The Consultative Committee for Space Data Systems

ATTITUDE DATA MESSAGE TEST PLAN/REPORT

CCSDS RECORD

CCSDS 504.2-Y-1

YELLOW BOOK

October 2022

FOREWORD

This document records the plans for prototype testing and results of that testing for the Conjunction Data Message, CCSDS 508.0-R-1, Red Book. As a record of prototype testing, it is expected that expansion, deletion, or modification of this document will **not** occur. This document is subject to CCSDS document management and change control procedures, which are defined in the *Organization and Processes for the Consultative Committee for Space Data Systems*. Current versions of CCSDS documents are maintained at the CCSDS Web site:

http://www.ccsds.org/

Questions relating to the contents or status of this document should be addressed to the CCSDS Secretariat at the address indicated on page i.

At time of publication, the active Member and Observer Agencies of the CCSDS were:

Member Agencies

- Agenzia Spaziale Italiana (ASI)/Italy.
- British National Space Centre (BNSC)/United Kingdom.
- Canadian Space Agency (CSA)/Canada.
- Centre National d'Etudes Spatiales (CNES)/France.
- China National Space Administration (CNSA)/People's Republic of China.
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR)/Germany.
- European Space Agency (ESA)/Europe.
- Federal Space Agency (FSA)/Russian Federation.
- Instituto Nacional de Pesquisas Espaciais (INPE)/Brazil.
- Japan Aerospace Exploration Agency (JAXA)/Japan.
- National Aeronautics and Space Administration (NASA)/USA.

Observer Agencies

- Austrian Space Agency (ASA)/Austria.
- Belgian Federal Science Policy Office (BFSPO)/Belgium.
- Central Research Institute of Machine Building (TsNIIMash)/Russian Federation.
- Centro Tecnico Aeroespacial (CTA)/Brazil.
- Chinese Academy of Sciences (CAS)/China.
- Chinese Academy of Space Technology (CAST)/China.
- Commonwealth Scientific and Industrial Research Organization (CSIRO)/Australia.
- Danish National Space Center (DNSC)/Denmark.
- European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)/Europe.
- European Telecommunications Satellite Organization (EUTELSAT)/Europe.
- Hellenic National Space Committee (HNSC)/Greece.
- Indian Space Research Organization (ISRO)/India.
- Institute of Space Research (IKI)/Russian Federation.
- KFKI Research Institute for Particle & Nuclear Physics (KFKI)/Hungary.
- Korea Aerospace Research Institute (KARI)/Korea.
- MIKOMTEK: CSIR (CSIR)/Republic of South Africa.
- Ministry of Communications (MOC)/Israel.
- National Institute of Information and Communications Technology (NICT)/Japan.
- National Oceanic and Atmospheric Administration (NOAA)/USA.
- National Space Organization (NSPO)/Chinese Taipei.
- Naval Center for Space Technology (NCST)/USA.
- Space and Upper Atmosphere Research Commission (SUPARCO)/Pakistan.
- Swedish Space Corporation (SSC)/Sweden.
- United States Geological Survey (USGS)/USA.

DOCUMENT CONTROL

Document	Title and Issue	Date	Status
CCSDS 508.1-Y-1	Attitude Data Message Test/Plan Report, CCSDS Record, Issue 1	Apr 2013	Initial Issue

