OSIRIS-REx
Software Interface Specification

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Software Interface Specification

Small Forces File

for
Mars Polar Lander, Stardust, Genesis, Mars Odyssey 2001 Orbiter, Deep Impact, Mars Reconnaissance Orbiter, Phoenix, Juno, GRAIL, MAVEN, and ORX

Version 3.0
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Navigation and Ancillary Information Facility

Table of Contents

List of Acronyms

delta-V	Change in velocity
DIF	Deep Impact Flyby
DSN	Deep Space Network
GNS	Acronym for the Genesis Spacecraft
GRA	Acronym for the GRAIL-A Spacecraft
GRB	Acronym for the GRAIL-B Spacecraft
GRL	Acronym for the GRAIL Mission
LANDSF	Program to produce Mars Polar Lander predict SFFs
M01	Acronym for the Mars Odyssey 2001 Orbiter spacecraft
M98	Mars Surveyor 98 Mission, consisting of the Mars Polar Lander (MPL) and Mars Climate Orbiter (MCO) spacecraft
MAKGNP	Program to produce Genesis long-term predict SFFs
MAKSDP	Program to produce Stardust predict SFFs
MAKSFF	Program to produce Mars Polar Lander and Stardust reconstruction SFFs
MAVEN	Mars Atmosphere and Volatile EvolutionN
MRO	Mars Reconnaissance Orbiter
MPL	Mars Polar Lander
MVN	Acronym for the MAVEN spacecraft
ODP	Orbit Determination Program
ORX	Acronym for the OSIRIS-Rex spacecraft
OSIRIS-Rex	Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer
PHX	Acronym for the Phoenix spacecraft
SDU	Acronym for the Stardust spacecraft
SFF	Small Forces File
SIS	Software Interface Specification
SMF_PREDICT	Program to produce Genesis short-term predict SFFs
SPAS	Spacecraft Performance Analysis Software
SRDS	Software Requirements and Design Specification

Change History

Version	Date	Reason
1.0	06-15-98	First draft, for review
1.1	09-05-98	Updated after first review
1.2	10-25-98	Updated after second review
1.3	11-09-98	Updated after third review
1.4	03-16-99	Updated to reflect optional addition of the SPICE DP SCLK
1.5	10-22-00	Updated for Genesis
1.6	01-08-01	Updated for Mars Odyssey 2001 Orbiter
1.7	02-24-01	Updated after GNS/M01 review
1.8	03-16-01	Replaced OPENED with OPEN in optional GNS fields
1.9	08-20-04	Updated for Deep Impact and MRO
2.0	09-02-04	Added clarification regarding sign of DMASS
2.1	11-24-04	Changed DI sections to match SFF updated for new packet format
2.2	07-29-05	Updated to cover predicted MRO SFF; updated reconstructed MRO SFF example;
2.3	10-17-05	Updated for Phoenix
2.4	10-06-06	Updated PHX quaternion description. Updated MRO predicted SFF example to indicate that predicted MRO SFFs may come with or without additional fields
2.5	01-22-09	Updated for Juno
2.6	05-05-10	Updated for GRAIL
2.7	08-24-10	Changed the last SFF field for JUNO from AD_STATE to AK_LEVEL
2.8	12-23-11	Changed deltaV units for GRAIL reconstructed SFF from m/s to kg*m/s
2.9	10-04-12	Updated for MAVEN
3.0	03-04-15	Updated for ORX

1. General Description

1.1 Purpose

The Small Forces File (SFF) provides to JPL's Orbit Determination Program (ODP) and interested science teams the cumulative delta-V effect of attitude thruster firings over one or more specified intervals of time. In some cases it also provides an estimate of the cumulative spacecraft mass loss due to the use of propellant in those attitude thrusters.

The same format file is also produced to model predicted accelerations.

1.2. Scope

This SIS is applicable for the Mars Polar Lander (MPL), Stardust (SDU), Genesis (GNS), Mars Odyssey 2001 Orbiter (M01), Deep Impact Flyby (DIF), Mars Reconnaissance Orbiter (MRO), Phoenix (PHX), Juno, GRAIL-A (GRA), GRAIL-B (GRB), Mars Atmosphere and Volatile EvolutionN (MAVEN) spacecraft, and Origins-Spectral Interpretation-Resource Identification-Security-Regolith Explorer (OSIRIS-Rex or ORX). It covers both "predict" and "reconstruction" situations. For Stardust predict situations, it covers two kinds of predict Small Forces Files: one containing delta-velocity (typically from spacecraft slews, dead-band walks and other delta-V generating events) and one containing acceleration (typically from cruise limit cycling).

