “Technical Bid” or “Price Bid” as appropriate.

B.1.7 Both the envelopes shall bear the name and address of the Bidder. All authorized persons who sign the offer are required to indicate his/her e-mail ID, mobile number and also general e-mail ID for easy and fast communication.

B.1.8 The two sealed envelopes shall be enclosed in a third sealed envelope. This envelope shall bear the following: “Supply, Installation and Commissioning of Equipment and Transfer of Technology for Polishing Primary Mirror Segments of the Thirty Meter Telescope”: Technical and Price Bids”, bear the name and address of the Bidder, and shall be addressed to:

The Director,
Indian Institute of Astrophysics (IIA),
II Block, Koramangala,
Bengaluru 560 034
India

If the envelopes are not sealed and marked as required, IIA will not take any responsibility for the bid’s misplacement or premature opening, whatsoever the reason may be. The technically qualified vendor is required to submit the soft copy of the technical bid after technical evaluation.

B.1.9 The Bidder has the option of sending the bid by registered post / courier or submitting the bid in person so as to reach IIA by the date and time indicated. IIA will not be responsible for late, delayed bids and loss of bids in transit, whatsoever the reason may be.

B.1.10 IIA reserves the right to accept/reject any or all bids without assigning any reasons.

B.1.11 Any other condition or guideline for submission of the bids shall be notified by IIA, if it finds necessary.

B.1.12 At any time prior to the deadline for submission of Bids, IIA may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, notify changes in the bidding documents through an amendment.

B.1.13 IIA may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Documents, in which case all rights and obligations of IIA and Bidder previously subject to the deadline will thereafter be subject to the deadline as extended.

B.1.14 In order to allow reasonable time for the prospective bidders for taking the amendment into account in preparation of their bids, IIA may, at its discretion, extend the deadline for the submission of the bids.

B.1.15 The amendments, if any, shall be notified in writing at IIA website and the amendments shall be binding on all the Bidders. Hence the Bidders shall view the notification in complete before submitting their bids.

B.1.16 The Bidder responding to announcement shall be deemed to have read and understood the documents in complete. Where counter terms and conditions have been offered by the company, the same shall not be deemed to have been accepted by IIA, unless a specific written acceptance thereof is obtained.

B.1.17 Any effort by a Bidder to influence IIA in the bid Evaluation, bid Comparison or contract award decisions may result in the rejection of their bid.

B.1.18 IIA reserves the right to accept/reject part/any one or more of the tendered/quoted items without assigning any reasons.

B.1.19 Any clearance from Government bodies of the country of origin, if required, for exporting the equipment under discussion to India, has to be obtained by the Bidder at their expense.

B.1.20 Any clarifications pertaining to this document may be obtained from IIA by the Bidders by writing at the following address at least seven days prior to the due date for submission of bids.

The Director,
Indian Institute of Astrophysics,
II Block, Koramangala
Bengaluru 560 034
India

Contact for Technical Queries: Mr. S. Sriram, Engineer (E), IIA (ssr@iiap.res.in)

Dr. G.C. Anupama, Sr. Professor, IIA (gca@iiap.res.in)

Contact for Commercial Queries: Mr. K.P Vishnu Vardhan, Stores & Purchase Officer, IIA
(pur_officer@iiap.res.in)

Mr.C.H.Basavaraju, Consultant, Administration
(basavaraju@iiap.res.in)

B.2 Technical Bid: Details

B.2.1The Technical bid shall include but not limited to the following items:

B.2.1.1Description of the technological approach proposed to be followed to execute the project

B.2.1.2Strategy to be followed for the execution of the project including tools and technologies to be used.

B.2.1.3Fabrication drawings of custom tools (as applicable).

B.2.1.4Project execution and management details, including details of the project team, escalation paths etc.

B.2.1.5Details of the resources, infrastructure or data expected to be provided by IIA to the successful bidder for undertaking the project.

B.2.1.6Risk identification and mitigation plans.

B.2.1.7Quality audit, control and assurance plans.

