| **Page** | **Section** | **Line** | **Type** | **Comment/ Rationale** | **Source of Comment (Name/Agency)** | **Suggested Disposition** | **Disposition****(Completed by Principal Editor)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1-2 | 1.4 |  |  | Add reference: Fundamentals of Spacecraft Attitude Determination and Control, authors: F. Landis Markley and John. L. Crassidis, Publisher: Springer, 2014 | J. Thienel/NASA | suggestion | Reference added |
| 5-4 | 5.2.3.2 |  |  | Define SPG4 and include a reference. | J. Thienel/NASA | suggestion | Done |
| 5-5 | 5.2.3.2 |  |  | Provide a reference for Draper Semianalytic Satellite Theory | J. Thienel/NASA | suggestion | Done |
| 5-6 | 5.2.5 |  |  | Add text describing an ephemeris as either definitive or predictive (or both) | J. Thienel/NASA | suggestion | Done |
| 5-8 | 5.3.4 | 27 |  | Change U (with overbar) to **u** for consistency. State that **u** is a unit vector.  | J. Thienel/NASA | fix | Done |
| 5-8 and 5-9 |  | 32 |  | Remove the equation relating U and U’. The equation appears on p. 5-9, and needs to be corrected. The standard quaternion multiplication symbol is an x with a circle around it, not \***.** The quaternion conjugate is not QT . It is generally written as Q\* and is {cos(phi/2),-**u** sin(phi/2)}. Equation should be written as:**x**f = Q x **x**i x Q\*Where ‘x’ should be the quaternion multiplication symbol (x with a circle around it). **x**f is the vector in the body frame, **x**i is the vector in the inertial. These vectors are defined at the top of p. 5-9.  | J. Thienel/NASA | fix | Modified, will work with CCSDS Editor of proper equation form. |
| 5-8 | Last equation |  |  | Correct the definition of the conjugate (see above). Q\*={cos(phi/2),-**u** sin(phi/2)}. Or Q\*={QC,-Q1,-Q2,-Q3} | J. Thienel/NASA | fix | Modified, will work with CCSDS Editor of proper equation form. |
| 5-11 | 5.3.6 |  |  | After the end of the sentence following Euler’s equation add a comment that for spacecraft with devices that generate angular momentum, like reaction wheels, that additional angular momentum must be included in Euler’s equation. | J. Thienel/NASA | suggestion | Done |
| 5-12 | 5.3.7 |  |  | Change the sentence before the 4 bullets. To propagate the attitude of a spacecraft without a gyro a simple algorithm could be followed.  | J. Thienel/NASA | suggestion | Done |
| 6-10 | 6.3.2 |  |  | Suggest adding a little more detail. Typical angle based sensors are sun sensors and earth sensors.  | J. Thienel/NASA | suggestion | Done |
| 6=10 | 6.3.4 |  |  | Star sensors now are typically autonomous and produce an attitude quaternion. Internally they use the location of stars in the FOV (and the magnitudes) to determine an attitude quaternion. So, the attitude quaternion from the star tracker becomes an attitude data type for use in an attitude estimation algorithm. So, another section could be added, or 6.3.4 expanded to cover autonomous star trackers. | J. Thienel/NASA | fix | Done |
| 2-1 | 2.1 thru 2.2.2 | All | te | You suggest in your comment on this section that we should "Discuss overlap with Navigation Data Message Overview".  | David Berry / NASA | After comparing this section of the Nav Data Definitions & Conventions (NDDC) line for line with the NDMOGB, I think we can propose to delete Section 2 of this document (i.e., the NDDC). At the Rome meetings, (I quote from the minutes) "We discussed what would be the best way to handle the possibly duplicated material in the two GreenBooks; there was general agreement that we wanted to avoid duplication of material where possible." On this basis, I propose to remove the entirety of Section 2 in the NDDC (the document you are editing). Much of it is duplicated word for word, and in other places the text in NDMO is slightly better than that in NDDC. Unfortunately, we lose figure 2-1, which I rather like. | Pending decision on intro material |
| 2-4 | 2.3 | All | ed/te | This one section of NDDC is not duplicated in NDMO.  | David Berry / NASA | I think we can justifiably move all of this text into section 1.2, applicability. | Pending decision on intro material |
| 3-1 | 3 | Title | te | I'm not sure this title applies anymore, now that the material relevant to the title has been moved to NDMO. | David Berry / NASA | Revise the Title of Section 3 to something more applicable (e.g., "Navigation Data Exchange: Data Types and Units" or something like that). | Pending decision on intro |