1.3 Applicable Documents

Several programs exist for creating this Small Forces File. See the relevant program User Guides for operating details. These are:

LANDSF	Mars Polar Lander predict SFFs
MAKSDP	Stardust predict SFFs
SMF_PREDICT	Genesis short-term predict SFFs
MAKGNP	Genesis long-term predict SFFs
MAKSFF	MPL, SDU, GNS, M01, DIF, MRO, PHX, Juno, GRA, GRB, MAVEN, and ORX reconstruction SFFs
SMALLFORCEMERGE	Program for merging predict and reconstruction SFFs

See the relevant Operations Procedures and Operational Interface Agreements for information about production procedures, schedules and file destinations.

2. Method of Generation

2.1 Predict Mode

A Small Forces File may be produced in "predict" mode by a program that models expected delta-V (and acceleration, in the case of Stardust) based on expected performance or knowledge of the spacecraft attitude control system and the mission profile. Separate programs for producing predict

Small Forces Files are available for the Mars Polar Lander, Stardust, Genesis, MRO, Juno, GRAIL, MAVEN, and ORX flight projects. See the LANDSF, MAKSDP, MAKGNP, SMF_PREDICT, and ATARPS/ATARPS2SFDF/MAKSFF User's Guides, respectively.

2.2 Reconstruction Mode

A Small Forces File may be produced in "reconstruction" mode by a set of scripts and programs that obtain Small Forces File packets returned from the spacecraft and post-process and/or reformat this data into an SFF. This process includes some computations of derived parameters. See the MAKSFF User's Guide and the relevant Operations Interface Agreements, Operational Procedures and SPAS SRDS documents for production details.

2.3 Merging Predict and Reconstruction Delta-V Files

The file merging information in this subsection does not deal with the format or content of an SFF and so is not a subject appropriate for detailed discussion in this SIS. See the appropriate operational procedure for the mission of interest for the official instructions about merging SFF files.

The ODP can read only one delta-V Small Forces File during execution. Consequently, means external to the ODP are needed to combine "predict" and "reconstruction" delta-V SFF data as needed into a single file.

For all spacecraft — MPL, SDU, GNS, M01, DIF, MRO, PHX, Juno, GRA, GRB, MAVEN, and ORX — the merging of reconstruction data with predict data can be accomplished with the SMALLFORCEMERGE program.

The ODP can also read only one accelerations file. Since there is no reconstruction accelerations file, merging of accelerations SFFs is not an issue. Note, however, that the accelerations file must be truncated to start where the delta-V reconstruction file ends; otherwise inconsistent data will be input to the ODP.

3. Detailed Data Object Definition

3.1 General Structure

A small forces file consists of two sections–header and data–separated by an end of header character flag on a line by itself:

```
<header>
$$EOH
<data>
```

where

<header>	is a set of KEYWORD=VALUE assignments
$$EOH	is end-of-header delimiter, on a line by itself

<data> is one or more small forces data records

There is no special end of file marker inserted at the end of the data section.

3.2 Header Section Structure

The header section consists of the following KEYWORD=VALUE assignments, each on a line by itself. Any amount of white space, including none, can appear on each side of the "=" sign.

MISSION_NAME = <character string>
SPACECRAFT_NAME = <character string>
DSN_SPACECRAFT_ID = <positive integer>
PRODUCTION_TIME = YYYY-MM-DD HR:MN:SC[.XXX]
PRODUCER_ID = <character string>

where

MISSION_NAME	name of the mission (Stardust, M98, GNS, M01, DI, MRO, PHX, JUNO, GRL, MAVEN, ORX)
SPACECRAFT_NAME	name of the spacecraft (Sdu, M98, Gns, Or1, Dif, Mro, Phx, Juno, Gra, Grb, Mvn,Orx)
DSN_SPACECRAFT_ID	DSN ID for the spacecraft: (Stardust = 29, Mars Polar Lander = 116, Genesis = 47, M01 = 53, DIF = 140, MRO = 74, PHX = 84, Juno = 61, GRA = 177, GRB = 181, Mvn = 202, Orx=64)
PRODUCTION_TIME	file production date and time, taken from the local computer clock
PRODUCER_ID	name/organization of the producer; example: NAIF/JPL

It is noted here that within the Stardust, Mars Surveyor 98, Genesis, Mars Odyssey 2001, Deep Impact, Mars Reconnaissance Orbiter, Phoenix, Juno, GRAIL, MAVEN, and ORX projects, and particularly their ground systems, several names for the missions and spacecraft are in use. The values for MISSION_NAME and SPACECRAFT_NAME shown in the table above seem not to be the best choices in all cases, but they are the only consistent set of names that can be placed in the SFF header by the SFF production programs. The software for which this SFF product was designed does not use either of these items (it uses only the DSN_SPACECRAFT_ID from the header) so the values (including case) for MISSION_NAME and SPACECRAFT_NAME placed in the header are not important.