CONTENTS

Section Page

1 **INTRODUCTION** **1-1**
1.1 PURPOSE 1-1
1.2 SCOPE 1-1
1.3 APPLICABILITY 1-1
1.4 RATIONALE 1-1
1.5 DOCUMENT STRUCTURE 1-2
1.6 REFERENCES 1-2
2 **SUMMARY CONCLUSION/RECOMMENDATION** **2-1**
3 **ATTITUDE DATA MESSAGES (ADM) TESTING GOALS** **3-1**
3.1 APM OVERVIEW 3-1
3.2 AEM OVERVIEW 3-1
3.3 ACM OVERVIEW 3-1
4 **TEST PLAN OVERVIEW** **4-1**
4.1 TESTING PHILOSOPHY 4-1
4.2 APM 4-1
4.3 AEM 4-3
4.4 ACM 4-4
5 **TEST PLAN DETAILS** **5-1**
5.1 TEST CASE APM#1: SPIN DATA UNIT TEST 5-1
5.1.1 TEST DESCRIPTION 5-1
5.1.2 EXPECTED RESULTS 5-1
5.2 TEST CASE APM#2: FULL MESSAGE 5-1
5.2.1 TEST DESCRIPTION 5-1
5.2.2 EXPECTED RESULTS 5-1
5.3 TEST CASE AEM#1: EULER ANGLE + DERIVATIVES UNIT TEST 5-1
5.3.1 TEST DESCRIPTION 5-1
5.3.2 EXPECTED RESULTS 5-2
5.4 TEST CASE AEM#2: COMPLEX MESSAGE 5-2
5.4.1 TEST DESCRIPTION 5-2
5.4.2 EXPECTED RESULTS 5-2
5.5 TEST CASE ACM#1: ACM ATTITUDE DATA UNIT TEST 5-2
5.5.1 TEST DESCRIPTION 5-2
5.5.2 EXPECTED RESULTS 5-2
5.6 TEST CASE ACM#2: ACM PHYSICAL CHARACTERISTICS UNIT TEST 5-3
5.6.1 TEST DESCRIPTION 5-3
5.6.2 EXPECTED RESULTS 5-3
5.7 TEST CASE ACM#3: COVARIANCE DATA UNIT TEST 5-3
5.7.1 TEST DESCRIPTION 5-3
5.7.2 EXPECTED RESULTS 5-3
5.8 TEST CASE ACM#4: MANEUVER DATA UNIT TEST 5-3
5.8.1 TEST DESCRIPTION 5-3
5.8.2 EXPECTED RESULTS 5-3

5.9 TEST CASE ACM#5: ATTITUDE DETERMINATION DATA UNIT TEST 5-4
5.9.1 TEST DESCRIPTION 5-4
5.9.2 EXPECTED RESULTS 5-4
5.10 TEST CASE ACM#6: USER-DEFINED PARAMETERS UNIT TEST 5-4
5.10.1 TEST DESCRIPTION 5-4
5.10.2 EXPECTED RESULTS 5-4
5.11 TEST CASE ACM#7: FULL MESSAGE 5-4
5.11.1 TEST DESCRIPTION 5-4
5.11.2 EXPECTED RESULTS 5-4
6 **TEST REPORT OVERVIEW 6-1**
7 **TEST REPORT DETAILS 7-1**
7.1 TEST CASE APM#1 7-1
7.2 TEST CASE APM#2 7-1
7.3 TEST CASE AEM#1 7-1
7.4 TEST CASE AEM#2 7-1
7.5 TEST CASE ACM#1 7-1
7.6 TEST CASE ACM#2 7-1
7.7 TEST CASE ACM#3 7-1
7.8 TEST CASE ACM#4 7-1
7.9 TEST CASE ACM#5 7-1
7.10 TEST CASE ACM#6 7-1
7.11 TEST CASE ACM#7 7-1

1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the prototype testing conducted on the CCSDS Attitude Data Messages (ADM), CCSDS 504x0p2.0.docx (reference [3]). An initial draft of this plan was prepared by the members of the CCSDS Navigation Working Group at the CCSDS Spring 2022 meetings conducted on-line.

1.2 SCOPE

The scope of this document is testing of the Attitude Data Messages version 2. The ADM is part of the technical program of the CCSDS Navigation Working Group. Document 504x0p2.0 is an update to the existing CCSDS/ISO Standard Attitude Data Messages CCSDS 504.0-B-1 (reference [2]). ADM document CCSDS 504x0p2.0 completed a joint CCSDS Agency Review; the process is described in reference [1]. In applicable places the prototyping includes results based on modifications to the reference [3] provided via the Review Item Discrepancy (RID) process described in reference [1].