B.2.1.8Change control process.

B.2.1.9Detailed time schedule for the project.

B.2.1.10Acceptance criteria and test plans in the factory and on-site.

B.2.1.11A copy of the Price Bid without indicating the quoted Price.

B.2.1.12 Other Commercial terms and conditions

B.2.2The technical Bid shall contain a comprehensive Compliance Matrix (in a Tabular Form) against the Scope of Work mentioned vide Section A, including all subsections. The compliance matrix shall clearly indicate any deviation with reference to the terms and specifications. Limitations and assumptions, if any, should be clearly mentioned. Scope description may explicitly state anything which is not covered.

B.3 Price Bid: Details

B.3.1 The Price Bid shall include the following:

B.3.1.1 Training (technology transfer) component.

B.3.1.2 An item wise break-up for all the deliverables mentioned in Section A.3

B.3.1.3 Free-issue material, imports etc.

B.3.1.4 Applicable taxes, duties or other statutory payments.

B.3.1.5 Installation and Commissioning.

B.3.1.6 Standard Warranty.

B.3.1.7 Extended Warranty for 2 years post Standard Warranty.

B.3.1.8 Any other cost such as for tooling, packaging, travel etc.

B.3.1.9 Insurance and freight.

B.3.1.10 Total cost along with proposed payment stages, schedule and percentage to be paid at each stage.

B.3.1.11 Mode of payment by IIA (like Letter of Credit, Site Draft etc.)

B.3.2 The offer should be complete to indicate that all products and services asked for are quoted.

B.3.3 Price bids shall be valid for a period of 90 days from the date of opening of bids. IIA may ask for the Bidder's consent to extend the period of validity. Such request and the response will be made in writing only. A Bidder agreeing to the request of IIA for extension of the bid will not be permitted to modify the bid (if already submitted).

B.3.4 Price bid shall be only in fully convertible currency or INR.

B.4 Eligibility Criteria and Qualification Process

B.4.1 Past experience of the Company during the past 5 years in executing projects involving similar precision optics fabrication.

B.4.2 Past experience of the Company in grinding and polishing thin, aspheric mirrors of size 1.5m dia or larger, using the SMP/FTP technique.

B.4.3 Bidder readiness with the FTP technology for polishing 1.5m dia (or larger), aspect ratio ~1/30 Glass Ceramic mirrors having at least 225 micron aspheric departure to an accuracy of 1.7 microns PV or better, with smoothness better than 3nm RMS as measured using 80mm-120mm sub-aperture interferometric test. The process shall also have demonstrated a micro-roughness better than 2nm RMS.

B.4.4 Manufacturing plants and equipment of the Company relevant to the Bid. Technical Staff relevant to the Bid.

B.4.5 Project planning and Execution methodology followed by the Company, with specific emphasis on schedule and cost control.

B.4.6 Company's Quality Policy and Programme, organizational setup for Quality Surveillance and Quality Assurance, Quality Audit programme, non-conformity control and reporting and testing and inspection facilities.

B.4.7 The Company should have executed projects involving similar precision optics fabrication during the past five years.

B.4.8 To assist in the evaluation of bids, IIA may at its discretion ask the bidder for a clarification of its bid. IIA may call for meetings with bidders to seek clarification at appropriate times. The bidders shall attend the meeting at their own cost. The request for clarification and the response shall be in writing.

B.4.9 Following the evaluation of technical bids, the price bids of qualified Bidders shall be opened to choose the Bidder to execute the project.

B.4.10 The evaluation committee may hold commercial discussion with the selected Bidder to execute the project.

B.4.11 Prior experience with similar projects, commitment and risk evaluation will play an important role in the selection process.

Section C: Terms and Conditions

The successful Bidder who is awarded the contract shall be subjected to the Terms and Conditions that include, but are not limited to the following. A detailed, mutually agreed upon Contract Agreement will be drawn and signed by both the parties at the time of the award of the contract.

C.1 Subcontracts

The following terms and conditions refer to jobs subcontracted by the Bidder:

C.1.1The Subcontractor is an independent contractor.

