Vera C. Rubin Observatory
Telescope & Site

LVV-P84: Alignment System Verification Test Plan and Report

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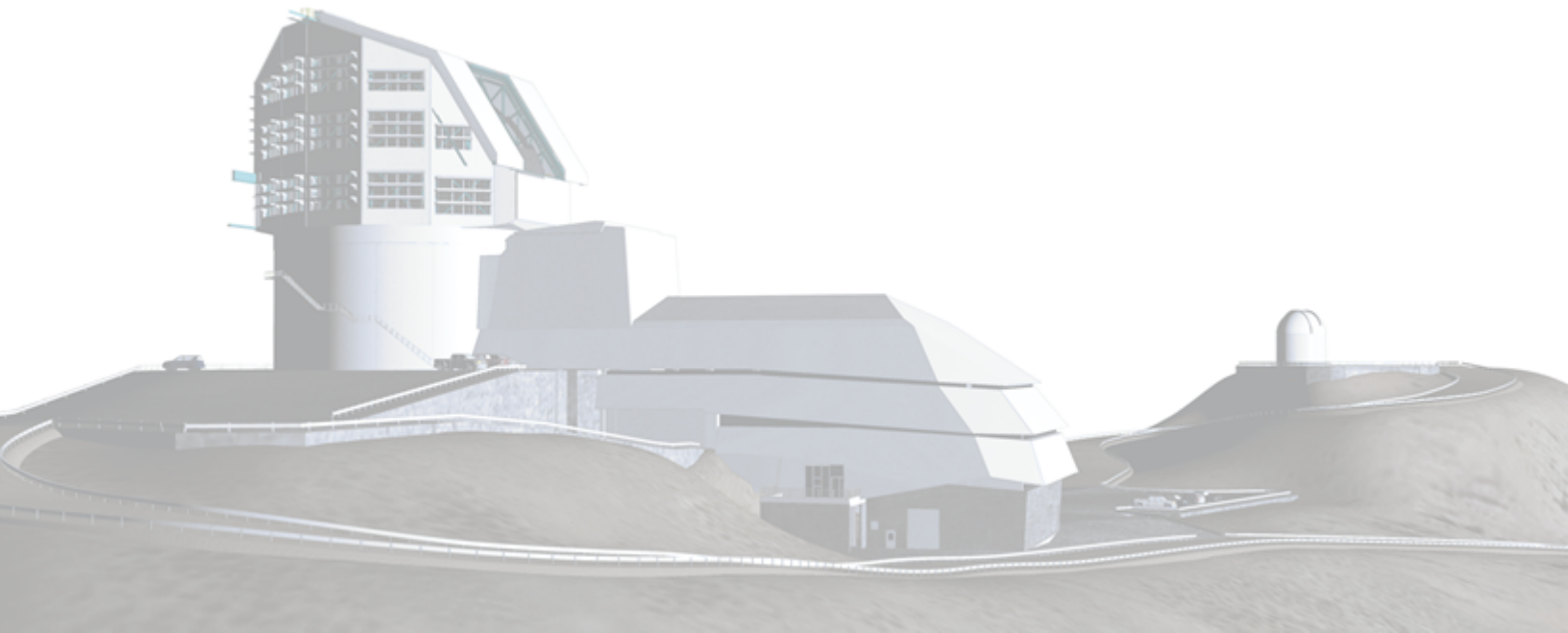
SCTR-51

Latest Revision: 2022-03-08



Abstract

This is the test plan and report for **Alignment System Verification**, an LSST milestone pertaining to the Telescope and Site Subsystem.
This document is based on content automatically extracted from the Jira test database on 2022-03-08 . The most recent change to the document repository was on 2022-03-08.

Change Record

Version	Date	Description	Owner name
	2022-03-04	First draft	Sandrine Thomas

Document curator: Sandrine Thomas
Document source location: `https://github.com/lsst-dm/SCTR-51`
Version from source repository: b2808cd

Contents

LVV-P84: Alignment System Verification Test Plan and Report

1 Introduction

1.1 Objectives

The objective of this test plan is to verify the Spatial Analyzer API is working before shipping the laser tracker from Tucson to Chile. This test plan consists of one test cycle that was initially started in March 2020 and was continued in July 2021.

1.2 System Overview

The Spatial Analyzer Controller (T2SA) interfaces with the laser tracker through the Spatial Analyzer API to execute scripts and measure the positions of the spherically mounted retroreflectors (SMR's).

1.3 Document Overview

This document was generated from Jira, obtaining the relevant information from the LVV-P84 Jira Test Plan and related Test Cycles (LVV-C150).

Section 1 provides an overview of the test campaign, the system under test (Alignment System), the applicable documentation, and explains how this document is organized. Section 2 provides additional information about the test plan, like for example the configuration used for this test or related documentation. Section 3 describes the necessary roles and lists the individuals assigned to them.

Section 4 provides a summary of the test results, including an overview in Table 3, an overall assessment statement and suggestions for possible improvements. Section 5 provides detailed results for each step in each test case.

The current status of test plan LVV-P84 in Jira is **Completed** .

1.4 References

[1] **[DMTN-140]**, Comoretto, G., 2021, *Documentation Automation for the Verification and Validation of Rubin Observatory Software*, DMTN-140, URL https://dmtn-140.lsst.io/

[2] **[DMTN-178]**, Comoretto, G., 2021, *Docsteady Usecases for Rubin Observatory Constructions*, DMTN-178, URL https://dmtn-178.lsst.io/

[3] **[LSE-160]**, Selvy, B., 2013, *Verification and Validation Process*, LSE-160, URL https://ls.st/LSE-160

2 Test Plan Details

2.1 Data Collection

Observing is not required for this test campaign.

2.2 Verification Environment

The SA API will be verified in the laser lab in Tucson.

2.3 Entry Criteria

In order to run these tests, the following criteria must be met first:

- All communications between the MTAlignment CSC and T2SA have already been verified

2.4 Exit Criteria

In order for this event to be considered complete, the following criteria must be met:

- All of the executions of the test cases have been populated with the actual results of the tests

2.5 Related Documentation

Jira Attachments	
To LVV-C150 results	AutoVectorsGroupsCAM_VertTrackertoCAM_HorizontalTracker.pdf
To LVV-C150 results	T2SATunnelTemplateMarch_12_Hor2020_03_12_17_26.xit64

All documents provided as attachments in Jira are downloaded to Github and linked here for convenience. However, since they are not properly versioned, they should be considered informal and therefore not be part of the verification baseline.

2.6 PMCS Activity

Primavera milestones related to the test campaign: Alignment July Acceptance Test - DM-31263

3 Personnel

The personnel involved in the test campaign is shown in the following table.