1.3 APPLICABILITY

The ADM describes standard formats for the interagency exchange of data required for spacecraft tracking and navigation (specifically, attitude parameters and attitude ephemeris). There are three distinct message types that make up the Attitude Data Messages. These are:

– Attitude Parameter Message (APM)

– Attitude Ephemeris Message (AEM)

– Attitude Comprehensive Message (ACM)

This document applies to the prototype testing required to advance the ADM version 2 and its three constituent messages from Red Book to Blue Book status.

In its new revision, the ADM now includes an additional message type, the Attitude Comprehensive Message or ACM. The APM and AEM are still present but have slightly changed. Testing of the APM, AEM will be adapted to the changes made.

1.4 RATIONALE

The CCSDS Procedures Manual states that for a Recommendation to become a Blue Book, the standard must be tested in an operational manner. The following requirements for an implementation exercise were excerpted from reference [1]:

> "At least two independent and interoperable prototypes or implementations must have been developed and demonstrated in an operationally relevant environment, either real or simulated."

This document outlines the Navigation Working Group's approach to meeting this requirement for the ADM 504.0-P-2.0.

1.5 DOCUMENT STRUCTURE

The first sections of this document describe the Test Plan for the prototyping activity; the last sections of the document provide a Test Report of the realized plan. Acronyms are provided in Annex A.

1.6 REFERENCES

The following documents are referenced in this document. At the time of publication, the editions indicated were valid. All documents are subject to revision, and users of this document are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below. The CCSDS Secretariat maintains a register of currently valid CCSDS documents.

[1] *Procedures Manual for the Consultative Committee for Space Data Systems*. CCSDS A00.0-Y-9. Yellow Book. Issue 9. Washington, D.C.: CCSDS, November 2003.

[2] *Attitude Data Messages*. Recommendation for Space Data System Standards, CCSDS 504.0-B-1. Blue Book. Issue 1. Washington, D.C.: CCSDS, September 2004.

[3] *Attitude Data Messages*. Draft Recommendation for Space Data System Standards, CCSDS 504-P-2.0 Pink Book. Issue 1.1. Washington, D.C.: CCSDS, May 2022.

2 SUMMARY CONCLUSION/RECOMMENDATION

The test plan and test reports documented herein substantiate that the organizations participating in the CCSDS Navigation Working Group have successfully conducted prototype testing of the Attitude Parameter Message, Attitude Ephemeris Message and Attitude Comprehensive Message described in the Attitude Data Messages (ADM) 504x0p2.0 document. During the testing, messages of the various types were produced by several different organizations, and the ability to read/process the messages was demonstrated. Based on the diversity of agencies able to read/write the messages, and the positive test results, the Navigation Working Group recommends that the revised 504x0p2.0 document be promoted to a Blue Book CCSDS Recommended Standard.

3 ATTITUDE DATA MESSAGES (ADM) TESTING GOALS

The test of the ADM will exercise the following three message types that together constitute the Attitude Data Messages:

- Attitude Parameter Message (updated from version 1 (reference [2]))
- Attitude Ephemeris Message (updated from version 1 (reference [2]))
- Attitude Comprehensive Message (new in version 2 (reference [3]))

The tests described in Section 5 and Section 6 of this plan will be conducted in order to meet the CCSDS requirements described in Section 2. In Section 7 and Section 8, the results of the testing are presented.

3.1 APM OVERVIEW

The APM is an ASCII file in "keyword=value" format. An XML format is also available. It contains a single state vector that must be propagated by the recipient. The file is organized into 3 sections: the Header section, Metadata section, and the Data section. The Header section contains identification information (version, creation date, originator). The Metadata section contains information regarding the object to which the state vector applies, applicable reference frame and time system. The Data section contains the attitude state in quaternion or Euler form, or other quantities as required (angular momentum vector, physical characteristics, spin). There is also an optional section that can contain user defined parameters.