C.1.2The Bidder shall provide as an independent contractor and not as an agent of IIA, all necessary personnel, materials, equipment and facilities to perform the Work.

C.1.3The Bidder shall not assign its rights or obligations to a third party without the prior written approval of IIA.

C.1.4Notwithstanding any subcontract under this Agreement, whether approved by IIA or not, the Bidder shall remain fully liable and responsible to IIA for the satisfactory and timely completion of the Work.

C.2 Payment

C.2.1IIA shall pay the Bidder the price in accordance with a mutually accepted milestone schedule.

C.2.2Upon completion of each milestone, the Bidder shall submit to IIA an Invoice for the amount corresponding to that milestone in Schedule.

C.2.3The Bidder shall submit documentary evidence, including but not limited to photographs and illustrations, as verification of completion of each Milestone. IIA may at its own discretion verify and substantiate that the milestone has indeed been performed or completed as invoiced by the Bidder. Such verification may require Bidder to submit to IIA additional documentation with regard to quality control normally expected during process of manufacture, and/or inspection by IIA and/or its authorized representatives.

C.2.4For any advance payment, the Bidder shall provide bank guarantee in favour of IIA for the equal amount in swift format.

C.3 Vesting of Title and Assumption of risk

C.3.1 On each item to be delivered by the Bidder, including an item of work in progress, in respect of which payments have been made in accordance with Clause C.2 above, IIA shall have a security interest in such items which shall be deemed to be released only at the time when the applicable deliverable Item is finally delivered to and accepted by IIA.

C.3.2 Risk for loss or damage to deliverable Items provided by the Bidder shall rest with the Bidder, until final acceptance by IIA.

C.3.3 Title to all deliverable Items provided by the Bidder shall pass from the Bidder to IIA upon final acceptance or the final payment under Clause C.2 above, whichever last occurs.

C.3.4 IIA shall not accept any liability for the Bidder and its subcontractors, their subsidiaries and/or their officers, employees or agents, servants, and assignees, or any of them or for their property. The Bidder shall indemnify and keep harmless IIA, its officers, employees consultants, servants, agents and assignees, or any of them, against any loss or liability, costs or claims, action or proceedings which they or any of them may incur by reasons of damage to property or injury, including death, caused to the employees of the Bidder, its subsidiaries and/or their officers, employees or agents, servants and assignees, or any of them in connection with the performance of Work under this Agreement, and caused by an act of commission or omission by the Bidder, its subsidiaries and/or their officers, employees or agents, servants and assignees, or all or any of them.

C.4 Intellectual Property rights

C.4.1 All Intellectual Property Rights existing in a party prior to the Contract (“**Background Intellectual Property Rights**”) shall remain with that party. Except to the extent necessary to complete the Work or expressly stated otherwise, neither party grants any rights in its Existing Intellectual Property Rights to the other party.

C.4.2 All Intellectual Property Rights arising directly from the Work (“**Generated Intellectual Property Rights**”) shall, upon completion of the Work, vest with the Bidder, IIA/ITCC and TMT project.

C.5 Confidential Information

C.5.1 The Receiving party, i.e. IIA/ITCC, shall protect the confidential information provided by the Disclosing party, i.e. Bidder, and keep it secure, and shall not at any time:

C.5.1.1 directly or indirectly disclose or distribute the confidential information to any person other than its representative, employee, agent or advisor, except where such disclosure is necessary for the purpose of the Work;

C.5.1.2 use or copy the confidential information except for the purpose of the Work;

C.5.1.3 in future use or copy the confidential information except for the purpose of projects funded by the Government of India, or its agencies.

C.5.2 Where the receiving party discloses confidential information to a representative, employee, agent or advisor under Clause C.5.1 the receiving party shall ensure that such person is aware of the confidential nature of that confidential information and is bound by suitable obligations of confidentiality to ensure that that person protects and keeps secure that confidential information and does not use the confidential information for any reason other than the purpose of the Work.