	T. Plan LVV-P84 owner:	**Sandrine Thomas**	
	T. Cycle LVV-C150 owner:	**Sandrine Thomas**	
Test Cases	**Assigned to**	**Executed by**	**Additional Test Personnel**
LVV-T1816	Sandrine Thomas		New River Kinematics Personnel Rubin Observatory Software Developer T&S Scientist
LVV-T1814	Sandrine Thomas	Colin Winslow	New River Kinematics Personnel Rubin Observatory Software Developer T&S Scientist
LVV-T1817	Sandrine Thomas	Colin Winslow	New River Kinematics Personnel Rubin Observatory Software Developer T&S Scientist
LVV-T1813	Sandrine Thomas	Mostafa Lutfi	New River Kinematics Personnel Rubin Observatory Software Developer T&S Scientist
LVV-T1815	Sandrine Thomas	Colin Winslow	New River Kinematics Personnel Rubin Observatory Software Developer T&S Scientist
LVV-T2181	Sandrine Thomas	Colin Winslow	New River Kinematics Personnel Rubin Observatory Software Developer T&S Scientist

4 Test Campaign Overview

4.1 Summary

T. Plan LVV-P84:	**Alignment System Verification**			Completed
T. Cycle LVV-C150:	**T2SA Factory Acceptance Test**			Done
Test Cases	**Ver.**	**Status**	**Comment**	**Issues**
LVV-T1816	1	Initial Pass	In July 2021 this execution was set to fail as the purpose was to verify that the laser was behaving when the laser was aligned with the optical axis of the optics. We realized that there was a problem of reflectors visibility and therefore had to make a mechanical change to how we will mount the laser in the cell. The mount will be at 45 deg and the tests will be repeated with the nominal position being tilted.	
LVV-T1814	1	Fail	The results of this test execution were captured while the laser tracker was set up in a vertical position. These steps were repeated when the laser tracker was reconfigured with a 45degree tilt in the *Testing of the T2SA with the laser tracker at 45 degrees* test case.	LVV-19977 LVV-19978 LVV-19979 LVV-19977 LVV-19978 LVV-19979
LVV-T1817	1	Pass	The results of this test execution were captured while the laser tracker was set up in a vertical position. These steps were repeated when the laser tracker was reconfigured with a 45degree tilt in the *Testing of the T2SA with the laser tracker at 45 degrees* test case.	
LVV-T1813	1	Fail	The results of this test execution were captured during the continuation of the tests in July 2021 after the laser tracker was reconfigured with a 45 degree tilt.	LVV-19986 LVV-19987 LVV-19988 LVV-19989 LVV-19986 LVV-19987 LVV-19988 LVV-19989

LVV-T1815	1	Pass	The results of this test execution were captured during the continuation of the tests in July 2021 after the laser tracker was reconfigured with a 45 degree tilt.
LVV-T2181	1	Blocked	As mentioned by the objective, this test case is meant to redo some of the original testing that was done when the laser tracker was set up horizontally. Specifically, the *Position Measurement of M1M3, M2 and the cam-era* test case and the *Motion tests* test case have been called to test and will be repeated with the laser tracker tilted at 45deg. LVV-19978 LVV-19978

Table 3: Test Campaign Summary

4.2 Overall Assessment

As a result of the Factory acceptance testing, the overall test can be considered a PASS. The test cycle was updated with additional tests that were a subset of tests that were initially done in March 2020. The tests that were done in July 2021 were able to address some of the problems that were seen as part of these initial tests and were seen to be passed as part of the latest test event.

4.3 Recommended Improvements

Not yet available.

5 Detailed Test Results

5.1 Test Cycle LVV-C150

Open test cycle *T2SA Factory Acceptance Test* in Jira.

Test Cycle name: T2SA Factory Acceptance Test
Status: Done

This covers the verification of the interface between the Spatial Analyzer software that controls the laser tracker and the Commandable SAL Component called the Alignment System Controller.
This is executed by the vendor, New River Kinematics, with our assistance.

5.1.1 Software Version/Baseline

Not provided.

5.1.2 Configuration

In March 2020, the T2SA Acceptance tests were initially executed with the laser tracker in a vertical position. The initial tests were put on hold due to the pandemic so the tests were continued in July 2021. However, when the tests were continued in July, it was discovered that the laser had a hard time reaching the retroreflector on the camera while parallel to the optical axis of M1M3. As a result, the laser tracker was reconfigured with a 45 deg tilt and a subset of the initial verification tests that were done in March 2020 were repeated in July 2021 with the new configuration.

5.1.3 Test Cases in LVV-C150 Test Cycle

5.1.3.1 LVV-T1816 - Measurement with the laser set up horizontally

Version **1**. Open *LVV-T1816* test case in Jira.

The objective of this test will be to verify the calibration of the laser holds whenever the orientation changes. Because the laser will be part of the M1M3 mirror cell, it is expected to change orientation several times during the night. This is mostly important for the tests that we want to conduct during the commissioning phase.

Preconditions:
The commands and interfaces have been successfully tested with the laser in a vertical position before being tested horizontally.

Execution status: **Initial Pass**

Final comment:
In July 2021 this execution was set to fail as the purpose was to verify that the laser was behaving when the laser was aligned with the optical axis of the optics. We realized that there was a problem of reflectors visibility and therefore had to make a mechanical change to how we will mount the laser in the cell. The mount will be at 45 deg and the tests will be repeated with the nominal position being tilted.

Detailed steps results:

Step 1 Step Execution Status: **Pass**

Description
Load Compensation using LOAD_TRACKER_COMPENSATION
If the file does not exist the error is 335

Expected Result
The files are loaded.

Actual Result
Verified files load, and incorrectly named files produce error 335

Step 2 Step Execution Status: **Pass**

Description
Measure M1M3, M2 and the camera position.
Ask for POS and OFFSET

Expected Result
The measurements for the positions and offsets of the M1M3, M2 and Camera are shown.

Actual Result

```
Forgot to query positions... whoops!

Offsets:
'ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_12;X:8.958377;Y:75.981318;Z:-664.202237;Rx:3.287680;Ry:-0.617449;Rz:1.037039;03


'ACK-300 RefFrame:FrameM2_0.00_0.00_0.00_12;X:-19.366712;Y:-5.084746;Z:-1751.262655;Rx:-0.839965;Ry:0.386325;Rz:1.880290;


'ACK-300 RefFrame:FrameM1M3_0.00_0.00_0.00_12;X:0.001793;Y:0.000320;Z:-0.002017;Rx:0.000057;Ry:-0.000031;Rz:-0.000012;03/
```

Step 3 Step Execution Status: **Pass**

Description
Move the laser horizontaly and set the altitude to the following:
For this step Alt = 0, Az = 0 and rot = 0

Expected Result
The laser is moved and the altitude is set.

Actual Result
This works fine.

Step 4 Step Execution Status: **Not Executed**

Description
Redo the compensation. LOAD_TRACKER_COMPENSATION

Expected Result
The files are loaded.

Actual Result
This step was not executed because it was determined that it wasn't necessary for this test.

Step 5 Step Execution Status: **Initial Pass**

Description
Remeasure M1M3, M2 and Camera (CMD:)
Ask for POS and OFFSET

Expected Result
The measurements for the positions and offsets of the M1M3, M2 and Camera are shown.

Actual Result
Measured M1m3 sucessfully.
Camera measurement failed least squares fit because it's too tight of an angle for the tracker.

Unable to track some SMRs because of the handle on the tracker blocking the beam, so we moved the cart closer to get more favorable angles.

We remeasured everything, but since we moved the cart between measuring with the tracker in a vertical orientation and remeasuring in horizontal orientation, we unfortunately can't make a direct comparison.

SO instead, we compared the measured distances between each or the 3 "Camera" SMRs with the tracker in both orientations. The difference between the two measurements is < 4 microns.

Generated a SA report detailing these results

5.1.3.2 LVV-T1814 - Position Measurement of M1M3, M2 and the camera

Version **1**. Open *LVV-T1814* test case in Jira.

The main objective of this test is to verify the T2SA is able to measure the positions of the fiducials placed adjacent to Camera and M1M3 using the Laser Tracker.

Preconditions:
The set-up procedure and all communications between the MTAlignment CSC and T2SA were verified.