3.3 Data Section Structure

The data section of a small forces file consists of one or more data records, each record occupying a single line:

<data record 1>

<data record 2>
...
<data record N>

Although the records are usually sorted in increasing order by STOPTIM field from the primary portion of the record, this sorting is not guaranteed.

3.3.1 Data Record Structure Overview

Each data record of a small forces file consists of two parts delimited by a comma, the primary data part and additional data part:

<primary data>,<additional data>

The additional data part is optional. If it's not present, the delimiting comma is omitted.

Spaces preceding or following commas are insignificant.

3.3.2 Data Record Primary Data Structure

The primary data part of a small forces data record consists of the following required parameters in the order shown, separated by commas:

INDEX,RECTYPE,GENTIM,STARTTIM,STOPTIM,DTIME,DMASS,DVX,DVY,DVZ

where

INDEX	index of the record in the file (1...N)
RECTYPE	type of the record, one character string: for velocity files: P = predicted, R = reconstructed for predicted acceleration files: A = continuous, X = discontinuous
GENTIM	record generation time; format: YYYY-MM-DD HR:MN:SC[.XXX]; taken from the local computer clock (implies UTC for TMOD computers)
STARTTIM (ET)	data accumulation period start time; format YYYY-MM-DD HR:MN:SC.XXX. For predict delta-V files, this item = STOPTIM and corresponds to the time for application of delta-V for a delta-V generating event event.
STOPTIM (ET)	data accumulation period stop time; format YYYY-MM-DD HR:MN:SC.XXX. For predict delta-V files, this item = STARTTIM and corresponds to the time for application of delta-V for a delta-V generating event event.
DTIME (Seconds)	For reconstruction files, data accumulation period duration (STOPTIM - STARTTIM). For SDU predict delta-V files, computed from a table of estimated delta-V generating event durations, varying by delta-V generating event type. For MPL predict files,

	corresponds to the length of the interval ending at STOPTIM that is used to determine the predicted delta-V. For GNS predict files, this is zero.
DMASS or DMASS rate (Kg or kg/sec)	Always zero for MPL, GNS, M01, DIF, MRO, PHX, Juno, GRA, GRB, MAVEN, and ORX files. For SDU reconstruction velocity files this is computed from estimated mass flow rate (parameter updated after each major maneuver) and thruster on time (kg). For Sdu predicted velocity files, computed from table of estimated mass decrement by delta-V generating event type (kg). For Sdu predicted acceleration files, mass flow rate is computed from specific impulse and predicted ACS acceleration (kg/sec). Positive DMASS value means mass loss.
DVX or AX (m/s[(1)] or m/s**2)	resultant delta-V in J2000 frame X direction for the accumulation time period; or for Stardust acceleration files, resultant acceleration in X direction
DVY or AY (m/s[(1)] or m/s**2)	resultant delta-V in J2000 frame Y direction for the accumulation time period; or for Stardust acceleration files, resultant acceleration in Y direction
DVZ or AZ (m/s[(1)] or m/s**2)	resultant delta-V in J2000 frame Z direction for the accumulation time period; or for Stardust acceleration files, resultant acceleration in Z direction

[(1)] DVX, DVY, and VDZ values in reconstructed SFF files for GRAIL have units of kg*m/s. To convert these values to the expected m/s units these deltaV values must be scaled by one over the spacecraft mass in kg (1/sc_mass_in_kg).

3.3.3 Data Record Additional Data Structure

The additional data part of a small forces data record consists of the following parameters requested by a particular mission in the order in which they appear in the mission's small forces APID, plus optional SPICE DPSCLK, separated by commas:

AAAA, BBBB, CCCC, ..., ZZZZ, DPSCLK

where

AAAA	a field from a mission small forces APID
BBBB	a field from a mission small forces APID
CCCC	a field from a mission small forces APID
...	...
ZZZZ	a field from a mission small forces APID
DPSCLK	SPICE double precision SCLK (SCLK ticks)

These additional data are not provided in the SFF for Mars Polar Lander but are provided in the SFFs for Stardust, Genesis, M01, DIF, MRO, PHX, Juno, GRA, GRB, MAVEN, and ORX. See the description below of the fields that will be included. SPICE double precision SCLK must be provided in any reconstruction SFF even if other additional fields aren't present in order use the file with as input to the MAKSFF program (version 3.0.0 or later).