C.5.3 The provisions of this Clause C.5 are subject to the provisions of Clause C.4.

C.6 Settlement of disputes and Arbitration

C.6.1 All disputes arising in connection with the interpretation or implementation of the contract shall be amicably settled by IIA and the Bidder, by direct discussion.

C.6.2 If IIA and the Bidder are unable to resolve a dispute within 30 working days of the dispute being referred to them in accordance with Clause C.6.1; the parties may agree to refer the dispute to mediation.

C.6.3 IIA and the Bidder appoint a mediation committee comprising of two nominees by IIA and two nominees by the Bidder. IIA and the Bidder will seek the opinion of this mediation committee to amicably settle the disputes.

C.6.4 In the event of a dispute or difference which cannot be resolved by mediation, the same shall be referred to an Arbitration Tribunal consisting of three members. Either party shall give notice to the other regarding its decision to refer the matter to arbitration. Within 30 days of such notice, one Arbitrator shall be nominated by each party and the third Arbitrator shall be nominated by agreement between the parties to this agreement.

C.6.5 The Arbitration and Conciliation Act 1996 has provisions for international commercial arbitration which shall be applicable if one of the parties has its central management and control in any foreign country. The supplier has the option to choose either the Indian Arbitration and Conciliation Act, 1996 or arbitration in accordance with the provisions of the United Nations Commission on International Trade Law (UNCITRAL) arbitration rules.

C.6.6 The venue of arbitration shall be in accordance with UNCITRAL or arbitration rules of India, whereby it may be in India or in any neutral country.

C.7 Force Majeure

C.7.1 Neither party shall be held responsible for any losses, if the fulfillment of any terms and conditions of this contract are delayed or prevented by acts of lawful Government, revolutions and other disorders, wars (declared or undeclared), acts of enemies, strikes, fires, floods, acts of God and, without limiting the foregoing, any other cause not within the control of the party whose performance is interfered with and which, by the exercise of reasonable diligence, they are unable to prevent.

C.7.2 Each party will promptly notify the other in writing when a condition of Force Majeure described in Clause C.7.1 arises. Neither party will be liable for any failure to perform its obligations hereunder if prevented from doing so by reason of Force Majeure, provided that it will have used all reasonable endeavours to perform its obligations notwithstanding such situation or event.

C.7.3 As soon as practicable after the lodging of such notice the Bidder and IIA shall jointly determine whether the situation constitutes Force Majeure and if so the appropriate measures to meet the situation. Either party shall not be liable for any penalty or damage resulting in delays to perform its obligations as a consequence of Force Majeure.

C.8 Termination

C.8.1 IIA may terminate the Work with sixty (60) days prior written notice by notifying the Bidder in writing. In the event that the Work is so terminated by IIA, then IIA shall pay the Bidder total amount of the costs and liabilities incurred by the Bidder up to the date of termination. The Bidder shall deliver to IIA all products connected with this work (manufactured and COTS) in an as is where is condition.

C.8.2 IIA may at any time terminate the contract by giving written notice with immediate effect in any of the following cases

C.8.2.1 If the Bidder is adjudged insolvent or if its financial position is such that within the framework of its national law, legal action leading towards bankruptcy is taken against it by its creditors or its Government.

C.8.2.2 If it is determined through appropriate proceedings that the Bidder has resorted to fraudulent or corrupt practices in connection with its securing or implementation of this Agreement.

C.8.2.3 IIA is not liable for any payments for termination arising out of C.8.2.1 and C.8.2.3

C.9 Packaging, Transportation and Insurance

C.9.1The packing of the product for shipment shall be appropriate depending upon the nature of transportation and handling hazards. The stores shall be packed securely to avoid any damage to the consignment in transit, loading, unloading and storage. The package shall contain a packing note quoting contract number and date, copy of shipping release and one set of test certificates. The package shall be marked with name and address of the contractor, lifting points and special handling instructions, if any.

C.9.2The Bidder is responsible for delivery at IIA including transportation charges and transit insurance.