Execution status: **Fail**

Final comment:
The results of this test execution were captured while the laser tracker was set up in a vertical position. These steps were repeated when the laser tracker was reconfigured with a 45degree tilt in the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

Issues found during the execution of LVV-T1814 test case:

- LVV-19977 Blocked SMR Coding Workaround
- LVV-19978 Update T2SA Test Steps
- LVV-19979 T2SA SAVE_SA_JOBFILE Command

Detailed steps results:

Step 1 Step Execution Status: **Pass w/ Deviation**

Description
To start a measurement, one needs to set the reference group of point using the command SET_REFERENCE_GROUP.
LTS-966-REQ-0015
Start without specifying a group name to trigger the error

Expected Result
Error 313 should be triggered

Actual Result
Expected Error 313 but got

```
'ERR-306: Did not find or set point group and target name.\r\n'
```

Step 2 Step Execution Status: **Pass**

Description
Repeat the step above with a valid group name. LTS-966-REQ-0015

Expected Result
Verify in SA that the group name is the correct one

Actual Result
Set Reference Group to M2, verified this shows up in SA

Step 3 Step Execution Status: **Pass**

Description
Next, one needs to set the working frame using SET_WORKING_FRAME. Start without specifying a group name to trigger the error LTS-966-REQ-0018

Expected Result
Error 314 should be triggered

Actual Result
Indeed we get Error 314

Step 4 Step Execution Status: **Pass**

Description
Repeat the test from above giving a working frame with the right format

Expected Result
Verify in SA that the working frame is the correct one. ACK 300

Actual Result

It works. As a naming convention for frames in our template files, we prefix with the word FRAME, ie FRAMEM2, FRAMECAM, etc

---

Step 5 Step Execution Status: **Not Executed**

Description

Use the command SET_STATION_LOCK with true and check that the laser is still locked on a SMR even when we move them LTS-966-REQ-0020

Expected Result

The laser should follow the target

Actual Result

There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected result is unrelated to what the step specifies.

Step 6 Step Execution Status: **Not Executed**

Description

Check of error 331, fail to lock station ?

Expected Result

There is no error as a result of the SET_STATION_LOCK command.

Actual Result

There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected error is unrelated to what the command actually does.

Step 7 Step Execution Status: **Not Executed**

Description

Repeat the step above with false and verify that the laser does not follow the SMR when it's being moved. LTS-966-REQ-0020.

Expected Result

The laser should not follow the target

Actual Result

There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected result is unrelated to what the step specifies.

Step 8 Step Execution Status: **Not Executed**

Description

Trigger error 317? LTS-966-REQ-0020

Expected Result

There is no error as a result of the SET_STATION_LOCK command.

Actual Result

There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected error is unrelated to what the command actually does.

Step 9 Step Execution Status: **Pass**

Description

Set the tolerance of the measurement. SET_LS_TOL:<n;n>. LTS-966-REQ-0021
That will allow to define if we need to go in another set of measurements.
1) Give a value greater than 0.1mm to trigger the error
2) Give s=0.01mm and verify that this is the right value

Expected Result

1) error 311 is triggered
2) ACK 300 and the right value is in T2SA

Actual Result

Set LS tolerances to rms_tol = 0.01, max_tol = 0.02, then measured M1M3.
received

```
ERR-311: RMS and Max least squares tolerance value are outside bounds. Tolerances set to defaults.
```

Reset tolerance to rms_tol = 0.1, max_tol = 0.2, then remeasured M1M3. Received ACK-300.

Step 10 Step Execution Status: **Pass**

Description

Before measuring the positions, the alignment system publishes the alt,Az and rot using the command PUBLISH_ALT_AZ_ROT. LTS-966-REQ-0031

Repeat the measurement with the camera.
For this step Alt = 0, Az = 0 and rot = 0

Expected Result

ACK 300 and verify that T2SA has all 3 values correct.
The alignment controller should receive the position of the Camera with the following format relative to M1M3:
<s>;X:<n>;Y:<n>;Z:<n>;Rx:<n>;Ry:<n>;Rz:<n>;<date>

Actual Result

Successfully set alt/az/rot and verified all are set to 0 in SA. Successfully measured camera

---

Step 11 Step Execution Status: **Pass**

Description

Measure the position of the M1M3 targets using the command CMD M1M3
1) POS<s, s, s>. LTS-966-REQ-0009
2) OFFSET <s;s;s; s;s;s;>. LTS-966-REQ-0010
Repeat for M2 and the camera

Expected Result

The alignment controller should receive the position of the M2 with the following format relative to M1M3:
<s>;X:**<n>**;Y:**<n>**;Z:**<n>**;Rx:**<n>**;Ry:**<n>**;Rz:**<n>;<date>**
or the offset OFFSET (<s>;dX:<n>;dY:<n>;dZ:<n>;dRx:<n>;dRy:<n>;dRz:<n>;<date>)
Same for the camera

Actual Result

Step 12 Step Execution Status: **Blocked**

Description

Block an SMR and repeat the test above.
Clear the error before continuing.

Expected Result

The measurement should fail and give the err-305.

Actual Result

Blocking an SMR did not cause the system to generate the expected error. Instead, it caused a dialog to pop up on the SA host, which must be manually clicked. However, this step is considered blocked because this issue is due to the fact that the system is waiting until it receives spatial information from at least 3 SMR's. Therefore, Scott will address this with a coding workaround so that the system recognizes one of the 3 SMR's has been blocked and generates an error as expected.

Issues found executing this step:

- LVV-19977 Blocked SMR Coding Workaround

Step 13 Step Execution Status: **Pass**

Description

Send the command PUBLISH_ALT_AZ_ROT with no argument
LTS-966-REQ-0031

Expected Result

Check that we get the error 320

Actual Result

Checked that we get Error 320 when we send blank strings instead of numeric values, and also when we send things other than numbers.

Step 14 Step Execution Status: **Pass**

Description
Generate the report.
After finishing up the testing, we want to generate a report by issuing the command GEN_REPORT with the report name.
LTS-966-REQ-0023

Expected Result
The report exists.

Actual Result
THe report exists, received

ACK-300

Step 15 Step Execution Status: **Blocked**

Description
Check the error when trying to generate the report by using a template name that does not exist.
Then clear the error
LTS-966-REQ-0023

Expected Result
Err-308
Then clear error and check that the system is READY

Actual Result
The report template name isn't supplied by ASC. It's internally stored by T2SA and we don't interact with it at all. If it's missing, it's a problem with the T2SA installationn

Issues found executing this step:

- LVV-19978 Update T2SA Test Steps

Step 16 Step Execution Status: **Pass**

Description

Save the settings by using the command SAVE_SETTINGS. LTS-966-REQ-0046

Error?

Expected Result
The settings should be the latest ones.

Actual Result
this forces an immediate writeout of saved settings in T2SA, guaranteeing changes will be saved even if T2SA crashes. Tested this by changing LS tolerance, saving settings, force-quitting T2SA, and then checking for the LS tolerance value after relaunching.

Step 17 Step Execution Status: **Fail**

Description
Save the job using the SAVE_SA_JOBFILE using both
1) the default (meaning sending no argument) and
2) a valid filename.
Verify that the job is saved with proper name

Send also a non valid filename and check that we get the error 316
LTS-966-REQ-0035

Expected Result
The jobs are saved unless the filename is incorrect in which case we would get the error 316.