3.2 AEM OVERVIEW

The AEM is an ASCII file in a hybrid "keyword=value" format (header and metadata are keyword=value, data lines have a positional field layout). An XML format is also available. The AEM contains attitude state vectors for an object at multiple points in time. The file is organized into 3 sections: the Header section, Metadata section, and the Data section. The Header section contains identification information (version, creation date, originator). The Metadata section contains information regarding the object to which the attitude applies, applicable reference frame, time system, interpolation parameters, and data start/stop times. The Data section contains the attitude state vector components at each epoch, plus additional derivatives or angular momentum coordinates. The recipient must interpolate to obtain arbitrary states between ephemeris points.

3.3 ACM OVERVIEW

The ACM is an ASCII file in a hybrid "keyword=value" format (header and metadata are keyword=value, data lines have a positional field layout). An XML format is also available. The ACM is comprehensive, in allowing users to exchange attitude, uncertainty data, maneuver, and many others. The file is organized into six distinct sections, as shown in the

table below (excerpted from Table 5-1 of the draft standard: the Header section, Metadata section, and the Data section with its six subsections as listed.

The Header section contains identification information (version, creation date, originator). The Metadata section contains information regarding the object to which the attitude applies, applicable reference frame, time system, interpolation parameters, and data start/stop times. The Data Section contains attitude and covariance time histories, as well as detailed specificity of physical properties, maneuver data, attitude determination data, and user parameters.

Table 3-1 ACM Layout and Ordering Specification

Section			Content	Status M/O
Header			A single header of the message	M
Metadata			A single Metadata section (data about data)	M
Data	attitude data #1	data description	One or more attitude state time histories (each consisting of one or more attitude states)	O
		data lines		
	⋮			
	attitude data #n	data description		
		data lines		
	physical properties		A single space object physical characteristics section	O
	covariance data #1	data description	One or more covariance time histories (each consisting of one or more covariance matrix diagonals)	O
		data lines		
	⋮			
	covariance data #n	data description		
		data lines		
	maneuver data #1		One or more maneuver specification sections	O
	⋮			
	maneuver data #n			
	attitude determination data		A single attitude determination Data section	O
	user-defined data		A single user-defined Data section	O

4 TEST PLAN OVERVIEW

4.1 TESTING PHILOSOPHY

The prototyping of the ADM is designed to be consistent with the changes made between ADM versions 1 and 2.

The tests described in the next sections are data oriented (not format oriented). The messages that are exchanged can be either XML or KVN messages.

Classically, all prototypes of the APM, AEM, ACM use KVN syntax. The messages are also converted to XML (back and forth) to check the consistency between XML and KVN formats.

4.2 APM

The APM version 1 has already been proved to be useable in an operational context. So the APM – version 2 is also useable in an operational context if the data present in the message are the same, or if it can be shown that the data in a version 1 message can be converted into data in a version 2 message.

Here is a close examination of the changes between version 1 and 2, and the subsequent need for testing.

Differences between versions 1 and 2	**Specific test needed ? (and justification)**
Header MESSAGE_ID added (optional)	No Additional information (MESSAGE_ID) is present, but it is not essential for attitude processing
MetaData No change	No
Quaternion Data Format change: QUAT_START / QUAT_STOP added in version 2. Direction: in version 2, the direction is implicitly from A to B.	No: the data are the same. Frame A and B have to be swapped in version2 if the direction is B2A in version 1.
Euler Data Format change: EULER_START / STOP added in version 2.	No: the data are the same. The data from a version 1 message should be sent as 2 blocks in version 2 if rates are present.

Direction: in version 2, the direction is implicitly from A to B. Rotation sequence: format change Angle names: format change Rates are not provided in Euler blocks in version 2.	Rates should now be provided in a specific "ANGVEL" bloc Rotation sequence 123 is written XYZ in version 2. X_ANGLE is now written ANGLE_1
Spin Data In version 2, the direction is implicitly from A to B. The version 1 spin block is still present in version 2. An alternative form has been added.	Partly Test of the additional features needed.
Inertia Block	No (no change)
Maneuver block Delta_mass added.	No as delta mass was not needed in version 1.