C.10 Acceptance Criteria

C.10.1Qualification of the custom built equipment (both numbers) by grinding and polishing roundels and demonstration of specifications as per acceptance criteria listed in Section A.2.4.

C.10.2 Qualification of custom built metrology equipment (Spherometer, 2D area Profilometer, high resolution sub aperture interferometer)as mentioned in section A.4.6 by demonstration on the polished roundel.

C.10.3On-site demonstration of the performance after delivery and installation, as specified in Section A.2.5

C.10.4All deliverables shall meet the requirements specified in Section A.4

C.10.5Stage inspection and final inspection of all deliverables will be carried out by the IIA/ITCC and/or their authorized representatives.

C.11 Patents, Copyrights and other Proprietary rights

The Bidder warrants that any deliverable Item provided to IIA shall to the best of its knowledge and belief be free of any rightful claim of any third party for infringement of patent, copyright, or other proprietary right.

C.12 Access to work

C.12.1 Work in progress and data and documentation related to the work, including design and test data necessary to understand the ability of the work to meet the specifications are subject to examination, evaluation, and inspection by IIA/ITCC and/or its authorized representatives, at reasonable times and with reasonable notice to the Bidder.

C.12.2 The Bidder shall provide IIA/ITCC and/or its authorized representatives, access to such documentation and to those of its premises where work on or in connection with the subject of this contract is being performed during normal business hours and subject to prior arrangement.

C.12.3IIA/ITCC may depute Engineers/Scientists of its choice from time to time who will be allowed by the Bidder to participate in the Work in respect of the disciplines in which they are specialized.

C.13 Warranty

The Bidder warrants that all Deliverable Items shall be free and clear of all liens and encumbrances pertaining to title at the time of delivery to IIA, India. The Bidder's liability and IIA's sole remedy under this warranty shall be limited to the Bidder procuring the removal of any such lien or encumbrance or the replacement of the goods and parts thereof that has been identified as defective of title. The Bidder will provide a minimum one year standard warranty from date of acceptance and installation of the deliverables at IIA.

And the Bidder warrants that:

all Deliverable Items that are procured or furnished by the Bidder or its subcontractors or suppliers shall be new and shall conform in grade and quality to all the requirements of the contract; where the grade or quality is not specifically defined therein, they shall be of a grade or quality suitable for their intended use;

all workmanship employed in the manufacture of deliverable Items shall be of good quality, free from faults and defects, and shall conform to the relevant specifications applicable to the said manufacture; and

all deliverable Items shall be free from defects arising out of the use of defective equipment or materials that would result in a total or partial failure of any deliverable item or which would render a deliverable item unsafe for its intended use.

C.14 Deliverable documentation and Standards

The deliverable documentation shall include, but not limited to, installation, operation and maintenance manuals, necessary drawings, and documents related to the training (both hard and soft copies). All documentation shall be in the English Language.

C.15 Progress reports

The Bidder shall provide IIA with detailed reports on progress of the Work and notify any deviations on the schedule. Monthly highlights and bi-monthly detailed reports on the progress of the work, up to the delivery date shall be provided.

C.16 Performance guarantee/Security Deposit:

C.16.1 The vendor shall furnish upfront Performance Bank Guarantee of 5% of the contract value, the validity of which will be during the performance of the contract and warranty period. The Bank Guarantee shall remain valid for a period of 60 days beyond the date of completion of the warranty period.

C.17 Liquidated Damages

C.17.1 If the party fails to deliver, as per agreed upon Delivery schedule, within the stipulated time specified or any extension thereof., the IIA/ITCC will be entitled to claim from the party as liquidated damages, a sum of one-half of one per cent (0.5%) per week of the contract price relating to that portion of the delay up to a maximum value of ten per cent (10%) of the contract price of the portion of delay. The work or part thereof will be deemed to have been delivered/completed only when all its component parts are accepted by IIA/ITCC.