| 3-2 | All | All | All | You have posed a question regarding SI units in your comment. | David Berry / NASA | Per our WG guidelines, SI units should be specified if at all possible. There are a couple in these tables that are not (e.g., Range Units, counts), but I think everything else currently in the tables is approved for use in SI. | Done |
| 3-3 | 4.1 | Title | ed/te | The title "Rationale" doesn't seem to fit. | David Berry / NASA | I think "General" is an approved title for his type of material, and it is used at the beginning of Sections 2 and 3. | Done |
| 3-3 | 4.1 | 1 | ed | Unnecessary Word: "the" | David Berry / NASA | From: "... describes the ancillary data types..."To: "... describes ancillary data types..." | Done |
| 3-3 | 4.1 | Last 2 | ed | The last sentence seems unnecessary, and we may not have supplied the stated formats and system data all the time, | David Berry / NASA | Remove last sentence: "For each ancillary data type covered, ... unified manner." | Done |
| 3-3 | 4.2 | 3 | te | I would add an as applicable as noted. | David Berry / NASA | From: "... the individual Recommended Standards."To: "... the individual Recommended Standards, as applicable." | Done |
| 3-3 | 4.3.2 | 1-2 | ed/te | I think that a coordinate frame also embodies a common center, not just mutually orthogonal axes. | David Berry / NASA | Either: (a) Consider adding "with common center" after "Cartesian axes" or(b) Consider moving definition of "frame origin" just under the definition of "coordinate frame" in the list. | (b) adopted |
| 3-5 | 4.3.4.4 | All | ed/te | The number of this section (i.e., 4.3.4.4) implies that TOD is part of the ICRS... I'm not sure the TOD discussion belongs in this section. At least we should change the title if TOD and ICRS are intimately related. | David Berry / NASA | Consider if TOD and ICRS should have related section numbers. If "yes", then change title of 4.3.4 to include the TOD If "no", then add a new 3-level title "4.3.5 True of Date Systems", followed by 4.3.5.1 "True of Date (TOD) Coordinate System" and 4.3.5.2 "Greenwich True of Date (GTOD) Coordinate System. | Decision was ‘No’.Change implemented. |
| 3-6 | 4.3.4.5 | 10 | ed | Typo: Name "Greenwich Rotating Coordinate Frame" is characterized as "GCR" (what I call a "tortured acronym)... but I think you wanted to call it GRC. | David Berry / NASA | Consider the proper name for the frame.Also note: The acronym "GRC" is expanded to "Greenwich Rotating Coordinates" in the glossary. | Both acronyms were found. Acronym deleted. |
| 3-6 | 4.3.4.6 | 3 | te | The equation is not understandable. | David Berry / NASA | Fix equation. | TBD |
| 3-7 | Figure 4-1 | Caption | ge | Regarding your comment on the diagram... I do not know the source definitively, however, in looking at very old drafts it appears that the figure was "hand drawn", and indicates that the reference was "[7] McCarthy D.D, 1996, 'IERS Conventions', IERS Technical Notes 13 and 21, Observatoire de Paris, Paris (or current update)". I think this would be analogous to what is cited as reference [1] in the GB 3.3. | David Berry / NASA | Figure out what to do given source information. | Source found, Tom will modify. |
| N/A | NA | N/A | ge | There are at least a couple of frames for which we might want to add a description, specifically, GCRF, and EME2000. At least for EME2000, the reference to J2000 in section 4.3.4.2 could be modified to add that ICRF and EME2000 are synonymous. | David Berry / NASA | Consider. | Added |
| 3-8 | 4.3.6 | 1 | ed | Odd terminology: "... frames attached to an orbit...". | David Berry / NASA | My suggestion:From: "... attached to..."To: "... associated with ..." | Done |
| 3-8 | 4.3.6 | 4 | ed | Punctuation and extra conjunctions. | David Berry / NASA | From: "... science instruments, and forces and torques."To: "... science instruments, forces, and torques. | Done |
| 3-8 | 4.3.6 (b) | 2-3 | ed | After the word "oriented", I think the purpose is stated too generally. | David Berry / NASA | Re-word to try to capture the concept of convenient definitions of mechanical equipment and/or science instruments. | Modified |
| 3-9 | 4.3.7.2 | bottom few | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 3-10 | 4.3.7.3 | bottom few | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 3-10 | 4.3.7.4 | Title | ed/te | No translation of "Q,S,W" is provided, though there is for "RTN" (also, notation is different ... Q,S,W comma separated, RTN not). | David Berry / NASA | 1. Provide meaning of QSW, either here or in Acronyms Annex2. Consider notation consistency (also look at T,N,W on previous page | Pending |
