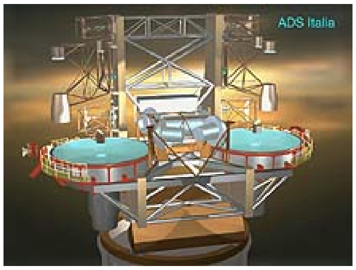




# LBT PROJECT

# 2 X 8,4m OPTICAL TELESCOPE

# Instrument Rotator and Cable Chain

# Integration and Acceptance Test Plan

| | Signature | Date |
|---|---|---|
| Prepared | Robert Meeks | 19-Mar-07 |
| Reviewed | | |
| Approved | | |

# 1. Revision History

| Issue | Date | Changes | Responsible |
|---|---|---|---|
| a | 19-Mar-07 | First Draft | Robert Meeks |
| | | | |
| | | | |
| | | | |

## 2. Table Of Contents

# 3. About this document

## 3.1. Purpose

The purpose of this document is to describe the overall plan for the shop integration and testing of the LBT instrument rotators. This document is not intended to provide assembly or test procedures but it is intended to identify the general approach to be followed for minimizing the risk of non-performance of the instrument rotators when they are installed on the telescope.

## 3.2. Reference Documents

| | | |
|---|---|---|
| [RD1] | 670s001c | Rotator and Cable Chain Technical Specification |
| [RD2] | 670s009a | Instrument Rotator and Cable Chain Installation and Handling Plan |

# 4. Specifications to be Verified by Review or Inspection

## 4.1. Introduction

Several of the specifications enumerated in [RD1] cannot be directly measured on the completed systems or it is more reasonable to verify performance through review or inspection instead. These specifications and verification requirements are discussed in this section.

## 4.2. Initialization time

System initialization time will be verified by demonstration. The system will be completely powered down with the telescope ready to observe. The rotator system will then be reinitialized and the elapsed time from start of reinitialization to when the rotator is ready to accept an observing command measured.

## 4.3. Environmental Specifications

Compliance with the environmental specification will be verified by reviewing designs and component selections to ensure they are compatible with the specified environmental conditions.

## 4.4. Operating Modes

Performance is specified for two modes: service and observing. Service mode is used for maintenance or positioning an instrument for observation. Observing mode is used for derotating an instrument during an observation. The modes are distinguished in this specification by their acceleration limits, balance requirements, and heat dissipation allowance. It is expected that only the surface temperature and the tracking specifications will differ between the operating modes. The ability to operate at the higher limits of the service mode will be verified while verifying individual performance requirements.

## 4.5. Reliability

### 4.5.1. Mean Time Between Failure

There is no intent to measure or analyze the MTBF. Compliance with this specification will only be demonstrated through a review of the design to verify that no high failure rate components are utilized.

### 4.5.2. Failure Modes

Prevention of over travel will be demonstrated by review of the design to verify that provisions are in place to detect and restrict out-of-limit excursions.

## 4.6. Maintainability

### 4.6.1. Rotation Lock

The presence of a rotation lock will be verified by inspection of the completed systems.

### 4.6.2. Counterweights

The capability for using counterweights to balance each instrument rotator within specified limits will be verified by analysis and demonstration..

### 4.6.3. Handling and Installation

The acceptability of handling and installation procedures will be verified by review prior to any installation work being done.

## 4.7. Safety

### 4.7.1. Emergency Stop

Compliance with emergency stop requirements will be verified by review.

### 4.7.2. Hard Stop

The presence of hard stops will be verified by inspection of the completed system.

### 4.7.3. Brakes

The presence of brakes and their capability to perform their required function will be demonstrated by inspection and review.

## 4.8. Status Devices

### 4.8.1. Limit Switches

The presence of limit switches and their capability to perform their required function will be demonstrated by inspection and review.

#### 4.8.2. Temperature and Health Sensors

The presence of temperature and health sensors will be demonstrated by inspection and review.

.

### 4.9. Space Requirements

Compliance with space requirements for both the physical system and the electronics will be verified by inspection and review.

### 4.10. Power Dissipation

Compliance with power dissipation requirements will be verified by analysis.