C.17.2 The detailed statement of liquidated damages will be notified to the party who will be entitled to submit the reasons against levy of liquidated damages to IIA/ITCC within 30 (thirty) days from the date of notification of the statement. Beyond this thirty (30) days period, the party is deemed to have accepted the liquidated damages claimed to have to be paid. This clause is not applicable when the delay is due to a failure on the part of the IIA/ITCC.

C.18 Tax Obligation

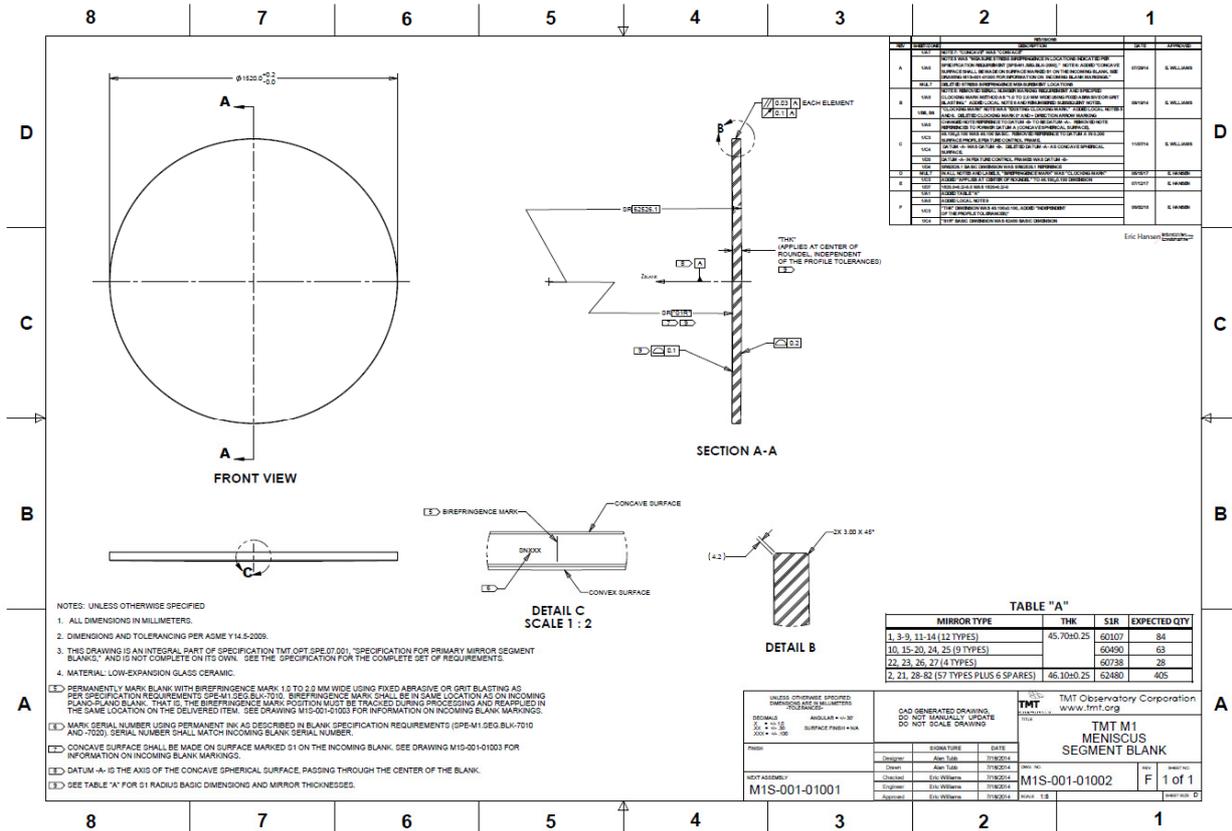
Applicable tax will be deducted at source at the applicable rates in respect of services and other intangible deliverable items.