Actual Result
Strictly speaking, we are not allowed to call the MTAlignment's python method with no argument. We can implement a default value in the MTAlignment, and can send an empty string as the argument, which causes ERR 316. Command is also producing Err316 with what I am pretty sure should be a valid filename though, so I'm marking this as a fail.

Issues found executing this step:

- LVV-19979 T2SA SAVE_SA_JOBFILE Command

Step 18 Step Execution Status: **Not Executed**

Description

Testing of the command SET_MEAS_INDEX to 4. LTS-966-REQ-0043
Then repeat the SAVE_SA_JOBFILE.

Expected Result

The index is set to 4.

Actual Result

This step was not able to be executed due to the pandemic. This step was executed later as part of the continuation of the Factory Acceptance Test in July 2021 per the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

Step 19 Step Execution Status: **Not Executed**

Description

Is there an error for SET_MEAS_INDEX?
LTS-966-REQ-0043

Expected Result

The command results in either ACK300 or ERR-333.

Actual Result

This step was not able to be executed due to the pandemic. This step was executed later as part of the continuation of the Factory Acceptance Test in July 2021 per the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

Step 20 Step Execution Status: **Not Executed**

Description

Testing of the command INC_MEAS_INDEX. LTS-966-REQ-0027

Expected Result

The increment is set and returns ACK300.

Actual Result

This step was not able to be executed due to the pandemic. This step was executed later as part of the continuation of the Factory Acceptance Test in July 2021 per the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

Step 21 Step Execution Status: **Not Executed**

Description

Check the command SET_POWER_LOCK: 0 or 1
LTS-966-REQ-0045

Expected Result

The tracker's camera is able to be enabled and disabled, returning ACK300.

Actual Result

This step was not able to be executed due to the pandemic. This step was executed later as part of the continuation of the Factory Acceptance Test in July 2021 per the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

5.1.3.3 LVV-T1817 - Motion tests

Version **1**. Open *LVV-T1817* test case in Jira.

In this test case we will move the targets in different direction and record the results of the motion
- motion in y (vertical)
- motion in z
- rotation along y
- rotation along z

We can conduct the test with the laser both in a vertical position and a horizontal position

Preconditions:
The following parameters have to be adjusted:

- SET_DRIFT_TOL should be set to a higher value to allow the motion of the order that are allowed in the tunnel
- SET_NUM_ITERATIONS to 1
- SET_NUM_SAMPLES to 3

- Randomization on
- Power-lock off

Execution status: **Pass**

Final comment:
The results of this test execution were captured while the laser tracker was set up in a vertical position. These steps were repeated when the laser tracker was reconfigured with a 45degree tilt in the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

Detailed steps results:

Step 1 Step Execution Status: **Pass**

Description
Make a first measurement to get the baseline of the M2 and the Camera position relative to M1M3

Expected Result
The position of the camera in reference to the camera frame is captured.

Actual Result
On first attempt, we forgot to set the camera rotation to 0, (it was 5 deg from a previous test). Unexpectedly, the tracker did not attempt to find the SMRs which are only slightly differently positioned from where we expect.
Initial camera position, in camera frame of reference:

```
'ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_2;X:-0.099417;Y:0.009627;Z:-0.112795;Rx:0.006489;Ry:0.053660;Rz:-0.001585;03/12
```

But resolved this by correcting the camera rotation

Step 2 Step Execution Status: **Pass**

Description
Move the structure in y axis by about 10mm if possible.
Then take the same measurement and record the position. If there is a ruler available, compare the motion measured with the actual motion.
** Then try and bring it back to nominal by moving it back by half of the value that was measured.
Take another measurement **

Repeat ** ** until we're in within 1mm.

~5 revolutions is about 1 inch

Expected Result

The measurements are taken and are within 1mm as expected.

Actual Result

We will move the camera structure by +2 revolutions up (~8mm)
Initially we ran into trouble because the tracker does not seem to be searching for the SMR at all... Scott worked on a fix
Then got results

```
initial measurement
ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_5;X:-0.071180;Y:7.455298;Z:-0.112868;Rx:0.005206;Ry:0.016533;Rz:0.000657;03/12/2
```

After first iteration moving back toward nominal:

```
'ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_6;X:-0.068382;Y:3.901858;Z:-0.116776;Rx:0.006854;Ry:0.038436;Rz:-0.002021;03/12
```

After second iteration

```
'ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_7;X:-0.104933;Y:0.712325;Z:-0.123621;Rx:0.006169;Ry:0.046394;Rz:-0.000799;03/12
```

After third iteration

```
'ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_8;X:-0.097767;Y:-0.035330;Z:-0.120993;Rx:0.006369;Ry:0.053244;Rz:-0.001400;03/1
```

Step 3 Step Execution Status: **Pass**

Description

Move the structure in z axis by less than a 10mm if possible.
Then take the same measurement and record the position.
** Then try and bring it back to nominal by moving it back by half of the value that was measured.
Take another measurement **

Repeat ** ** until we're in within 1mm.

[There is a dial indicator allowing to move the cart by +/- 0.5 inches. Note that we need to keep track of the number of revolution of the arrow as each revolution is ~0.050 inches
.6 inches on the way toward us (12 revolution)
.4 inches on the way back]

Expected Result

The measurements are taken and are within 1mm as expected.

Actual Result

Took initial measuremnts on Cam and M2, dial was at 4.

'ACK-300 RefFrame:FrameM2_0.00_0.00_5.00_9;X:-0.256686;Y:-0.116646;Z:-0.062667;Rx:0.002226;Ry:0.081264;Rz:0.003958;03/12/

'ACK-300 RefFrame:FrameCAM_0.00_0.00_5.00_9;X:-0.100149;Y:-0.033987;Z:-0.121444;Rx:0.001629;Ry:0.053691;Rz:-5.001706;03/1

then cart into the tunnel until dial was at 42.

Incremented measurement index, then remeasured cam and M2

'ACK-300 RefFrame:FrameM2_0.00_0.00_5.00_10;X:-0.198055;Y:-0.001666;Z:7.870649;Rx:0.002616;Ry:0.080003;Rz:0.004325;03/12/

'ACK-300 RefFrame:FrameCAM_0.00_0.00_5.00_10;X:-0.172625;Y:-0.487319;Z:7.803832;Rx:0.002056;Ry:0.052748;Rz:-5.001263;03/1

Tried to move back toward nominal position, but overshot a bit

'ACK-300 RefFrame:FrameCAM_0.00_0.00_5.00_11;X:0.045699;Y:0.881950;Z:-15.735222;Rx:-0.000338;Ry:0.054476;Rz:-5.002011;03/

'ACK-300 RefFrame:FrameM2_0.00_0.00_5.00_11;X:-0.400159;Y:-0.293055;Z:-15.703755;Rx:0.000292;Ry:0.081652;Rz:0.005893;03/1

Final iteration:

'ACK-300 RefFrame:FrameCAM_0.00_0.00_5.00_12;X:-0.010894;Y:0.291359;Z:-5.549460;Rx:0.001370;Ry:0.052778;Rz:-5.002555;03/1

'ACK-300 RefFrame:FrameM2_0.00_0.00_5.00_12;X:-0.300399;Y:-0.178240;Z:-5.501536;Rx:0.001870;Ry:0.079665;Rz:0.004046;03/12

Step 4 Step Execution Status: **Not Executed**

Description

Rotate the structure along the y axis and take a measurement.
** Then try and bring it back to nominal by moving it back by half of the value that was measured.
Take another measurement **

Repeat ** ** until we're in within 1mm.

Expected Result

The measurements are taken and are within 1mm as expected.

