

TMT

THIRTY METER TELESCOPE

QUALITY ASSURANCE PLAN

TMT.PMO.MGT.10.008.CCR09

16 March 2016

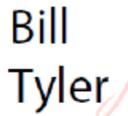
DOCUMENT APPROVAL

Author Release Note:

Updated (ref. [CR197](#)) to add hyperlink to AD9, TMT MRB Process (TMT.PMO.MGT.15.021.CCR07) as an administrative change per CCB approved [CR179](#).

This is one of the TMT documents cited in the Contribution Agreement, Part 7, "TMT Technical Specifications and Procedures Documents".

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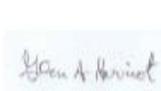
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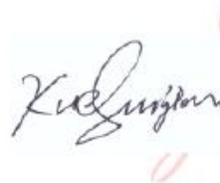
SYSTEMS ENGINEERING CONFIGURATION MANAGEMENT DOCUMENT RELEASE

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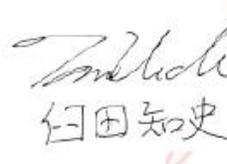
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1. INTRODUCTION

1.1 INTRODUCTION

The TMT Project quality assurance program provides a systematic process for checking to see whether a product or service being developed for the TMT observatory will meet/satisfy specified design requirements. In addition, an effective quality assurance system will improve work processes and efficiency and a contractor's/supplier's credibility. The quality assurance system emphasizes catching defects before they get into the final product.

1.2 PURPOSE

The TMT Project Quality Assurance Plan describes procedures, processes and methods that TMT Project and TMT Partner staff will use to establish and maintain effective quality assurance programs throughout the life of the TMT observatory. These QA programs provide requirements for prevention and detection of defects, and other quality control measures to help assure that the products and services supplied will meet the TMT Observatory design requirements and specifications (see AD7).

1.3 SCOPE

This TMT Project Quality Assurance Plan is applicable for all procurements and contracted services, acquisition of components and systems, materials and supplies, including spares that are to be used in the assembly and installation, testing, and operation of the TMT Observatory. The quality provisions of the plan also encompass support equipment and procedures/processes used for assembly and testing, including handling, transportation (shipping) and storage of all materials/equipment for the observatory. Appropriate quality assurance requirements will be implemented for the procurement and use of consumables (i.e., welding and leak test gasses, segment refurbishment process chemicals, laboratory supplies, etc.).

Note, the TMT Project Manager may direct that certain provisions of this QA Plan will be implemented during design/prototype qualification and testing activities of TMT and Observatory critical elements.

1.4 APPLICABLE DOCUMENTS

- AD1. [TMT Configuration Control Plan](#), (TMT.SEN.SPE.05.004.CCR19)
- AD2. [Requirements for TMT Software Quality Assurance Plans](#)
(TMT.SFT.TEC.14.011.REL06)
- AD3. [TMT Reviews, Definitions, Guidelines, and Procedures](#), (TMT.SEN.SPE.12.002.REL05)
- AD4. [Part Identification and Serial Numbering Methodology](#), (TMT.SEN.SPE.13.002.REL01)
- AD5. TMT Project Quality Assurance Inspection Report Template, (TMT.PMO.MGT.14.043)
Document in preparation
- AD6. [Calibration Laboratories and Measuring and Test Equipment – General Requirements](#),
ANSI/NCSS Z 540.1 Edition 94 (Reaffirmed 2002)
- AD7. [Guidelines for Supplier Quality Requirements](#), (TMT.PMO.MGT.10.009.CCR03)
- AD8. [TMT Acceptance Testing Process Description](#), (TMT.SEN.SPE.14.005.REL01)
- AD9. [Material Review Board Process](#), (TMT.PMO.MGT.15.021.CCR07)

1.5 REFERENCE DOCUMENTS

- RD1. [TMT Observatory Requirements Document \(ORD\)](#), (TMT.SEN.DRD.05.001)
- RD2. Deleted, Superseded by AD7
- RD3. [TMT Quality Assurance Survey](#), (TMT.PMO.MGT.10.011)
- RD4. [TMT Environmental, Safety and Health \(ES&H\) Plan](#), (TMT.PMO.MGT.10.002)
- RD5. [TMT Acronyms and Abbreviations](#) (TMT.PMO.MGT.07.013)