The following tests are then proposed:

Test #	Purpose	Agencies, Direction	Msg Type
APM#1	Spin Data test Test of the new features	X => Y => X	APM
APM#2	Full message (in particular for KVN-XML format consistency check)	X => Y => X	APM
~~APM#3 TBC~~	~~Show equivalence between version 1 and version 2 messages for quaternion and euler angles.~~	~~X => Y => X~~	~~APM~~

Note: all the tests include KVN <-> XML conversion.

4.3 AEM

The AEM version 1 has already been proved to be useable in an operational context. So the AEM – version 2 is also useable in an operational context if the data present in the message are the same, or if it can be shown that the data in a version 1 message can be converted into data in a version 2 message.

Here is a close examination of the changes between version 1 and 2, and the subsequent need for testing.

Differences between versions 1 and 2	**Specific test needed ? (and justification)**
Header MESSAGE_ID added (optional)	No Additional information (MESSAGE_ID) is present, but it is not essential for attitude processing.
MetaData QUATERNION_TYPE: removed in version 2 as the order is imposed (Q1, Q2, Q3, QC ⇔ "LAST"). EULER_ROT_SEQ: format change in version 2 (as in APM) ATTITUDE_DIR removed in version 2: the direction is A2B implicitly in version 2 (as in APM) RATE_FRAME: can be any frame in version 2, and not just REF_FRAME_A or REF_FRAME_B)	No: the information is the same QUATERNION_TYPE: elements should be reordered if it was "FIRST" in version 1. EULER_ROT_SEQ: value should be changed. Example "XYZ" instead of "123". ATTITUDE_DIR: swap A and B if the value is "B2A" in version 1. RATE_FRAME/ANGVEL_FRAME: possibilities in version 2 include those allowed in version 1
Data lines QUATERNION/RATE: now called QUATERNION/ANGVEL (same information) EULER_ANGLE/RATE: now called EULER_ANGLE/ANGVEL (same information) EULER_ANGLE/DERIVATIVE: new in version 2	Partly "EULER_ANGLE/DERIVATIVE" is a new type of line. "SPIN/NUTATION_MOM" is a new type of line.

SPIN/NUTATION_MOM: new in version 2	

The following tests are then proposed:

Test #	Purpose	Agencies, Direction	Msg Type
AEM#1	Euler angles / derivative test	X => Y=> X	AEM
AEM#2	Complex message (containing at least 2 blocks)	X => Y => X	AEM
~~AEM#3 TBC~~	~~Show equivalence between version 1 and version 2 messages for quaternion and Euler angles.~~	~~X => Y=> X~~	

Note: all the tests include KVN <-> XML conversion.

4.4 ACM

The ACM contains 6 different data blocks that are: Attitude State Time History, Space Object Physical Characteristics, Covariance Time History, Maneuver Specification, Attitude Determination Data, and User-Defined Parameters.

The testing strategy is inspired by what is done for the ODM V3 (OCM):

- 1 round-trip test for each data block (only one block in the message).

- 1 test with a full message.

Some of the tests will implement specific features:

- data lines with relative or absolute times

- values taken from SANA registry

The objectives of all these tests is to check that :

- the standard contains accurate descriptive information of the data contained in the message, and that the messages that are exchanged are compliant with the description,

- the data present in the message can be used effectively in a (real or simulated) operational context, and that, in particular, no important information is missing.