3.3.3.1 Stardust Mission Additional Data

For the Stardust mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

Q1, Q2, Q3, Q4, RCS1N, RCS2N, RCS3N, RCS4N, RCS5N, RCS6N, RCS7N, RCS8N, TCM1N, TCM2N, TCM3N, TCM4N, TCM5N, TCM6N, TCM7N, TCM8N, RCS1T, RCS2T, RCS3T, RCS4T, RCS5T, RCS6T, RCS7T, RCS8T, TCM1T, TCM2T, TCM3T, TCM4T, TCM5T, TCM6T, TCM7T, TCM8T

where

Q1	First element of average attitude quaternion at time of thruster firings
Q2	Second element of average attitude quaternion at time of thruster firings
Q3	Third element of average attitude quaternion at time of thruster firings
Q4	Fourth element of average attitude quaternion at time of thruster firings (scalar component)
RCS1N	Number of firings during time period for RCS1
RCS2N	Number of firings during time period for RCS2
RCS3N	Number of firings during time period for RCS3
RCS4N	Number of firings during time period for RCS4
RCS5N	Number of firings during time period for RCS5
RCS6N	Number of firings during time period for RCS6
RCS7N	Number of firings during time period for RCS7
RCS8N	Number of firings during time period for RCS8
TCM1N	Number of firings during time period for TCM1
TCM2N	Number of firings during time period for TCM2
TCM3N	Number of firings during time period for TCM3
TCM4N	Number of firings during time period for TCM4
TCM5N	Number of firings during time period for TCM5
TCM6N	Number of firings during time period for TCM6

TCM7N	Number of firings during time period for TCM7
TCM8N	Number of firings during time period for TCM8
RCS1T	Accumulated on time during time period for RCS1
RCS2T	Accumulated on time during time period for RCS2
RCS3T	Accumulated on time during time period for RCS3
RCS4T	Accumulated on time during time period for RCS4
RCS5T	Accumulated on time during time period for RCS5
RCS6T	Accumulated on time during time period for RCS6
RCS7T	Accumulated on time during time period for RCS7
RCS8T	Accumulated on time during time period for RCS8
TCM1T	Accumulated on time during time period for TCM1
TCM2T	Accumulated on time during time period for TCM2
TCM3T	Accumulated on time during time period for TCM3
TCM4T	Accumulated on time during time period for TCM4
TCM5T	Accumulated on time during time period for TCM5
TCM6T	Accumulated on time during time period for TCM6
TCM7T	Accumulated on time during time period for TCM7
TCM8T	Accumulated on time during time period for TCM8

3.3.3.2 Genesis Mission Additional Data

For the Genesis mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the output of the SMF_RECON program. These data items are separated by commas and appear on the same line as, and after, the primary data.

SPACECRAFT_MASS, SPACECRAFT_INERTIA, ACS_MODE, TLM_SRC_BCKSHELL, USED_SRC_BCKSHELL, TLM_CANN_COVER, USED_CANN_COVER, TLM_B_ARRAY_POS, USED_B_ARRAY_POS, TLM_E_ARRAY_POS, USED_E_ARRAY_POS, TLM_H_ARRAY_POS, USED_H_ARRAY_POS, TLM_L_ARRAY_POS, USED_L_ARRAY_POS, PRE_H_X_COMP, PRE_H_Y_COMP, PRE_H_Z_COMP, PRE_OMEGA, POST_H_X_COMP, POST_H_Y_COMP, POST_H_Z_COMP, POST_OMEGA, START_SEQ_COUNT, STOP_SEQ_COUNT, SRC_SEQ_FLAG

where

SPACECRAFT_MASS	The mass of the spacecraft in kilograms.

SPACECRAFT_INERTIA	The inertia of the spacecraft in (kilograms * meters^2).
ACS_MODE	One of the ACS mode strings.
TLM_SRC_BCKSHELL	May be OPEN, CLOSED or UNKNOWN. The string is the position of the sample return canister back shell as read from the telemetry.
USED_SRC_BCKSHELL	May be OPEN, CLOSED or UNKNOWN. The string is the position of the sample return canister back shell as read from the mass properties file.
TLM_CANN_COVER	May be OPEN, CLOSED or UNKNOWN. The string is the position of the canister cover as read from the telemetry.
USED_CANN_COVER	May be OPEN, CLOSED or UNKNOWN. The string is the position of the canister cover as read from the mass properties file.
TLM_B_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the B array as read from the telemetry.
USED_B_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the B array as read from the mass properties file.
TLM_E_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the E array as read from the telemetry.
USED_E_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the E array as read from the mass properties file.
TLM_H_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the H array as read from the telemetry.
USED_H_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the H array as read from the mass properties file.
TLM_L_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the L array as read from the telemetry.
USED_L_ARRAY_POSITION	May be STOWED, DEPLOYED, UNSHADED or UNKNOWN. The string is the position of the L array as read from the mass properties file.
PRE_H_X_COMP	The X component of the angular momentum direction vector (unit vector) before the maneuver segment. The vector is in the