Actual Result

This step was not able to be executed due to the pandemic. This step was executed later as part of the continuation of the Factory Acceptance Test in July 2021 per the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

Step 5 Step Execution Status: **Pass**

Description

For the rotation along the z axis, we will simulate the rotation by swapping Target 1 to Target 2, Target 2 to Target 3 and Target 3 to Target 1 using the software.

Then the rotation value sent toT2SA from the ASC would be 120.
Measure the position and verify that the targets in SA have indeed moved by 120.

Expected Result
The measurements are taken and the targets have moved by 120 as expected.

Actual Result
We decided not to do the 120 degree rotation, because our triangle is not a perfect equilateral triangle and so when we get an out of tolerance error. Instead, we will simulate a 5 degree camrot movement without actually moving the targets, and then look for the 5 degrees to show up in the offsets.

Initial measurement prior to rotation

```
'ACK-300 RefFrame:FrameCAM_0.00_0.00_0.00_8;X:-0.098292;Y:-0.033101;Z:-0.120204;Rx:0.006344;Ry:0.053388;Rz:-0.001932;03/
```

Then, incremented index and told T2SA that the camera rotator has moved 5 degrees (but it really hasn't, so we expect a 5 degree z rotation offset in our next measurement...

Then measured and got results

```
'ACK-300 RefFrame:FrameCAM_0.00_0.00_5.00_9;X:-0.099674;Y:-0.033590;Z:-0.121127;Rx:0.001604;Ry:0.053812;Rz:-5.001797;03/1
```

-5.002 degree Rz offset shows up as expected

Step 6 Step Execution Status: **Not Executed**

Description

Send the command PUBLISH_ALT_AZ_ROT with ROT = 5deg
and repeat the test on the camera

Expected Result
The command is accepted and the tracker locates the position of the SMRs.

Actual Result
This step was not able to be executed due to the pandemic. This step was executed later as part of the continuation of the Factory Acceptance Test in July 2021 per the *Testing of the T2SA with the laser tracker at 45 degrees* test case.

5.1.3.4 LVV-T1813 - Communication Protocol Interface Command: getting started

Version **1**. Open *LVV-T1813* test case in Jira.

The objective of this test case will be to verify the initial commands used to set the system up and calibrate it, using a TCP/IP protocol.

Preconditions:

Execution status: **Fail**

Final comment:
The results of this test execution were captured during the continuation of the tests in July 2021 after the laser tracker was reconfigured with a 45 degree tilt.

Issues found during the execution of LVV-T1813 test case:

- LVV-19986 Develop Remote Start of SA
- LVV-19987 Distinction Between Disconnect and Warming Up States
- LVV-19988 T2SA CMD Verification
- LVV-19989 Failed “LST 0” Command

Detailed steps results:

Step 1 Step Execution Status: **Pass**

Description

Verification of the communication protocol: Commands and responses must:

- Contain only ASCII printable characters and whitespace
- Messages always end with carriage return (0x0D '\r') + Line feed (0x0A '\n')
- If the command is rejected T2SA will send back ERR-300 followed by carriage return (0x0D '\r') + Line feed (0x0A '\n'
- Messages always begin with the character '!' or '?'. '!' to represent command and '?' to query for a value.

Expected Result

The commands and responses follow the proper format:
Commands and responses must:

- Contain only ASCII printable characters and whitespace
- Messages always end with carriage return (0x0D '\r') + Line feed (0x0A '\n')
- If the command is rejected T2SA will send back ERR-300 followed by carriage return (0x0D '\r') + Line feed (0x0A '\n'
- Messages always begin with the character '!' or '?'. '!' to represent command and '?' to query for a value.

Actual Result

The commands and responses followed the proper format:
Commands and responses includes:

- Contained only ASCII printable characters and whitespace
- Messages ended with carriage return (0x0D '\r') + Line feed (0x0A '\n')
- If the command is rejected T2SA did send back ERR-300 followed by carriage return (0x0D '\r') + Line feed (0x0A '\n'
- Messages always began with the character '!' or '?'. '!' to represent command and '?' to query for a value.

Step 2 Step Execution Status: **Blocked**

Description

Start SA remotely from the Alignment system controller (through T2SA).
From the Alignment System Controller and with the laser connected, query the laser status using the “LSTA” command, and verify that is connected. The laser should be off. (LTS-966-REQ-0008).

Expected Result

The application SA should start
We should not see the return LNC but LOFF
This will also show that the T2SA can receive commands from and responds to the the Alignment system controller

Actual Result

This step is blocked because remote start of SA is still in development.
However, the laser status was still found through Query as part of this test.

Issues found executing this step:

- LVV-19986 Develop Remote Start of SA

Step 3 Step Execution Status: **Pass**

Description

Verify the heart beat of the system (LTS-966-REQ-0002)

Expected Result

The heartbeat is incremented by T2SA at least every 0.5 sec through a range o f0x00000000 - 0xffffffff

Actual Result

According to requirement LTS-966-REQ-0002, it does provide status response while SA_SDK is completing measurement and analysis process.

Step 4 Step Execution Status: **Pass**

Description

Disconnect the laser by using the command “LST 2” and check that the return is telling us that the laser is disconnected. (REQ-LTS-966-0036).

Expected Result

Return should be LNC. There should also be an acknowledgement ACK300.

Actual Result

Returned LNC and ACK300.

Step 5 Step Execution Status: **Initial Pass**

Description

Try to turn the laser on, LST 1.

Also using the command 'STAT', we should see that the laser is in an error mode LTS-966-REQ-0011.

Expected Result

We should get an error. Err-301 for both commands

Actual Result

We got Err-323 : Could not start instrument interface. We could not get trigger Err-301.

Step 6 Step Execution Status: **Initial Pass**

Description

Clear error using command CLERCL -> This part was descoped for the 2021 run.
Reconnect the laser and turn it on using the command "LST 1"

Example Code

LST 1

Expected Result

Return should be LON and it should tell us how long we need to wait until it warms up (warm with the remaining time in sec).

We should also get the ACK300 code

Actual Result

Returned LON. Also got the ACK300 code. Does not show the warm up time.

Used LST-2 to shut everything down. Then, we unplugged and plugged back the controller to restart it.
The PDU will need to be on.

Step 7 Step Execution Status: **Fail**

Description

Ask for the status of the laser tracker using the command 'LSTA', several time during the warming process.
Once the warm up is ready, then use the command 'STAT', LTS-966-REQ-0011.

Verify that this is done from the MTAlignment CSC to verify LTS-966-REQ-0012 and LTS-966-REQ-0001 and LTS-966-REQ-0004.

Expected Result

Return should first be WARM, "i" seconds. Then when it is warm, it should say LON.
The laser should be in the state READY as a return of the command STAT.

Actual Result

Laser in READY state. We got ACK300. We got LNC while warming up.

The capability will be moved to CSC. And Scott will add a functionality to make sure we are able to get the distinction between the disconnection and the warming up states

Issues found executing this step:

- LVV-19987 Distinction Between Disconnect and Warming Up States

---

Step 8 Step Execution Status: **Initial Pass**

Description

Start the measurement with the single point measurement. Choose a measurement profile name (s) in the alignment system controller and pass it to the T2SA using the command SINGLE_POINT_MEAS_PROFILE <s> (LTS-966-

REQ-0019).

Then proceed to the single point measurement using MEAS_SINGLE_POINT (which is a position or an offset measurement?). LTS-966-REQ-0024

Before the end of the measurement, use the 'STAT' command to check it's taking a measurement.