Here is a summary of the tests that are planned:

Attitude data	Physical	Covariance	Maneuver	Att determ.	User def.
①⑦~~⑧~~	②⑦	③⑦	④⑦	⑤⑦	⑥⑦

A summary of the tests is presented below:

Test #	**Purpose**	**Agencies, Direction**	**Msg Type**
ACM#1	Attitude states history	X => Y=> X	ACM
ACM#2	Physical data	X => Y => X	ACM
ACM#3	Covariance data	X => Y=> X	ACM
ACM#4	Maneuver	X => Y=> X	ACM
ACM#5	Attitude determination	X => Y=> X	ACM
ACM#6	User defined data	X => Y=> X	ACM
ACM#7	Full message	X => Y=> X	ACM
~~ACM#8 TBC~~	~~Message containing attitude data / some processing (or analysis)~~	~~X => Y(-> X)~~	~~ACM~~

Notes:

- All the tests include KVN <-> XML conversion.

5 TEST PLAN DETAILS

5.1 TEST CASE APM#1: SPIN DATA UNIT TEST

5.1.1 TEST DESCRIPTION

In this test, X will create an APM message for a spinning object and send it to Y. The message will contain the appropriate header information, as well as reference frame information, and spin data (containing angular momentum vector coordinates). Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.1.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the message and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.2 TEST CASE APM#2: FULL MESSAGE

5.2.1 TEST DESCRIPTION

In this test, X will create an APM message that contains all data blocks send it to Y. At least one type of block shall be present twice. The message will contain the appropriate header information, as well as reference frame information. Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.2.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the merged data blocks and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.3 TEST CASE AEM#1: EULER ANGLE + DERIVATIVES UNIT TEST

5.3.1 TEST DESCRIPTION

In this test, X will create an AEM message containing Euler angles and associated derivatives. The message will contain the appropriate header information, as well as reference frame information, and attitude data (Euler angles and derivatives). Y will ingest the message and will generate a quaternion ephemeris and send it back to X.

5.3.2 EXPECTED RESULTS

It is anticipated that the quaternion ephemeris determined by Y and sent to X will be consistent with the reference quaternion already computed by X. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test

5.4 TEST CASE AEM#2: COMPLEX MESSAGE

5.4.1 TEST DESCRIPTION

In this test, X will create an AEM message containing 2 data blocks. The message will contain the appropriate header information, as well as reference frame information, and the appropriate data. One type of data block shall be “Quaternion”, and the other type shall be “Euler angles”. Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.4.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the spacecraft attitude data and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.5 TEST CASE ACM#1: ACM ATTITUDE DATA UNIT TEST

5.5.1 TEST DESCRIPTION

For this test, X will send an ACM describing a sequence of spacecraft attitude states as a function of relative time to Y. In this simple case, a quaternion ephemeris will be shared. Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.5.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the attitude state time history and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.6 TEST CASE ACM#2: ACM PHYSICAL CHARACTERISTICS UNIT TEST

5.6.1 TEST DESCRIPTION

For this test, X will send an ACM describing space object physical characteristics to Y. In this simple case, an inertia matrix and drag characteristics will be shared. Y will ingest the message, write it back out and transmit the message back to Y for comparison and verification.

5.6.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the space object physical characteristics and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.7 TEST CASE ACM#3: COVARIANCE DATA UNIT TEST

5.7.1 TEST DESCRIPTION

For this test, X will send an ACM describing a sequence of spacecraft attitude covariances as a function of absolute time to Y. In this simple case, two covariance blocks will be included: (1) covariance containing quaternion errors; and (2) covariance containing angle and gyro bias errors. Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.7.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the sequence of spacecraft attitude and gyro bias covariances as a function of absolute time and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.8 TEST CASE ACM#4: MANEUVER DATA UNIT TEST

5.8.1 TEST DESCRIPTION

For this test, X will send an ACM describing space object attitude maneuvers to Y. In this simple case, a “target momentum” maneuver will be shared. X will ingest the message, write it back out and transmit the message back to Y for comparison and verification.

5.8.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the space object maneuvers and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.9 TEST CASE ACM#5: ATTITUDE DETERMINATION DATA UNIT TEST

5.9.1 TEST DESCRIPTION

For this test, X will send an ACM describing attitude determination characteristics and settings to Y. Y will ingest the message, write it back out and transmit the message back to X for comparison and verification..