	EME2000 reference frame.
PRE_H_Y_COMP	The Y component of the angular momentum direction vector (unit vector) before the maneuver segment. The vector is in the EME2000 reference frame.
PRE_H_Z_COMP	The Z component of the angular momentum direction vector (unit vector) before the maneuver segment. The vector is in EME2000 reference frame.
PRE_OMEGA	The spin rate before the maneuver segment in radians/second.
POST_H_X_COMP	The X component of the angular momentum direction vector (unit vector) after the maneuver segment. The vector is in the EME2000 reference frame.
POST_H_Y_COMP	The Y component of the angular momentum direction vector (unit vector) after the maneuver segment. The vector is in the EME2000 reference frame.
POST_H_Z_COMP	The Z component of the angular momentum direction vector (unit vector) after the maneuver segment. The vector is in the EME2000 reference frame.
POST_OMEGA	The spin rate after the maneuver segment in radians/second.
START_SEQ_COUNT	The SRC_SEQ_COUNT of the first packet associated with this record.
STOP_SEQ_COUNT	The SRC_SEQ_COUNT of the next header packet associated with this record.
SRC_SEQ_FLAG	May be TRUE or FALSE. False, indicates that a problem has been detected with the SRC_SEQ_COUNT either for this record or for a packet between this record and the previous record. TRUE, indicates no problem has been detected.

3.3.3.3 Mars Odyssey 2001 Mission Additional Data

For the M01 mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

AVG_ATT_QUAT_Q1, AVG_ATT_QUAT_Q2, AVG_ATT_QUAT_Q3, AVG_ATT_QUAT_Q4, RCS1_ACC_ON_CMDS, RCS2_ACC_ON_CMDS, RCS3_ACC_ON_CMDS, RCS4_ACC_ON_CMDS, TCM1_ACC_ON_CMDS, TCM2_ACC_ON_CMDS, TCM3_ACC_ON_CMDS, TCM4_ACC_ON_CMDS, ME1_ACC_ON_CMDS, ME2_ACC_ON_CMDS, RCS1_ACC_ON_TIME, RCS2_ACC_ON_TIME, RCS3_ACC_ON_TIME, RCS4_ACC_ON_TIME, TCM1_ACC_ON_TIME, TCM2_ACC_ON_TIME, TCM3_ACC_ON_TIME, TCM4_ACC_ON_TIME, ME1_ACC_ON_TIME, ME2_ACC_ON_TIME where

AVG_ATT_QUAT_Q1	resultant attitude quaternion for the accumulation period – quat. 1
AVG_ATT_QUAT_Q2	resultant attitude quaternion for the accumulation period – quat. 2
AVG_ATT_QUAT_Q3	resultant attitude quaternion for the accumulation period – quat. 3
AVG_ATT_QUAT_Q4	resultant attitude quaternion for the accumulation period – quat. 4
RCS1_ACC_ON_CMDS	number of firings during the accumulation period for RCS1
RCS2_ACC_ON_CMDS	number of firings during the accumulation period for RCS2
RCS3_ACC_ON_CMDS	number of firings during the accumulation period for RCS3
RCS4_ACC_ON_CMDS	number of firings during the accumulation period for RCS4
TCM1_ACC_ON_CMDS	number of firings during the accumulation period for TCM1
TCM2_ACC_ON_CMDS	number of firings during the accumulation period for TCM2
TCM3_ACC_ON_CMDS	number of firings during the accumulation period for TCM3
TCM4_ACC_ON_CMDS	number of firings during the accumulation period for TCM4
ME1_ACC_ON_CMDS	number of firings during the accumulation period for descent thruster 1
ME2_ACC_ON_CMDS	number of firings during the accumulation period for descent thruster 2
RCS1_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS1 in millisecs.
RCS2_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS2 in millisecs.
RCS3_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS3 in millisecs.
RCS4_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS4 in millisecs.
TCM1_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM1 in millisecs.
TCM2_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM2 in millisecs.
TCM3_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM3 in millisecs.
TCM4_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM4 in millisecs.
ME1_ACC_ON_TIME	Accumulated ON time during the accumulation period for descent

	thruster 1 in millisecs.
ME2_ACC_ON_TIME	Accumulated ON time during the accumulation period for descent thruster 2 in millisecs.

3.3.3.4 Deep Impact Mission Additional Data

For the DIF spacecraft the additional data part of a small forces data record consists of the following parameters extracted from the second small forces APID of each pair used for computing delta V, occurring in the order in which they appear in the APID, plus the packet sequence count values for both APIDs in the pair. These data items are separated by commas and appear on the same line as, and after, the primary data.