Ask for the position POINT_POS <refFrame>(LTS-966-REQ-0009)
Ask for the offset POINT_ <refFrame> (LTS-966-REQ-0010)

Expected Result
ACK300

During the measurement we should get EMP as a return for the 'STAT' command.

After the measurement, we get the position POS (<s>;X:**<n>**;Y:**<n>**;Z:**<n>**;Rx:**<n>**;Ry:**<n>**;Rz:**<n>;<date>**)
we get the offset OFFSET (<s>;dX:**<n>**;dY:**<n>**;dZ:**<n>**;dRx:**<n>**;dRy:**<n>**;dRz:**<n>;<date>**)

Actual Result
As expected, we got ACK-300. However, due to the use of Jupyter notebooks for this test, we were unable to send commands in parallel. We were still able to get the single point measurement, but this will need to be fully verified later when we are not limited to the number of commands we can send at a time.

Step 9 Step Execution Status: **Pass**

Description
Repeat the previous test blocking the target and ensure you get an error 306. (LTS-966-REQ-0024)

Expected Result
Get an error 306

Actual Result
We used wrong name for the point we measured and got Err-306.

Step 10 Step Execution Status: **Pass**

Description
Send a measurement profile that does not exist and check the status. (LTS-966-REQ-0019)

Expected Result
Get the error 307

Actual Result
Sending measurement profiles that do not exist consistently results in an ERR-307.

Step 11 Step Execution Status: **Pass**

Description
Load the template file LOAD_SA_TEMPLATE_FILE with a valid template name. LTS-966-REQ-0022

Expected Result
ACK300 and check that the file template is the correct one in SA

Actual Result
Got the ACK300.

Step 12 Step Execution Status: **Pass**

Description
Change the name of the template to a non valid template and repeat the loading of the template. LTS-966-REQ-0022

Expected Result
We should get an error ERR-312

Actual Result
We got Err-312.

Step 13 Step Execution Status: **Pass**

Description

Set up the randomization to false (SET_RANDOMIZE_POINTS 0). LTS-966-REQ-0014
SET_NUM_ITERATIONS: The number of iterations is set to 1. LTS-966-REQ-0013
SET_NUM_SAMPLES:<i>. The number of sample is set to 1 LTS-966-REQ-0017

Measure the position of M1M3 (CMD M1M3). LTS-966-REQ-0039
Then ask POS M1M3 as well as the offsets. (These 2 should be equal)

Check that POS * OFFSET = ID

Expected Result

We should get an acknowledgment (ACK300) and when the measurement is done we will get the position with he following format:
POS: <s>;X:**<n>**;Y:**<n>**;Z:**<n>**;Rx:**<n>**;Ry:**<n>**;Rz:**<n>;<date>**
OFFSET: <s>;dX:**<n>**;dY:**<n>**;dZ:**<n>**;dRx:**<n>**;dRy:**<n>**;dRz:**<n>;<date>**

Actual Result

Got ACK300.
Measurement done.
Position and offset showed.

Step 14 Step Execution Status: **Fail**

Description

Use CMD with an unknown name and check the error received. LTS-966-REQ-0039

Expected Result

The error should be 305 or 300?

Actual Result

T2SA received the command. But, we did not get any error returned.

Issues found executing this step:

- LVV-19988 T2SA CMD Verification

Step 15 Step Execution Status: **Pass**

Description

Change the number of the iterations using SET_NUM_ITERATIONS 5 for instance and repeat the M1M3 measurement. LTS-966-REQ-0013

Expected Result

ACK300 and ensure that each points were measured 5 times. At the end we should get the absolute position of M1M3.

Actual Result

We got ACK300 . Each points were measured 5 times. Got the absolute position of M1M3.

Step 16 Step Execution Status: **Pass**

Description

Check the error 322. One option is to send a negative value or not an integer to SET_NUM_ITERATIONS. LTS-966-REQ-0013

Expected Result

error 322 is triggered

Actual Result

We got Err-322.

Step 17 Step Execution Status: **Pass**

Description

Change the number of samples to 3 using SET_NUM_SAMPLES 3 leaving the iterations are set to 5. LTS-966-REQ-0017

Expected Result

ACK300 and ensure that the points are measured 15 times.

Actual Result

We got ACK300. The points were measured 9 times as expected.

Step 18 Step Execution Status: **Pass**

Description

Check the error 321. One option is to send a negative value or not an integer to SET_NUM_SAMPLES. LTS-966-REQ-0017

Expected Result

error 321 is triggered

Actual Result

We got Err-321.

Step 19 Step Execution Status: **Pass**

Description

Same exercise for the randomization. SET_RANDOMIZE_POINTS to TRUE and repeat the measurement of M1M3. LTS-966-REQ-0014

Expected Result

ACK300 and verify that the order of the measurements is random and different from the previous step.

Actual Result

We got ACK300. Measurements were random from the previous step.

Step 20 Step Execution Status: **Pass**

Description

Check error 302 by giving the value 0 to it. LTS-966-REQ-0014

Expected Result
trigger check error 302

Actual Result
We got Err-302 for string value.

Step 21 Step Execution Status: **Not Executed**

Description
Repeat the measurement of M1M3 and halt the measurement using HALT. **:** LTS-966-REQ-0016
Then check status using the command 'STAT'

Expected Result
ACK300 and the measurement should stop and the status STAT should be READY.
Err 330????

Actual Result
Because we used a Jupyter notebook for this test, we were only able to send commands in series. Therefore, we were unable to send a HALT command before the measurement was finished.

Step 22 Step Execution Status: **Not Executed**

Description
Trigger of error 319:
Use the command 'HALT' when the tracker is not measuring. LTS-966-REQ-0016

Expected Result
Error 319

Actual Result
Because we used a Jupyter notebook for this test, we were only able to send commands in series. Therefore, we were unable to provoke ERR-319 using the HALT command.

Step 23 Step Execution Status: **Pass**

Description
Proceed to a reset using the command RESET_T2SA. LTS-966-REQ-0032
Then ask the status STAT.

Expected Result

ACK 300 and the system is reset. At the end of the process the status of the system should be READY.

Actual Result

We got ACK 300. We got the status “READY” at the end of the process.

Step 24 Step Execution Status: **Not Executed**

Description

Trigger 318: Proceed to a reset while T2SA is measuring?
LTS-966-REQ-0032

Expected Result

The T2SA does not trigger ERR-318

Actual Result

Because we used a Jupyter notebook for this test, we were only able to send commands in series. Therefore, we were unable to provoke ERR-318.

Step 25 Step Execution Status: **Not Executed**

Description

Move the laser and send the command NEW_STATION. Verify in SA that the new station was added and repeat a measurement of M1M3. LTS-966-REQ-0033
Also test the error 329 by covering reflectors?

Expected Result

The new station should appear in SA and the measurement of M1M3 should give the new position

Actual Result

Due to the lack of personnel support to safely re-configure the testing set up, this step was skipped.

Step 26 Step Execution Status: **Fail**

Description

Using the command “LST 0” Turn the laser off
Use LSTA to check that the laser is off

Expected Result
ACK 300 and LOFF

Actual Result
We got ACK300. Reported the status as LNC instead of LOFF.

Issues found executing this step:

- LVV-19989 Failed “LST 0” Command

5.1.3.5 LVV-T1815 - Check Procedures Testing

Version **1**. Open *LVV-T1815* test case in Jira.