1.6 CHANGE RECORD

Revision	Date	Section	Modifications
DRF01	06 August, 2010	All	Initial draft
DRF02	23 June, 2013	All	Various edits, reformat to TMT template.
DRF03	17 October, 2013	All	Various edits.
DRF04	20 November, 2013	All	Edits in Sections 2, 3 and 5.
REL01	04 December, 2013	All	Various edits.
REL02	25 February, 2014	Approval Page	Added Document Approval Page.
CCR07 (DRF01)	15 August, 2014	All	Corrected revision status. Updated Approval Page, Sections 1.4, 1.5, 1.6 and minor typos in document. (ref. CR148)
CCR07	23 September, 2014	All	Initial CCR Release. Added new AD2 Applicable Document. Added reference to AD2 in 3.4.1. Adjusted AD references throughout document. Updated AD and RD links. (ref. CR148)
CCR08 (DRF01)	23 Aug 2015	All	Updated AD/RDs and started edits to align document with TMT Project Supplier Quality Requirements.
CCR08	13 Oct 2015	All	Updates (Ref. CR169) to: <ul style="list-style-type: none"> a) AD/RD documents; b) Various edits to comply with TMT Guidelines to Supplier Quality Requirements (AD7) (ref. CR170). c) Added to Document Approval Page: "This is one of the TMT documents cited in the Contribution Agreement, Part 7, "TMT Technical Specifications and Procedures Documents".
CCR09	16 Mar 2016	1.4	Add a hyperlink to MRB Process version for AD9 (ref. CR197) as an administrative change per CCB approved CR179 .

2. QUALITY SYSTEM

2.1 POLICY

Appointed by the TMT Project Manager, the TMT Project Quality Assurance Officer will establish and maintain a program to administer the quality aspects of the TMT Project. The Quality Assurance Officer reports directly to the TMT Project Manager.

The TMT Project is planning for a minimum TMT operational life of 50 years. Plans for continuing a QA program after completion of Telescope/Observatory construction, installation, and commissioning activities will be determined by the TMT Project Manager.

2.2 APPLICABILITY

The provisions of this plan are applicable to TMT Project and the TMT Project Partners and contractors/suppliers participating in the TMT Project.

2.3 DEVIATIONS AND WAIVERS

The Work Package Manager and the TMT Quality Assurance Officer may request deviations or waivers from the requirements. The deviations or waivers may only be authorized by the TMT Project Manager or their designee. The request for QA deviations and waivers will be processed in accordance with the TMT Configuration Control Plan (see AD1) and TMT Acceptance Testing Process Description (see AD8).

2.4 CONFLICTING REQUIREMENTS

Where there are conflicts between the requirements of this TMT Project Quality Assurance Plan and TMT design documentation or Work Package specifications, the provisions of the design documentation or specification shall prevail. Conflicts shall be brought to the attention of the TMT Project Quality Assurance Officer, who will as necessary, consult with TMT System Engineering and the TMT Work Package Manager for resolution.

3. QUALITY ASSURANCE PROGRAM

3.1 REVIEW OF TMT WORK PACKAGE DOCUMENTS

TMT QA Officer or their designee will review the TMT Work Package (WP) and Statement of Work (SOW) documentation to assure that there are adequate quality assurance program requirements included. The WP or the SOW document must state/list the specific set of quality assurance documents that must be complied with.

3.2 QUALITY PROCEDURES/INSTRUCTIONS

Requirements and/or procedures for accomplishing complex or application of critical QA actions will be documented and approved by the TMT Work Project Manager and Quality Assurance Officer or their designee prior to implementation.

3.3 TMT SOFTWARE QUALITY ASSURANCE PROGRAM

3.3.1 Summary of the TMT Software Quality Program

- TMT software quality is a product of a continuous process that happens over the life of the project.
- Software requirements are developed and documented, but can be prioritized and refined throughout the life of the project in response to change.
- Software testing is the core of TMT software quality. TMT Software QA and their subsystem team participates in the software test process.
- Software is delivered in feature-oriented iterations. Each iteration delivers user-oriented features that are fully tested and documented.
- All software teams participate in a single configuration control plan and use the TMT software repository for all source code.
- Adequate documentation is required for delivery. Software acceptance is driven by the software test suite and full coverage of requirements.
- Subsystems containing deliverable software shall establish and manage a TMT software quality program consistent with the requirements in "Requirements for TMT Software Quality Assurance Plans", (see AD2).