ADFDIV1ACMTM_SF_B0012, ADFDIV2ACMTM_SF_B0013, ADFDIV3ACMTM_SF_B0014, ADFDIV4ACMTM_SF_B0015, ADFRCS1ACMTM_SF_B0016, ADFRCS2ACMTM_SF_B0017, ADFRCS3ACMTM_SF_B0018, ADFRCS4ACMTM_SF_B0019, ADFACCDVXCC_SF_B0020, ADFACCDVYCC_SF_B0021, ADFACCDVZCC_SF_B0022, ADFACCDVXEME_SF_B0023, ADFACCDVYEME_SF_B0024, ADFACCDVZEME_SF_B0025, ADFACC1_SF_B0027, ADFACC2_SF_B0028, ADFACC3_SF_B0029, ADFACC4_SF_B0030, ADFGLATTERRX_B0305, ADFGLATTERRY_B0306, ADFGLATTERRZ_B0307, PACKET_SEQ_CNT, PREV_PACKET_SEQ_CNT

Where

ADFDIV1ACMTM_SF_B0012	Accumulated Thruster On-Time - Divert 1
ADFDIV2ACMTM_SF_B0013	Accumulated Thruster On-Time - Divert 2
ADFDIV3ACMTM_SF_B0014	Accumulated Thruster On-Time - Divert 3
ADFDIV4ACMTM_SF_B0015	Accumulated Thruster On-Time - Divert 4
ADFRCS1ACMTM_SF_B0016	Accumulated Thruster On-Time - RCS 1
ADFRCS2ACMTM_SF_B0017	Accumulated Thruster On-Time - RCS 2
ADFRCS3ACMTM_SF_B0018	Accumulated Thruster On-Time - RCS 3
ADFRCS4ACMTM_SF_B0019	Accumulated Thruster On-Time - RCS 4
ADFACCDVXCC_SF_B0020	X accumulated delta-v in body frame
ADFACCDVYCC_SF_B0021	Y accumulated delta-v in body frame
ADFACCDVZCC_SF_B0022	Z accumulated delta-v in body frame
ADFACCDVXEME_SF_B0023	X Accumulated delta-v Earth Mean Equator J2000 Inertial frame
ADFACCDVYEME_SF_B0024	Y Accumulated delta-v Earth Mean Equator J2000 Inertial frame
ADFACCDVZEME_SF_B0025	Z Accumulated delta-v Earth Mean Equator J2000 Inertial frame
ADFACC1_SF_B0027	SIRU angle data word 7 - Accelerometer 1 Delta Velocity reading

ADFACC2_SF_B0028	SIRU angle data word 7 - Accelerometer 2 Delta Velocity reading
ADFACC3_SF_B0029	SIRU angle data word 7 - Accelerometer 3 Delta Velocity reading
ADFACC4_SF_B0030	SIRU angle data word 7 - Accelerometer 4 Delta Velocity reading
ADFGLATTERRX_B0305	TCM guidance law attitude error contribution X axis
ADFGLATTERRY_B0306	TCM guidance law attitude error contribution Y axis
ADFGLATTERRZ_B0307	TCM guidance law attitude error contribution Z axis
PACKET_SEQ_CNT	packet sequence count the second packet in the pair from which the delta V was computed
PREV_PACKET_SEQ_CNT	packet sequence count the first packet in the pair from which the delta V was computed

3.3.3.5 Mars Reconnaissance Orbiter Mission Additional Data

For the MRO mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

AVG_ATT_QUAT_Q1, AVG_ATT_QUAT_Q2, AVG_ATT_QUAT_Q3, AVG_ATT_QUAT_Q4, ACS1_ACC_ON_CMDS, ACS2_ACC_ON_CMDS, ACS3_ACC_ON_CMDS, ACS4_ACC_ON_CMDS, ACS5_ACC_ON_CMDS, ACS6_ACC_ON_CMDS, ACS7_ACC_ON_CMDS, ACS8_ACC_ON_CMDS, TCM1_ACC_ON_CMDS, TCM2_ACC_ON_CMDS, TCM3_ACC_ON_CMDS, TCM4_ACC_ON_CMDS, TCM5_ACC_ON_CMDS, TCM6_ACC_ON_CMDS, ACS1_ACC_ON_TIME, ACS2_ACC_ON_TIME, ACS3_ACC_ON_TIME, ACS4_ACC_ON_TIME, ACS5_ACC_ON_TIME, ACS6_ACC_ON_TIME, ACS7_ACC_ON_TIME, ACS8_ACC_ON_TIME, TCM1_ACC_ON_TIME, TCM2_ACC_ON_TIME, TCM3_ACC_ON_TIME, TCM4_ACC_ON_TIME, TCM5_ACC_ON_TIME, TCM6_ACC_ON_TIME

where

AVG_ATT_QUAT_Q1	Resultant attitude quaternion for the accumulation period – quaternion element 1, spacecraft body to MME of date
AVG_ATT_QUAT_Q2	Resultant attitude quaternion for the accumulation period – quaternion element 2, spacecraft body to MME of date
AVG_ATT_QUAT_Q3	Resultant attitude quaternion for the accumulation period – quaternion element 3, spacecraft body to MME of date
AVG_ATT_QUAT_Q4	Resultant attitude quaternion for the accumulation period – quaternion element 4, spacecraft body to MME of date
ACS#_ACC_ON_CMDS	number of firings of each of the eight (8) ACS thrusters during

	the accumulation period
TCM#_ACC_ON_CMDS	number of firings of each of the six (6) TCM thrusters during the accumulation period
ACS#_ACC_ON_TIME	Accumulated ON time of each of the eight (8) ACS thrusters during the accumulation period
TCM#_ACC_ON_TIME	Accumulated ON time of each of the six (6) TCM thrusters during the accumulation period