The objective of this test case will be to verify the following commands:

- 2FACE
- ADM
- DRIFT

Preconditions:

Execution status: **Pass**

Final comment:
The results of this test execution were captured during the continuation of the tests in July 2021 after the laser tracker was reconfigured with a 45 degree tilt.

Detailed steps results:

Step 1 Step Execution Status: **Pass**

Description

Execute a 2 Face check using the following command: 2FACE_CHECK with the point group. LTS-966-REQ-0028
Check the status using STAT

Expected Result

There should be an acknowledgment if the check passed the tolerance ACK 300.
The status while doing the check should be 2Face check

Actual Result

We got ACK300 and the status 2 Face Check.

Step 2 Step Execution Status: **Pass**

Description

Change the tolerance setting for the 2 face check using SET_2FACE_TOL. LTS-966-REQ-0030
First set it up to a value outside the bounds (??) and check that we get an error.
Then set it up to a tolerance that will trigger an out of tolerance value
Repeat the 2Face check with this tolerance configuration

Expected Result

When the value set is out of tolerance, we should get the error 309
Then when we set the value inside the bound we should get ACK300. The return from the test should be 303.

Actual Result

For Tolerance, we got Err-303. Need to change the test description.

Step 3 Step Execution Status: **Pass**

Description

SET_DRIFT_TOL to 0.1 and check that the value that is in T2SA is 0.1. LTS-966-REQ-0034
Then measure the drift using the MEAS_DRIFT command. LTS-966-REQ-0026

Expected Result

The drift test should start and if the drift test passes the return should be 300.

Actual Result

Drift test passed. We got ACK300.

Step 4 Step Execution Status: **Pass**

Description

Set the tolerance to a small value (0.01?) and rerun the test. The value should be small enough to make the drift test fail.

Expected Result

error 305 or 310 should be triggered

Actual Result

We got Err-304 as expected.

Step 5 Step Execution Status: **Not Executed**

Description

Run through the ADM (Command?)
Check the status during the test: STAT

Expected Result

Result from Status: ADM

Actual Result

This step was not executed because the ADM as a command has since been descoped

5.1.3.6 LVV-T2181 - Testing of the T2SA with the laser tracker at 45degrees

Version **1**. Open *LVV-T2181* test case in Jira.

The objective of this test case is to re-verify some of the steps that were initially done as part of the FAT testing in March 2020 but with the laser tracker tilted at 45deg.

Preconditions:

Execution status: **Blocked**

Final comment:
As mentioned by the objective, this test case is meant to redo some of the original testing that was done when the laser tracker was set up horizontally. Specifically, the *Position Measurement of M1M3, M2 and the camera* test case and the *Motion tests* test case have been called to test and will be repeated with the laser tracker tilted at 45deg.

Issues found during the execution of LVV-T2181 test case:

- LVV-19978 Update T2SA Test Steps

Detailed steps results:

Step 1 Step Execution Status: **Pass**

Description
To start a measurement, one needs to set the reference group of point using the command SET_REFERENCE_GROUP. LTS-966-REQ-0015
Start without specifying a group name to trigger the error

Expected Result
Error 313 should be triggered

Actual Result
Expected error should be Err-306(which we got).

Step 2 Step Execution Status: **Pass**

Description
Repeat the step above with a valid group name. LTS-966-REQ-0015

Expected Result
Verify in SA that the group name is the correct one

Actual Result
We got ACK300.

Step 3 Step Execution Status: **Pass**

Description
Next, one needs to set the working frame using SET_WORKING_FRAME. Start without specifying a group name to trigger the error LTS-966-REQ-0018

Expected Result
Error 314 should be triggered

Actual Result
We got Err-314.

Step 4 Step Execution Status: **Pass**

Description
Repeat the test from above giving a working frame with the right format

Expected Result
Verify in SA that the working frame is the correct one. ACK 300

Actual Result
We got ACK300.

Step 5 Step Execution Status: **Not Executed**

Description
Use the command SET_STATION_LOCK with true and check that the laser is still locked on a SMR even when we move them LTS-966-REQ-0020

Expected Result
The laser should follow the target

Actual Result
There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was

skipped because the expected result is unrelated to what the step specifies.

Step 6 Step Execution Status: **Not Executed**

Description

Check of error 331, fail to lock station ?

Expected Result

There is no error as a result of the SET_STATION_LOCK command.

Actual Result

There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected result is unrelated to what the step specifies.

Step 7 Step Execution Status: **Not Executed**

Description

Repeat the step above with false and verify that the laser does not follow the SMR when it's being moved. LTS-966-REQ-0020.

Expected Result

The laser should not follow the target

Actual Result

There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected result is unrelated to what the step specifies.

Step 8 Step Execution Status: **Not Executed**

Description

Trigger error 317? LTS-966-REQ-0020

Expected Result
There is no error as a result of the SET_STATION_LOCK command.

Actual Result
There is a misunderstanding of what the SET_STATION_LOCK command is expected to do. This test step was skipped because the expected result is unrelated to what the step specifies.

Step 9 Step Execution Status: **Pass**

Description
Set the tolerance of the measurement. SET_LS_TOL:<n;n>. LTS-966-REQ-0021
That will allow to define if we need to go in another set of measurements.
1) Give a value greater than 0.1mm to trigger the error
2) Give s=0.01mm and verify that this is the right value

Expected Result
1) error 311 is triggered
2) ACK 300 and the right value is in T2SA

Actual Result
rms_tol = 0.01, max_tol = 0.02
We got Error 311 in response to asking for measurement, but not for setting tolerance.
We got ACK300.

Step 10 Step Execution Status: **Pass**

Description
Before measuring the positions, the alignment system publishes the alt,Az and rot using the command PUBLISH_ALT_AZ_ROT. LTS-966-REQ-0031

Repeat the measurement with the camera.
For this step Alt = 0, Az = 0 and rot = 0

Expected Result
ACK 300 and verify that T2SA has all 3 values correct.
The alignment controller should receive the position of the Camera with the following format relative to M1M3:

<s>;X:<n>;Y:<n>;Z:<n>;Rx:<n>;Ry:<n>;Rz:<n>;<date>

Actual Result

We got ACK300 and Position of the camera with proper format.

Step 11 Step Execution Status: **Pass**

Description

Measure the position of the M1M3 targets using the command CMD M1M3

1) POS<s, s, s>. LTS-966-REQ-0009

2) OFFSET <s;s;s; s;s;s;>. LTS-966-REQ-0010

Repeat for M2 and the camera

Expected Result

The alignment controller should receive the position of the M2 with the following format relative to M1M3:

<s>;X:**<n>**;Y:**<n>**;Z:**<n>**;Rx:**<n>**;Ry:**<n>**;Rz:**<n>;<date>**

or the offset OFFSET (<s>;dX:<n>;dY:<n>;dZ:<n>;dRx:<n>;dRy:<n>;dRz:<n>;<date>)

Same for the camera

Actual Result

We got ACK300. We got position and offset values for all three targets.

Step 12 Step Execution Status: **Initial Pass**

Description

Block an SMR and repeat the test above.

Clear the error before continuing.

Expected Result

The measurement should fail and give the err-305.

Actual Result

It was initially seen from the *Position Measurement of M1M3, M2 and the camera* test done in March 2020 that using

three total SMR's for this test impacted our ability to verify the error code. However, the vendor introduced a workaround in the code to allow for us to verify that an error could be provoked using only three SMR's. As a result, we received ERR-326 "Fail Least Squares Best Fit". Although this was not the expected result, this step was still seen as an initial pass because this is the expected error when the laser tracker can only detect 2 total SMR's. The laser tracker expects to detect a total of 12 total SMR's so ERR-305 would only be given when there are 11 SMR's detected

---

Step 13 Step Execution Status: **Pass**

Description

Send the command PUBLISH_ALT_AZ_ROT with no argument
LTS-966-REQ-0031

Expected Result

Check that we get the error 320

Actual Result

We got Err-320 as expected.

