

## Deep Space Network Files

The OSIRIS-REx mission receives spacecraft tracking data from the Deep Space Network (DSN). Both mission navigators and science team members working on radio science investigations use these data. The OSIRIS-REx navigation and radio science teams receive DSN Tracking and Navigation File (trk-2-34) data, Media Calibration Files (Ionosphere Calibration Files, Troposphere Calibration File, trk-2-23), and Weather Files (trk-2-24) files via secure FTP. The files are all formatted in standard ways, documented in a series of Software Interface Specifications (SIS) noted in Table 1. The DSN SIS documents are not mission specific, they are applicable to all DSN produced data products. The DSN files are transferred to a secure area within the OSIRIS-REx Science Processing and Operations Center (SPOC) data repository. For archival, DSN data files are retrieved from the SPOC data repository and prepared for delivery to the Planetary Data System.

Table 1. DSN Data Product SIS References

Data Product	SIS Reference	Availability
Tracking and Navigation Files	TRK 2-34 DSN Tracking System Data Archival Format, DSN No. 820-013, TRK-2-34, Rev N. JPL D-76488. November 7, 2013.	<a href="https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/DSN_TRK-2-34/dsn_trk-2-34.2013-11-07.pdf">https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/DSN_TRK-2-34/dsn_trk-2-34.2013-11-07.pdf</a>
Ionosphere and Troposphere Calibration Files	TRK 2-23 Media Calibration Interface, DSN No. 820-013, TRK-2-23, Rev C. JPL D-16765. March 5, 2008.	<a href="https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/DSN_TRK-2-23/dsn_trk-2-23.2008-03-05.pdf">https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/DSN_TRK-2-23/dsn_trk-2-23.2008-03-05.pdf</a>
Weather Files	TRK 2-24 Tracking System Interfaces Weather Data Interface, DSN No. 820-013, TRK-2-24, Rev A. JPL D-16765. March 15, 2006.	<a href="https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/DSN_TRK-2-24/dsn_trk-2-24.2006-03-15.pdf">https://pds-geosciences.wustl.edu/radiosciencedocs/urn-nasa-pds-radiosci_documentation/DSN_TRK-2-24/dsn_trk-2-24.2006-03-15.pdf</a>

The OSIRIS-REx data archive has been designed and implemented in the PDS4 standard as required by the PDS Management Council for missions confirmed for flight after November 1, 2011. A consequence of the change in standard from PDS3 to PDS4 is that data formats that were previously PDS compliant are no longer compliant or present serious labeling challenges. The DSN Tracking and Navigation Files formatted in compliance with their respective SIS documents present such a problem.

The DSN Tracking and Navigation Files (trk-2-34) are natively formatted as a binary collection of approximately 18 different data record types. Not all data record types are present in each file. Each of the data record types can be described in a PDS4 .XML label as a PDS4 Table\_Binary object. The difficulty in labeling the natively formatted trk-2-34 files is that data records are not sorted by type, meaning that in a worst-case scenario, the PDS .XML label would be required to have a Table\_Binary specification for each data record in the trk-2-34 file, resulting in an XML label file that is hundreds of times larger in size than the data file. To remedy this unwieldy labeling result, the original trk-2-34 files (formatted according to the SIS referenced in Table 1), have been sorted by data record type.

The InSight mission was the first mission to archive DSN tracking data in the PDS4 standard and developed a method to sort and label trk-2-34 tracking data files. The OSIRIS-REx trk-2-34 tracking data products are produced using the same method (and software) as developed by the InSight team. A full explanation of this method can be found in *Interior Exploration Using Seismic Investigations, Geodesy, and Heat Transport (InSight) Mission Rotation and Interior Structure Experiment (RISE) PDS Archive Software Interface Specification, Rev. 1.0, June 27, 2017* ([https://pds-geosciences.wustl.edu/insight/urn-nasa-pds-insight\\_documents/document\\_rise/RISE\\_InSight\\_SIS\\_Raw.pdf](https://pds-geosciences.wustl.edu/insight/urn-nasa-pds-insight_documents/document_rise/RISE_InSight_SIS_Raw.pdf)).

## Small Forces Files

The OSIRIS-REx navigation team also uses Navigation and Ancillary Information Facility (NAIF) produced Small Forces Files (SFF). These files record the cumulative delta-v effect of attitude thruster firings over a specified time period(s). An estimate of mass loss due to fuel usage may also be included. The OSIRIS-REx team retrieves these files from the NAIF webserver (<https://naif.jpl.nasa.gov/pub/naif/ORX/misc/sff/>) and stores them in the SPOC data repository. The SFFs are retrieved from the SPOC repository and prepared for delivery to the PDS.

The Small Forces Files are formatted natively as character files with a KEYWORD=VALUE header structure followed by data records in a comma separated variable structure. The full format is described in the Small Forces File Software Interface Specification, Version 3.0, March 15, 2015 (located in the OSIRIS-REx DSN bundle documents collection as SIS\_NAF018\_ORX-SFF\_CCv0001.pdf). The OSIRIS-REx archive team is required to modify the original SFFs as described in the SIS so that the data files are PDS4 compliant. The original SFFs have UNIX style line ending of <LF>. The PDS4 standard requires that delimiter separated variable data formats have <LF><CR> line endings. The OSIRIS-REx archive team has made this modification in all archival SFFs.