3.3.3.6 Phoenix Mission Additional Data

For the PHX mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

AVG_ATT_QUAT_Q1, AVG_ATT_QUAT_Q2, AVG_ATT_QUAT_Q3, AVG_ATT_QUAT_Q4, RCS1_ACC_ON_CMDS, RCS2_ACC_ON_CMDS, RCS3_ACC_ON_CMDS, RCS4_ACC_ON_CMDS, TCM1_ACC_ON_CMDS, TCM2_ACC_ON_CMDS, TCM3_ACC_ON_CMDS, TCM4_ACC_ON_CMDS, DE1_ACC_ON_CMDS, DE2_ACC_ON_CMDS, DE3_ACC_ON_CMDS, DE4_ACC_ON_CMDS, DE5_ACC_ON_CMDS, DE6_ACC_ON_CMDS, DE7_ACC_ON_CMDS, DE8_ACC_ON_CMDS, DE9_ACC_ON_CMDS, DE10_ACC_ON_CMDS, DE11_ACC_ON_CMDS, DE12_ACC_ON_CMDS, RCS1_ACC_ON_TIME, RCS2_ACC_ON_TIME, RCS3_ACC_ON_TIME, RCS4_ACC_ON_TIME, TCM1_ACC_ON_TIME, TCM2_ACC_ON_TIME, TCM3_ACC_ON_TIME, TCM4_ACC_ON_TIME, DE1_ACC_ON_TIME, DE2_ACC_ON_TIME, DE3_ACC_ON_TIME, DE4_ACC_ON_TIME, DE5_ACC_ON_TIME, DE6_ACC_ON_TIME, DE7_ACC_ON_TIME, DE8_ACC_ON_TIME, DE9_ACC_ON_TIME, DE10_ACC_ON_TIME, DE11_ACC_ON_TIME, DE12_ACC_ON_TIME

where

AVG_ATT_QUAT_Q1	Resultant attitude quaternion for the accumulation period. Imaginary quaternion element 1, MME of J2000 to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion-rotated vector is given by q*vq where q* is the conjugate of quaternion q.
AVG_ATT_QUAT_Q2	Resultant attitude quaternion for the accumulation period. Imaginary quaternion element 2, MME of J2000 to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion-rotated vector is given by q*vq where q* is the conjugate of quaternion q.
AVG_ATT_QUAT_Q3	Resultant attitude quaternion for the accumulation period. Imaginary quaternion element 3, MME of J2000 to spacecraft body. This quaternion uses the convention that for some vector v,

	the quaternion-rotated vector is given by q*vq where q* is the conjugate of quaternion q.
AVG_ATT_QUAT_Q4	Resultant attitude quaternion for the accumulation period. Real quaternion element, MME of J2000 to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion-rotated vector is given by q*vq where q* is the conjugate of quaternion q.
RCS1_ACC_ON_CMDS	number of firings during the accumulation period for RCS1
RCS2_ACC_ON_CMDS	number of firings during the accumulation period for RCS2
RCS3_ACC_ON_CMDS	number of firings during the accumulation period for RCS3
RCS4_ACC_ON_CMDS	number of firings during the accumulation period for RCS4
TCM1_ACC_ON_CMDS	number of firings during the accumulation period for TCM1
TCM2_ACC_ON_CMDS	number of firings during the accumulation period for TCM2
TCM3_ACC_ON_CMDS	number of firings during the accumulation period for TCM3
TCM4_ACC_ON_CMDS	number of firings during the accumulation period for TCM4
DE1_ACC_ON_CMDS	number of firings during the accumulation period for DE1
DE2_ACC_ON_CMDS	number of firings during the accumulation period for DE2
DE3_ACC_ON_CMDS	number of firings during the accumulation period for DE3
DE4_ACC_ON_CMDS	number of firings during the accumulation period for DE4
DE5_ACC_ON_CMDS	number of firings during the accumulation period for DE5
DE6_ACC_ON_CMDS	number of firings during the accumulation period for DE6
DE7_ACC_ON_CMDS	number of firings during the accumulation period for DE7
DE8_ACC_ON_CMDS	number of firings during the accumulation period for DE8
DE9_ACC_ON_CMDS	number of firings during the accumulation period for DE9
DE10_ACC_ON_CMDS	number of firings during the accumulation period for DE10
DE11_ACC_ON_CMDS	number of firings during the accumulation period for DE11
DE12_ACC_ON_CMDS	number of firings during the accumulation period for DE12
RCS1_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS1 in milliseconds
RCS2_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS2 in milliseconds
RCS3_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS3 in milliseconds
RCS4_ACC_ON_TIME	Accumulated ON time during the accumulation period for RCS4