5.9.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the attitude determination data and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.10 TEST CASE ACM#6: USER-DEFINED PARAMETERS UNIT TEST

5.10.1 TEST DESCRIPTION

For this test, X will send an ACM describing user-defined parameters to Y. In this simple case, additional satellite characteristics will be shared (thruster direction in body frame for 2 thrusters). Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.10.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the user-defined parameters and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

5.11 TEST CASE ACM#7: FULL MESSAGE

5.11.1 TEST DESCRIPTION

For this test, X will send an ACM containing the merged data blocks of all of the previous unit test content to Y. Y will ingest the message, write it back out and transmit the message back to X for comparison and verification.

5.11.2 EXPECTED RESULTS

It is anticipated that X and Y will successfully write and read the merged data blocks and that the round-trip consistency test will yield a match. Assuming that these criteria are met, the test will be considered successful. In the event of discrepancies, troubleshooting will be conducted by the participants in the test.

6 TEST REPORT OVERVIEW

Engineers at XXX will prepare test data sheets as applicable, and send them to the Navigation Working Group via email.

The Test Report Details will be consolidated in Section 8 of this document. A summarization of the test process and the recommendation of the Navigation Working Group may be found in Section 3 of the report. The report will be submitted to the CCSDS Engineering Steering Group (CESG) and CCSDS Management Council (CMC), along with results of the Agency Reviews. At that time, a formal request will be submitted to the CMC for progression of the ADM to CCSDS Blue Book status.

The next page contains a format for the test data sheets that will be used to report the results of individual tests. The form includes sections for the producer of the message and the consumer of the message (producing agency, producing test engineer, consuming agency, and consuming test engineer).

SAMPLE

Attitude Data Messages P1.1 Prototype Test Data Sheet

1	Report Date:	
2	Program Under Test:	Attitude Data Messages P2.0 (ADM) Prototype
3	Test Case Number:	
4	Agencies Participating in this Test Case:	
5	Agency Responsible for Producing Test Message	
6	Producing Test Engineer:	
7	Agency Responsible for Consuming Test Message	
8	Consuming Test Engineer:	
9	Spacecraft:	
10	Results (Pass, Partial Pass, Fail):	
11	Variances from Expected Result:	
12	Comments:	

7 TEST REPORT DETAILS

7.1 TEST CASE APM#1

7.2 TEST CASE APM#2

7.3 TEST CASE AEM#1

7.4 TEST CASE AEM#2

7.5 TEST CASE ACM#1

7.6 TEST CASE ACM#2

7.7 TEST CASE ACM#3

7.8 TEST CASE ACM#4

7.9 TEST CASE ACM#5

7.10 TEST CASE ACM#6

7.11 TEST CASE ACM#7

ANNEX A

ABBREVIATIONS AND ACRONYMS

(INFORMATIVE)

ASCII	American Standard Code for Information Interchange
CCSDS	Consultative Committee for Space Data Systems
CNES	Centre National d'Etudes Spatiales
DLR/GSOC	Deutsches Zentrum für Luft und Raumfahrt (German Aerospace Center)/German Space Operations Center
ESA/ESOC	European Space Agency/European Space Operations Center
ESA/ESAC	European Space Agency/European Space Astronomy Center
JAXA	Japan Aerospace Exploration Agency
KVN	Keyword = Value Notation
NASA/GSFC	National Aeronautics and Space Administration/Goddard Space Flight Center
NASA/JPL	National Aeronautics and Space Administration/Jet Propulsion Laboratory
NASA/JSC	National Aeronautics and Space Administration/Johnson Space Flight Center
NavWG	CCSDS Navagation Working Group
OCM	Orbital Conjunction Message
SANA	Space Assigned Numbers Authority
XML	Extensible Markup Language
XSLT	Extensible Stylesheet Language Transformations