| 3-10 | 4.3.7.4 | last | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 3-11 | 4.4.1 | 2 | te | Says that "... understanding of time system is essential for: ... exchange and processing of navigation data". I can certainly understand the requirement with respect to processing, but question whether the exchange itself requires such understanding...  | David Berry / NASA | I think "exchange and" can be removed here...  | Done |
| 3-11 | 4.4.1 | para 1 | te | The list of 3 ways relative differences between time frames are depicted doesn't account for the fact that:TAI - GPS is constant (19 s)TAI - TT is constant (-32.184 s) | David Berry / NASA | 1. Change "time frames" to "time scales".2. Add (4) constant | Done |
| 3-13 | 4.4.2.3.2 | 3 | ed/te | The value assigned to LB has no units designation. | David Berry / NASA | I presume this is seconds, so add "seconds" after the value. | Units (which are strange) put in. |
| 3-13 | 4.4.2.3.2 | 5 | ed/te | The units on the "TCB - TDB" value are not correct... "s/a" is shown.  | David Berry / NASA | I believe this should be seconds per year past 1977. Is "s/a" meant to be "seconds per annum"? If so, maybe should spell it out. | Changed |
| 3-15 | 4.5 | n/a | ge | Should we list some of the astrodynamic constants? or point to an authoritative reference? The guidance here is a bit general. | David Berry / NASA | Consider | Reference provided |
| 3-15 | 4.6 | 4 | ed | Punctuation... end of sentence has ",." (comma followed by period). | David Berry / NASA | Correct. | Done |
| 3-15 | 4.7.1 | 3 | ed | End of line has some typos. | David Berry / NASA | Correct | Done |
| 3-17 | 4.8.2 | 5 | ed | The sentence that starts with "Corrections applied..." is not a complete sentence. | David Berry / NASA | I'm not sure exactly what you were trying to convey, so I don't have a specific suggestion. Generally, complete the sentence. | Done |
| 3-17 | 4.8.2 | 11 | ed | Missing word ("or") | David Berry / NASA | From: "... either independently of simultaneously with..."To: "... either independently of or simultaneously with..." | Done |
| 5-1 | 5.1 | Title | ed/te | Correct Title? The title is "Rationale", but I think "General" might be better. This title was used in section 2 and 3. | David Berry / NASA | Consider changing "Rationale" to "General" | Done |
| 5-1 | Table 5-1 | n/a | te | The data type "Mass Flow Rate" appears in the "Hardware" row of the table, but I think it might be better in the "Physical" row (e.g., "Spacecraft Mass" is in the "Physical" row). | David Berry / NASA | Consider moving "Mass Flow Rate" from "Hardware" to "Physical" (or vice versa). | Done |
| 5-2 | 5.2.2.1.1 | All | ed | I think this section might be misnumbered. Is it really a subtopic for general? Or one level up? | David Berry / NASA | Consider changing numbering to 5.2.2.2 | Changed to one level up |
| 5-2 | 5.2.2.1.1 | 2 | ed | Word choice. (I'm not positive about this one, however, in this sentence "manifested" makes sense in that it implies the presence of various errors in the tracking data. Using "manifest" would indicate that they are very numerous | David Berry / NASA | From: manifestTo: manifested | Done |
| 5-25-3 | 5.2.2.2 | n/a | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 5-5 | 5.2.3.3 | n/a | ed | Section numbering... should this section appear right after the Classical Keplerian Elements? | David Berry / NASA | Consider moving this text to 5.2.2.4 | Moved |
| 5-5 | 5.2.4.2 | 2 | ed/te | The vector symbols did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 5-6 | 5.2.4.3 | -- | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 5-6 | 5.2.5 | 1-3 | ed | The first sentence here seems unrelated to the heading. | David Berry / NASA | Consider either moving to section 5.2.3 and smoothing it out, or deleting. | Done |
| 5-7 | 5.3.3 | 1 | ed/te | The end of the first sentence refers to "this orientation", but I think using "this" makes it ambiguous | David Berry / NASA | Consider specifying enough info about the orientation to remove ambiguity. | Done |
| 5-7 | 5.3.4 | 1-2 | ed | I think the sentence is a bit backward/awkward as written. | David Berry / NASA | From: "Several attitude representations are available, and the choice of a particular representation is generally suited to the attitude stabilization mode of the spacecraft."To: "Several attitude representations are available, and the particular representation is generally chosen to suit the attitude stabilization mode of the spacecraft." | Done |