Step 14 Step Execution Status: **Pass**

Description

Generate the report.
After finishing up the testing, we want to generate a report by issuing the command GEN_REPORT with the report name.
LTS-966-REQ-0023

Expected Result

The report exists.

Actual Result

the report exists (in spatial analyzer under the Reports collection)

Step 15 Step Execution Status: **Blocked**

Description

Check the error when trying to generate the report by using a template name that does not exist.
Then clear the error

LTS-966-REQ-0023

Expected Result

Err-308
Then clear error and check that the system is READY

Actual Result

At the time of the test, it wasn't clear how the GEN_REPORT command was supposed to be used. It was assumed that the test was to generate a report without initially specifying a name and so this step was skipped because the T2SA automatically generates a name for any report missing one. This step will need to be revised so that it is clear we are testing that trying to specify an incorrect report name will result in the expected error.

Issues found executing this step:

- LVV-19978 Update T2SA Test Steps

Step 16 Step Execution Status: **Pass**

Description

Save the settings by using the command SAVE_SETTINGS. LTS-966-REQ-0046

Error?

Expected Result

The settings should be the latest ones.

Actual Result

Saved settings.

Step 17 Step Execution Status: **Pass**

Description

Save the job using the SAVE_SA_JOBFILE using both
1) the default (meaning sending no argument) and
2) a valid filename.
Verify that the job is saved with proper name

Send also a non valid filename and check that we get the error 316
LTS-966-REQ-0035

Expected Result
The jobs are saved unless the filename is incorrect in which case we would get the error 316.

Actual Result
We got Err-316. Got ACK300 for valine filename.

Step 18 Step Execution Status: **Pass**

Description
Testing of the command SET_MEAS_INDEX to 4. LTS-966-REQ-0043
Then repeat the SAVE_SA_JOBFILE.

Expected Result
The index is set to 4.

Actual Result
We got ACK300. Index set to 4.
Saved the job file.

Step 19 Step Execution Status: **Pass**

Description
Is there an error for SET_MEAS_INDEX?
LTS-966-REQ-0043

Expected Result
The command results in either ACK300 or ERR-333.

Actual Result
Got Error 333 for string . But. it accepts negative number.

Step 20 Step Execution Status: **Pass**

Description

Testing of the command INC_MEAS_INDEX. LTS-966-REQ-0027

Expected Result

The increment is set and returns ACK300.

Actual Result

ACK300. Increment worked.

Step 21 Step Execution Status: **Pass**

Description

Check the command SET_POWER_LOCK: 0 or 1
LTS-966-REQ-0045

Expected Result

The tracker's camera is able to be enabled and disabled, returning ACK300.

Actual Result

We got ACK300. Off and On worked fine.

Step 22 Step Execution Status: **Pass**

Description

Make a first measurement to get the baseline of the M2 and the Camera position relative to M1M3

Expected Result

The position of the camera in reference to the camera frame is captured.

Actual Result

We got ACK 300 and EMP.

Step 23 Step Execution Status: **Pass**

Description

Move the structure in y axis by about 10mm if possible.

Then take the same measurement and record the position. If there is a ruler available, compare the motion measured with the actual motion.
** Then try and bring it back to nominal by moving it back by half of the value that was measured.
Take another measurement **

Repeat ** ** until we're in within 1mm.

~5 revolutions is about 1 inch

Expected Result
The measurements are taken and are within 1mm as expected.

Actual Result
We took an initial measurement using the telescope to verify y = 0mm. Then we moved the structure to about 10mm using the SA and took another measurement with the telescope. Using the telescope we confirmed y = 10.05mm. Then again using the values displayed on the SA, we moved the height of the structure to what was about 5mm. Using the telescope we confirmed y = 4.995mm. Finally, we moved the structure back to its initial position and confirmed using the telescope y = 0mm.

Step 24 Step Execution Status: **Pass**

Description
Move the structure in z axis by less than a 10mm if possible.
Then take the same measurement and record the position.
** Then try and bring it back to nominal by moving it back by half of the value that was measured.
Take another measurement **

Repeat ** ** until we're in within 1mm.

[There is a dial indicator allowing to move the cart by +/- 0.5 inches. Note that we need to keep track of the number of revolution of the arrow as each revolution is ~0.050 inches
.6 inches on the way toward us (12 revolution)
.4 inches on the way back]

Expected Result
The measurements are taken and are within 1mm as expected.

Actual Result
We initially moved the structure and measured the change to be 38mm using the telescope. Using the live measurement values displayed by SA, we moved the structure back about halfway. The SA showed that the structure was now about 14mm, which we confirmed to be the same as reported by the telescope. We moved it back to the 0mm position again using the SA and confirmed the z was around 0.26mm using the telescope.

Step 25 Step Execution Status: **Pass**

Description
Rotate the structure along the y axis and take a measurement.
** Then try and bring it back to nominal by moving it back by half of the value that was measured.
Take another measurement **

Repeat ** ** until we're in within 1mm.

Expected Result
The measurements are taken and are within 1mm as expected.

Actual Result
WE were able to measure and query and got the expected results, first rotating about 11 degrees, then 5.9, then back to within .16 deg of the original position

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Step 26 Step Execution Status: **Pass**

Description
For the rotation along the z axis, we will simulate the rotation by swapping Target 1 to Target 2, Target 2 to Target 3 and Target 3 to Target 1 using the software.

Then the rotation value sent toT2SA from the ASC would be 120.
Measure the position and verify that the targets in SA have indeed moved by 120.

Expected Result
The measurements are taken and the targets have moved by 120 as expected.

Actual Result

We're simulating camera rotation here without actually altering anything in the test setup, counter-rotating the expected position in the SA manually so that we can measure a 120 degree rotation without actually moving things around. WE also simulated a scenario where the camera rotator is miscalibrated and we query the camera offsets to measure the error

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Step 27 Step Execution Status: **Pass**

Description

Send the command PUBLISH_ALT_AZ_ROT with ROT = 5deg
and repeat the test on the camera

Expected Result

The command is accepted and the tracker locates the position of the SMRs.

Actual Result

We got ACK300. When the tracker attempts to measure the test camera SMRS, we can see it first seeking the 5 degree rotated point, before finding the real SMR location (since our test rig does not actually rotate).

A Documentation

The verification process is defined in LSE-160. The use of Docsteady to format Jira information in various test and planing documents is described in DMTN-140 and practical commands are given in DMTN-178.

B Acronyms used in this document

Acronym	Description
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
CSC	Commandable SAL Component
DM	Data Management
DMTN	DM Technical Note
IP	Internet Protocol
LSE	LSST Systems Engineering (Document Handle)
LSST	Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope)
LTS	LSST Telescope and Site (Document Handle)
LVV	LSST Verification and Validation
M1M3	Primary Mirror Tertiary Mirror
M2	Secondary Mirror
PDU	Power Distribution Unit
PMCS	Project Management Controls System
RMS	Root-Mean-Square
SAL	Service Abstraction Layer
SO	scientific operations
T&S	Telescope and Site
TCP	Transmission Control Protocol
TS	Test Specification
deg	degree; unit of angle