3.4 DESIGN AND DEVELOPMENT CONTROL

Recommended, but not mandatory for the design and development phase, the TMTPO QA requirements of this plan will be implemented. Upon conclusion of the development phase and at the time of the subsystem Final Design Review and/or the Fabrication Readiness Review (see AD3), the TMTPO QA requirements set forth in this Plan become applicable.

3.4.1 Document Controls

The TMTPO has established a configuration control and release system for documents that define the design requirements, drawings, specifications, interfaces, and operation of the TMT Observatory (see AD1). Baseline configuration and change control of the requirements and designs for operational and support equipment are also under TMT Project Configuration Control System.

3.4.2 Design Reviews

Design reviews for TMT Project Subsystems and Systems will be conducted according to TMT Reviews, Definitions, Guidelines, and Procedures (see AD3). TMT Project Quality Assurance personnel will participate in the subsystem/system reviews.

3.4.3 Workmanship Standards

Unless otherwise noted, commercial or special workmanship standards developed and qualified for TMT applications will be used by the contractors and suppliers for TMTPO materials, equipment, and facilities (see AD7). Whenever critical system processes are necessary for the production of materials and equipment, process QA requirements including acceptance criteria for inspection and test purposes will be identified and recorded (see AD4 and RD3). Where a product cannot be verified by post process inspection and/or test, definition and monitoring of in-process controls and/or inspections may be required. Questions regarding workmanship standards and requirements for specific processes should be directed to the TMT Work Package Manager and the TMTPO Quality Assurance Officer.

3.5 QA TRAINING

TMT Project and TMT Partner personnel assigned to provide quality assurance support will receive sufficient training to become proficient in the areas necessary to perform any QA operations required/associated with their task assignments. The TMT Project Quality Assurance Officer, will assist in providing training resources and determining training requirements with input from the TMT Work Package Manager.

3.6 VERIFICATION OF SAFETY TRAINING

TMT Project personnel engaged in activities which have a high potential for hazards involving personnel or equipment will receive appropriate ES&H training and certification. Training and certification requirements for TMT Project personnel engaged in hazardous occupations will be determined by the TMT ES&H Officer and coordinated with the TMT Project Quality Assurance Officer and TMT Work Package Manager. Prior to the initiation of hazardous operations, the on-site Quality Assurance Representative will verify that personnel ES&H training (safety) and certification requirements are met. The verification will be conducted in accordance with the TMT Project Environmental, Safety & Health (ES&H) System Safety Plan (see RD4).

3.7 QUALITY ASSURANCE AUDITS

Audits will be performed to provide a systematic and independent examination to determine whether TMT Project QA activities and related results comply with planned quality objectives, and whether these objectives are suitable and implemented effectively. Audits will be conducted by personnel independent of the QA personnel engaged in the performance of the work at intervals of approximately six months. In-process audits may be performed during the fabrication activities to ensure compliance with fabrication requirements.

3.8 INSPECTION AND TEST PLANNING

Fabrication, test, and installation planning will include provisions for inspection. Applicable TMT Project plans will be jointly reviewed by TMT Work Package Manager and the TMT Project QA Officer for the placement of quality assurance inspection Mandatory Control Points (MCPs), scheduled stop work points where work (activity) cannot resume until approved by a QA representative.

3.9 PROCUREMENTS

3.9.1 Pre-Procurement Activity

Contractor's/Supplier's Procurement Requirements will be written to use contractors/suppliers existing QA system to the fullest extent possible consistent with the provisions of this plan after review and approval by the TMT Work Package Manager and the TMT QA Officer or their designee. Should a contractor/supplier lack an existing quality system, the contractor/supplier will be required to develop and qualify a quality assurance program in compliance with TMT Project QA requirements as negotiated at contract award (see AD7 for detailed requirements information).