| 5-8 | 5.3.4 | mid-page | ed | The equation after "This gives the following relation..." appears to have too much space between terms. | David Berry / NASA | Tighten up space between terms if possible. | Done |
| 5-9 | 5.3.4 | 7 | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 5-9 | 5.3.4 | near end | ed | Subject/verb agreement. The sentence "However, the definition of roll, pitch, and yaw axes vary from mission to mission" | David Berry / NASA | From: "...definition of roll, pitch, and yaw axes vary..."To: "...definition of roll, pitch, and yaw axes may vary..." | Done |
| 5-13 | 5.5.2 | n/a | ed/te | The vector symbols did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 5-13 | 5.5.3 | n/a | ed/te | The vector symbols and operations did not translate well. | David Berry / NASA | Ensure that font used for the vector symbols and operations is understandable. | TBD? |
| 5-14 | 5.6 | last | ed | Acronym use... spell out. | David Berry / NASA | From: CGTo: center of gravity | Done |
| 6-1 | 6.1 | Title | ed/te | Correct Title? The title is "Rationale", but I think "General" might be better. This title was used in section 2 and 3. | David Berry / NASA | Consider changing "Rationale" to "General" | Done |
| 6-1 | 6.1 | Last 2 sentences | ed/te | The last 2 sentences are pretty redundant. | David Berry / NASA | Either combine text into one sentence, or delete the second. | Combined |
| 6-1 | 6.2.2.1 | 6 | ed | Minor typo. | David Berry / NASA | From: "... coherency, and additional reference..."To: "... coherency, an additional reference..." | Done |
| 6-2 | 6.2.2.1 | last | ed/te | Lists angles as a radiometric tracking data type.  | David Berry / NASA | Remove "angles" from the list of radiometric data types. | Done |
| 6-2 | 6.2.2.2 | next to last | ed | Word out of place. | David Berry / NASA | From: "...modulating the downlink (and return carrier for a relay satellite) carrier..."To: "...modulating the downlink carrier (and return carrier for a relay satellite) ..." | Done |
| 6-3 | 6.2.2.3 | 9 | ed | Minor typo. | David Berry / NASA | From: "... sources, on at the ground station..."To: "... sources, one at the ground station..." | Done |
| 6-26-36-4 | 6.2.2.3 | n/a | ed/te | Pictures of relay scenarios might be good here... as it is only ground stations are shown. | David Berry / NASA | Consider. | Picture of relay scenario added |
| 6-4 | 6.2.2.5 | 7 | ed | Missing period. | David Berry / NASA | From: "... for satellite use are being developed Spacecraft transmitters..."To: "... for satellite use are being developed**.** Spacecraft transmitters..." | Done |
| 6-4 | 6.2.2.5 | para 2, line 1 | ed | Minor typo. | David Berry / NASA | From: "... aid of a atomic-based..."To: "... aid of an atomic-based..." | Done |
| 6-5 | 6.2.2.5 | para 2, line 3 | ed | Minor typo. | David Berry / NASA | From: "... when an forward/uplink is not..."To: "... when a forward/uplink is not..." | Done |
| 6-6 | 6.2.2.7 | 1 | ed/te | Word choice. Not sure "minimal" is right here, but also not sure of the intent of the sentence. | David Berry / NASA | From: "The minimal Doppler..."To: "The least accurate Doppler..." ??? | Done |
| 6-6 | 6.2.2.8 | 6 | te | Delta-DOR usually uses quasars because they are more like a point source. | David Berry / NASA | From: "... any extragalactic object when..."To: "... any extragalactic object (usually a quasar) when... | Done |
| 6-6 | 6.2.2.8 | last | te | Your comment indicates a need for a Delta-DOR reference. Ref [14] and [33] are good. | David Berry / NASA | Consider | Done |
| 6-9 | 6.2.3 | 1 | ge | Compared to some of the topics in this document, the "acceleration" topic looks a bit sparse. | David Berry / NASA | Consider if there is other information worthy of being discussed here...  | Modified |
| 6-11 | 6.3.6 | All | ge | From the description, it's not clear to me how this information is used in attitude determination... it may be applicable only to AD for the GNSS satellites themselves (?). I just wonder if this is relevant to our CCSDS standards work. | David Berry / NASA | Consider. | Removed |
| B-1 | Annex B | All | ge | No specific comment at this time, but just before we prepare to publish, we should do a scrub on Annex B to remove acronyms not in the book and add acronyms that are in the book but not in the Annex. | David Berry / NASA | Put this activity on the document development schedule. |  |