## 5. Electronics Integration

Electronics integration entails constructing the electronics modules and cables then testing them in the lab. Each of the electronics modules will be built in the lab and tested on the rotator simulator first. A test will also be done on one of the rotator assemblies being integrated in the shop *if feasible*. In principle, testing on the simulator is enough and there is very little to be gained by constraining an additional test to the readiness of the rotator in Tucson. But if the second test on the actual hardware can be done without any schedule conflict it will be. All the electronics integration can be done in the LBT lab in Tucson.

## 6. Shop Integration and Test

This section gives an overview of the how integration and test will be performed in Tucson. The purpose of the shop integration is primarily to reduce risk by ensuring that all major components fit and function properly before moving to the mountain. [RD2] lists the major steps for installing the instrument rotators on the mountain.

### 6.1. Facilities

The bent Gregorian rotator and cable chain assembly will be integrated at he Gemini flexure test rig located on the NOAO campus in Tucson. This machine provides the ability to assembly the entire instrument rotator and cable chain on a structure simulating the rotator gallery and to move it around in various gravity orientations to verify performance.

The NOAO facility does not have the capacity for a structure the size of the DGR. This assembly will be integrated in a local shop (assuming space can be located) but will not be operated in all orientations. Integration in Tucson will consist primarily of a trial assembly to verify fit and a functional test to verify basic operation.

### 6.2. Equipment

In addition to the flex rig machine, a structure simulating the rotator gallery with bearing, motor mount, and cable chain interfaces is required to integrate the BGR.

Integrating the DGR requires a large plate simulating the back of the primary mirror cell and a support structure to position it at a convenient height for working.

### 6.3. Mechanical integration

Mechanical integration involves preassembly of the motor assemblies and related components and assembly of all subsystems onto the test structure. The major preassembly steps are discussed here and are similar for the BGR and DGR.

#### 6.3.1. Assemble Motor Assemblies

- Install pinion shaft into motor
- Attach motor to motor bracket
- Assemble brake or gearbox
- Install absolute encoder
- Install rotating union
- Install other brackets and mounts

#### 6.3.2. Assembly onto dummy fixtures

- Install bearing
- Install rotator gear
- Install motor mounts
- Install motor assemblies
- Install encoders
- Install cable trays and energy chain
- Install cable chain motor assemblies

## 7. Acceptance Testing

### 7.1. Angular velocity

Measuring maximum angular velocity requires a dummy instrument load. It will only be measured if a suitable dummy mass is constructed.

### 7.2. Angular acceleration

Measuring maximum angular acceleration also requires a dummy instrument load. It will only be measured if a suitable dummy mass is constructed.

### 7.3. On-sky error

On-sky error will be measured by recording encoder following error while tracking and analyzing the results. This could also be verified after optical commissioning if a suitable camera is available.

### 7.4. Mass, moment, and imbalance capacity

Mass, moment, and imbalance capacity will be verified by analysis and demonstration if a suitable dummy weight is available.

### 7.5. Cable chain relative angle

The relative angle range of the cable chain will be verified by demonstrating that it operates properly without exceeding the range of the position sensor. This will verify that the tracking accuracy is substantially better than required.

### 7.6. Cable chain tracking accuracy

The tracking accuracy of the cable chain will be verified by demonstrating that it operates properly without exceeding the range of the position sensor. This will verify that the tracking accuracy is substantially better than required.

### 7.7. Cable chain range of motion

The range of motion of the cable chain will be verified by demonstrating that it can be operated through the full specified range.

### 7.8. Cable chain capacity

The capacity of the cable chain will be verified by demonstrating that it operates according to specification when will with the specified cable load.

**--oOo--**

Doc_info_start
Title: *Instrument Rotator and Cable Chain Integration and Acceptance Test Plan*
Document Type: Report
Source: Steward Observatory
Issued by: Robert Meeks
Date_of_Issue: *19 Mar 2007*
Revised by:
Date_of_Revision:
Checked by:
Date_of_Check:
Accepted by:
Date_of_Acceptance:
Released by:
Date_of_Release:
File Type: MS Word
Local Name: *Instrument Rotator and Cable Chain Integration and Acceptance Test Plan*
Category: 600 Telescope Auxiliaries
Sub-Category: 670 Instrument Rotators
Assembly: 670 Instrument Rotators General
Sub-Assembly:
Part Name:
CAN Designation: *670s015*
Revision: *a*
Doc_info_end