3.9.2 Procurement Document Content

Procurement documents (including Purchase Orders) will be coordinated as necessary with the TMT Work Package Manager, technical and quality assurance personnel to ensure that appropriate and applicable technical and quality requirements are included (see AD7 for details).

3.9.3 QA End Item Data Package (QA EIDP)

The QA EIDP will be developed for all subsystems which together comprise the Observatory and TMT. This QA EIDP Package shall contain, at a minimum, all critical data pertinent to each subsystem to be included with the delivery of each item (see AD7 for details).

4. QUALITY ASSURANCE PROCESSES

4.1 GENERAL

Quality Assurance processes will be used throughout the TMT Project life cycle to control and maintain the quality of TMT equipment and science systems to assure maximum science return.

4.2 QA SUPPORT OF DESIGN VERIFICATION

At appropriate stages of the design process, the TMT System Engineering Group, will schedule and conduct periodic reviews (see AD3) of subsystem designs and implementation plans. These reviews are intended to ensure that the design output will meet the TMT Project subsystem design and operational requirements. The TMT QA Officer and/or TMT QA Representative will participate in these reviews to help determine if adequate QA planning and verification methods have been included in the subsystem management planning.

4.3 RAW MATERIAL PROCUREMENTS

Suppliers of raw materials will be required to provide certifications indicating that materials being provided are in compliance with requirements specified in the design or procurement documents. Reports of chemical and physical tests are required for critical usage materials to verify conformance to applicable specifications and drawings.

4.4 TRACEABILITY OF MATERIALS

To assure successful operation of the TMT and Observatory, certain materials were selected and included in the design for their unique properties. These materials are defined as critical and will require identification by lot, batch or production run and the country of origin. Materials process records will be retained and maintained in the TMT Project Documentation Control Center. Questions regarding traceability requirements for specific items should be directed to the TMT Work Package Manager and the TMT Project Quality Assurance Officer.

4.5 RECEIVING INSPECTION

Receiving inspection will be performed to ensure that articles procured by the TMT Project, or TMT Project Partner contractors and suppliers, conform to contractor/supplier design or procurement document requirements.

4.6 QA MONITORING OF CRITICAL PROCESS CONTROLS

Critical (special) process controls are required for those activities that require strict adherence to procedures and/or process specifications and training and certification of personnel to perform the work/process. Critical processes may be a contract and/or drawing and/or specification requirement. Examples of critical processes include heat treat, soldering, welding, anodizing, chemical film treatment, non-destructive testing (NDT), mirror segment polishing, segment handling and alignment, etc.

Processes considered critical processes will be controlled using manufacturing travelers or procedures established and qualified prior to TMT Project equipment/hardware production.

4.7 IN-PROCESS INSPECTION

In-process inspections will be required where subsequent assembly stages will prevent inspection access, and to detect defects early in the process. In-process inspections will be identified in fabrication and assembly planning documents as Mandatory Control Points (MCPs). Further processing of the item will be stopped until the inspection is completed and the MCP inspection results approved. Another form of MCP is the Setup Verification Inspection that must be completed prior to the start of fabrication.

4.8 ACCEPTANCE TESTS QA INSPECTION

Acceptance tests will be performed after completion of all required subsystem fabrication and assembly activity (see AD8 for details). The TMT Project Quality Assurance representatives will conduct inspections and record inspection data following completion of all acceptance testing activities.

4.9 IN-PROCESS INSPECTION AT THE TMT PROJECT SITES

In-process inspection at the TMT Project sites will be performed to the same constraints as those detailed in paragraph 4.7.

4.10 FINAL INSPECTION AT THE TMT SITES

TMT Project Quality Assurance representatives will conduct final inspection at the TMT Observatory and R&D sites at the conclusion of all fabrication, assembly, testing and acceptance activities.

4.11 INSPECTION REPORT

A TMT Project Inspection Report (IR) (see AD5) will be prepared by the TMT Project or TMT Partner QA representative and submitted to Work Package Manager for hardware discrepancies. The IR may also be used to document other inspection findings or data describing the current condition of the subsystem/science equipment or hardware or other deliverable materials.