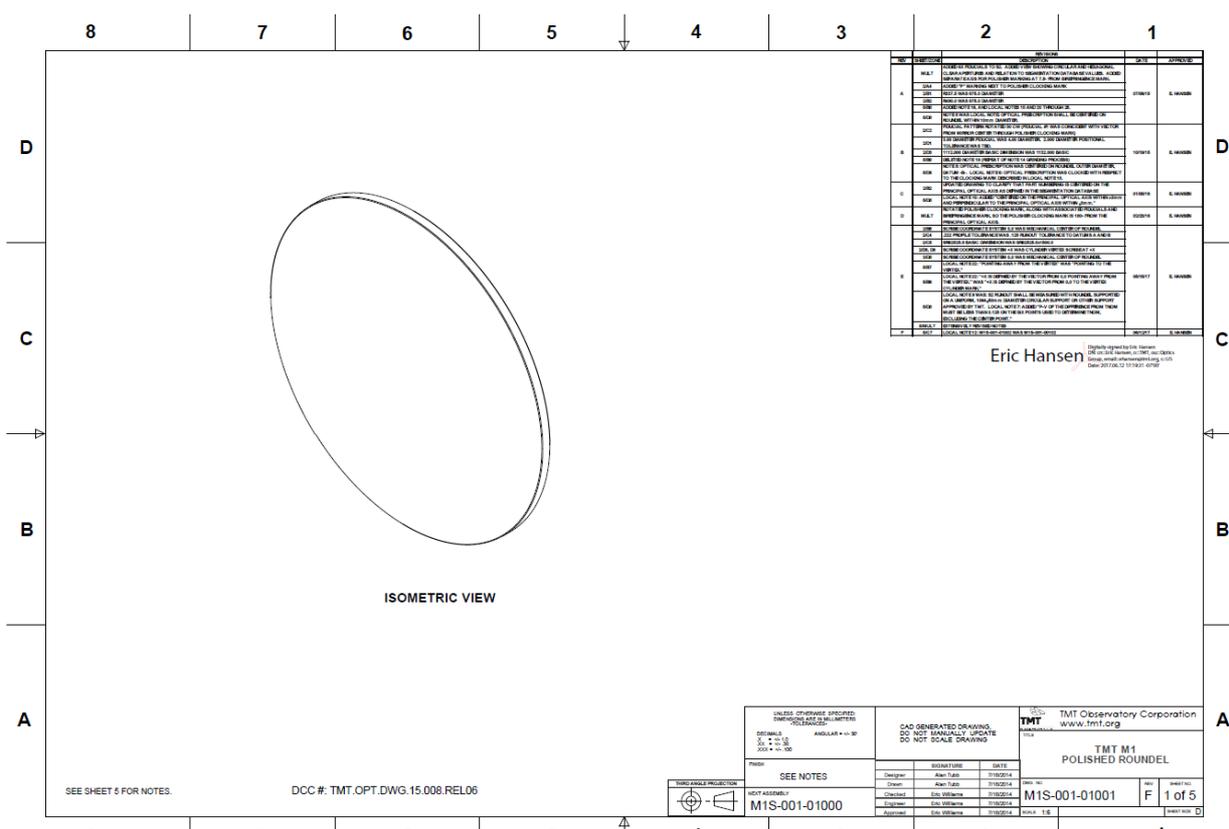
C.19 Governing law

The above terms and conditions shall be governed by, and construed in accordance with, the law for the time being in force in India.

Annexure A

Blank Drawing [M1S-001-01001 & M1S-001-01002]





UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS DECIMALS: 0.1, 0.2, 0.5, 1.0, 2.0, 5.0, 10.0 ANGLES: 15, 30, 45, 60, 90, 120, 150, 180	CAD GENERATED DRAWING NOT MANUALLY UPDATED DO NOT SCALE DRAWING	TMT Observatory Corporation www.tmt.org TMT M1 POLISHED ROUNDL
Project: M1S-001-01000 Title: SEE NOTES Date: 11/15/2014 Author: Eric Hansen	Designer: Alan Tait Checker: Eric Hansen Engineer: Eric Hansen Approver: Eric Hansen	Date: 11/15/2014 Sheet: 1 of 5 Drawing ID: M1S-001-01001