4.12 DISCREPANT MATERIAL PROCESSING

When an article does not conform to applicable engineering design documentation it will be identified as non-conforming (i.e., as discrepant material). It will be segregated from on-going work operations, and held for further action. When a discrepancy has been identified and documented it will be reported to the responsible TMT Work Package Manager, TMTPO and TMT Partner Quality Assurance representative (see AD2).

Only the TMT Work Package Manager responsible for the item submitted to the discrepancy evaluation process, or their designees are authorized to issue dispositions for the discrepant item subject to review and approval of the TMTPO.

The disposition of discrepant material associated with TMT Project science activities will be determined by the TMT Science Work Package Manager, subject to review and approval of the TMTPO.

4.12.1 Material Review Action

A Material Review Board will be convened to determine the disposition of nonconforming articles that cannot be resolved by the initial discrepant hardware review. The Material Review Board will issue a Material Review Action to the TMT Work Package Manager with the concurrence of the TMT Project Quality Assurance Officer to determine the final disposition (see AD9).

4.12.2 Material Review Actions at a Contractor

Material Review Actions conducted at a contractor/supplier are the responsibility of that contractor/supplier. TMTPO and TMT Partner personnel will not participate as member of the contractor/supplier Material Review Board. However, Contractor/Supplier Material Review Actions will be subject to review and concurrence by TMT Work Package Managers and quality assurance personnel. Contractor/Supplier Material Review Actions will become a part of the QA EIDP.

4.12.3 Discrepant Material Storage

Discrepant Material will be identified and to the degree possible, kept separate from acceptable material until the disposition action has been completed.

4.13 QUALITY RECORDS

The TMT Project Quality Assurance Office will maintain quality records which provide evidence of inspections, tests, as built configuration, and Material Review actions.

The TMTPO will establish a facility and procedures for the long term storage of TMT Project QA documentation and other related records. Satellite record storage facilities may also be established for equipment or materials. This data shall be maintained for at least the duration of the 50 year operational life of the TMT.

4.14 CALIBRATION

All electrical, electronic, and computer controlled inspection equipment, linear, mechanical, optical, temperature, and vacuum/pressure instrumentation and gauges used for product acceptance testing, qualification, or validation will be calibrated and certified. This includes commercial products and support equipment.

By default, calibrations will be in accordance with ANSI/NCSL Z 540-1 (see AD6), Calibration Laboratory and Measuring and Test Equipment General Requirements. TMT Project System Engineering representative must approve a TMT Project unique calibration plan with the concurrence of the TMT Project Quality Assurance Officer or their designee.

5. ORGANIZATION

5.1 THE TMT PROJECT QUALITY ASSURANCE ORGANIZATION

The TMTPO Quality Assurance organization consists of the TMTPO Quality Assurance Officer, TMT Work Package Managers and TMT Quality Assurance Representatives.

5.2 QUALITY ASSURANCE OFFICER

The Quality Assurance Officer will be delegated as the primary authority responsible for planning, management, and implementation of the quality assurance tasks defined in this plan. The QA officer will be supported by TMTPO and TMT Partner technical and science personnel responsible for quality assurance in the Work Package or subsystem organizations and the Quality Assurance Representatives.

5.3 QUALITY ASSURANCE REPRESENTATIVES

The QA Representatives will assist the TMT Project QA Officer and the TMT Work Package Managers in the implementation of this plan according to the provisions detailed in paragraph 6.3. Quality Assurance Representatives may be engineering or science personnel performing quality assurance functions under the direction of the Quality Assurance Officer.

6. RESPONSIBILITIES

6.1 RESPONSIBILITIES OF THE QUALITY ASSURANCE OFFICER

The TMT Project Manager delegates to the TMT Project Quality Assurance Officer the responsibilities for the following:

1. Establish and document the TMT Project quality assurance requirements.
2. Develop plans and recommendations for QA activities.
3. Prepare and maintain the Quality Assurance Plan.
4. Identify, acquire, and position any equipment that may be required for the implementation of TMT Project QA activities.
5. Assist in the acquisition, training, and supervision of QA personnel to support required TMT Project and TMT Partner quality activities.
6. In conjunction with the TMT Work Package Managers and TMT Partner Work Package Managers, prepare task assignments and work instructions where necessary for personnel performing QA functions.
7. Provide QA supervision for TMT Project and TMT Partner personnel as required.
8. Prepare quality requirements for implementation at TMT Project and TMT Partner contractors/vendors and suppliers.
9. Participate/support contract award activities, including proposal evaluation, fact finding, and negotiations.
10. Support Pre-Procurement activities as follows:
 - a. Make recommendations to the TMTPO Business Manager and the TMTPO procurement/contracts organization for the inclusion of appropriate quality requirements in TMT Work Packages and contracts.
 - b. Review procurement documentation such as Requests for Proposals/Quotes and technical statements of work, for the inclusion of appropriate quality requirements.
 - c. Participate as a member in Source Evaluation Boards and associated evaluation sub-committees for competitive major procurements.
 - d. Review quality assurance plans and other quality documentation submitted by the contractors for approval, prior to release of the contract. Negotiate corrective action where necessary.
 - e. Participate in contract negotiations to interpret, clarify, and resolve quality issues.
11. Review and approve contractor/supplier quality assurance plans, processes and procedures.
12. Assure the implementation of adequate quality processes and procedures throughout the TMT Project lifecycle.
13. Issue periodic quality status reports to the TMTPO regarding QA activities.
14. Investigate quality problems, develop recommendations for corrective action and provide follow-up on corrective/preventive action requirements, where appropriate.
15. Identify, review, and report QA related problems that require TMTPO attention.
16. Concur with the TMT Work Package Manager in Material Review Actions.
17. Establish an audit program of the TMT Project QA activities.

18. Assure that the TMT Project requirements for TMT Project Furnished Property (TMTPFP) requirements are met.
19. Provide assurance that quality records are collected in the TMT Project database and maintained as specified by the TMTPO.

6.2 RESPONSIBILITIES OF THE TMT WORK PACKAGE MANAGER

The TMT Work Package Manager is responsible for the following:

1. Work with the TMT QA Officer to define the appropriate QA requirements for the different phases of the Work Package Statement of Work.
2. Providing resources necessary to implement the requirements established by item 1 above and this Quality Assurance Plan.
3. Providing justification and technical information to the TMTPO Property Administrator in support for modifications of TMTPFP.
4. To assure adequate QA requirements and instructions are implemented in hardware and software procurements/contracts, fabrication, assembly and test activities.
5. Providing dispositions of discrepant hardware on TMTPO Inspection Report forms (see AD7 and AD9).
6. Development of procedures and support equipment for handling, packaging, transportation and storage in accordance with TMTPO requirements. Verify that these procedures are implemented when necessary.

6.3 RESPONSIBILITIES OF QUALITY ASSURANCE REPRESENTATIVES

The TMTPO Quality Assurance Representatives report to the TMT Quality Assurance Officer, and are responsible for the following:

1. Monitoring and auditing quality activities to assure compliance with TMTPO approved contractor/supplier QA plans and contractor/supplier QA procedures and processes.
2. Auditing contractor's procurement and quality surveillance records to verify the inclusion of TMT Project quality requirements into sub-contractor/supplier procurements.
3. Participation in design reviews.
4. Performing/witness inspections at TMTPO QA Mandatory Control Points (MCPs) including test activities using the contractor's equipment, inspection procedures, flow plans, and instructions.
5. Preparing in-process inspection reports.
6. Witnessing acceptance testing for proper test set up and compliance with approved test procedure requirements.
7. Monitoring contractor/supplier Material Review Board operations.
8. Reviewing contractor/supplier Material Review Action records.
9. Providing periodic status reports to TMTPO and Work Package Manager of progress and/or problems that affect quality and schedule.
10. Performing final pre-ship inspections at the contractor/supplier facility prior to hardware shipment.
11. Verifying the content and accuracy of the contractor/supplier QA End Item Data Package (QA EIDP).

12. Preparation of a final Inspection Report reflecting the product quality status.
13. Perform audits and inspections to verify conformance to the QA program requirements at the TMT/Observatory site and TMT R&D facilities.
14. Concur with the responsible TMT Work Package Manager when in agreement with discrepant material dispositions; otherwise raise the discrepant item to Material Review Action.
15. Verifying that TMTPO handling, packaging, transportation (shipping) and storage requirements are met.