	in milliseconds
TCM1_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM1 in milliseconds
TCM2_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM2 in milliseconds
TCM3_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM3 in milliseconds
TCM4_ACC_ON_TIME	Accumulated ON time during the accumulation period for TCM4 in milliseconds
DE1_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE1 in milliseconds
DE2_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE2 in milliseconds
DE3_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE3 in milliseconds
DE4_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE4 in milliseconds
DE5_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE5 in milliseconds
DE6_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE6 in milliseconds
DE7_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE7 in milliseconds
DE8_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE8 in milliseconds
DE9_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE9 in milliseconds
DE10_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE10 in milliseconds
DE11_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE11 in milliseconds
DE12_ACC_ON_TIME	Accumulated ON time during the accumulation period for DE12 in milliseconds

3.3.3.7 Juno Mission Additional Data

For the Juno mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

AVG_ATT_QUAT_Q1, AVG_ATT_QUAT_Q2, AVG_ATT_QUAT_Q3, AVG_ATT_QUAT_Q4, FL1_ACC_ON_CMDS, FL2_ACC_ON_CMDS, FL3_ACC_ON_CMDS, FL4_ACC_ON_CMDS, FA1_ACC_ON_CMDS, FA2_ACC_ON_CMDS, RL1_ACC_ON_CMDS, RL2_ACC_ON_CMDS, RL3_ACC_ON_CMDS, RL4_ACC_ON_CMDS, RA1_ACC_ON_CMDS, RA2_ACC_ON_CMDS, FL1_ACC_ON_TIME, FL2_ACC_ON_TIME, FL3_ACC_ON_TIME, FL4_ACC_ON_TIME, FA1_ACC_ON_TIME, FA2_ACC_ON_TIME, RL1_ACC_ON_TIME, RL2_ACC_ON_TIME, RL3_ACC_ON_TIME, RL4_ACC_ON_TIME, RA1_ACC_ON_TIME, RA2_ACC_ON_TIME, ACS_MODE, AK_LEVEL

where

AVG_ATT_QUAT_Q1	resultant attitude quaternion for the accumulation period. Imaginary quaternion element 1, International Celestial Reference System (ICRS) to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion- rotated vector is given by q*vq where q* is the conjugate of quaternion q.
AVG_ATT_QUAT_Q2	resultant attitude quaternion for the accumulation period. Imaginary quaternion element 2, ICRS to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion- rotated vector is given by q*vq where q* is the conjugate of quaternion q.
AVG_ATT_QUAT_Q3	resultant attitude quaternion for the accumulation period. Imaginary quaternion element 3, ICRS to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion- rotated vector is given by q*vq where q* is the conjugate of quaternion q.
AVG_ATT_QUAT_Q4	resultant attitude quaternion for the accumulation period. Real quaternion element, ICRS to spacecraft body. This quaternion uses the convention that for some vector v, the quaternion- rotated vector is given by q*vq where q* is the conjugate of quaternion q.
FL1_ACC_ON_CMDS	number of firings during the accumulation period for Forward Lateral Thruster 1
FL2_ACC_ON_CMDS	number of firings during the accumulation period for Forward Lateral Thruster 2
FL3_ACC_ON_CMDS	number of firings during the accumulation period for Forward Lateral Thruster 3
FL4_ACC_ON_CMDS	number of firings during the accumulation period for Forward Lateral Thruster 4
FA1_ACC_ON_CMDS	number of firings during the accumulation period for Forward Axial Thruster 1

FA2_ACC_ON_CMDS	number of firings during the accumulation period for Forward Axial Thruster 2
RL1_ACC_ON_CMDS	number of firings during the accumulation period for Rear Lateral Thruster 1
RL2_ACC_ON_CMDS	number of firings during the accumulation period for Rear Lateral Thruster 2
RL3_ACC_ON_CMDS	number of firings during the accumulation period for Rear Lateral Thruster 3
RL4_ACC_ON_CMDS	number of firings during the accumulation period for Rear Lateral Thruster 4
RA1_ACC_ON_CMDS	number of firings during the accumulation period for Rear Axial Thruster 1
RA2_ACC_ON_CMDS	number of firings during the accumulation period for Rear Axial Thruster 2
FL1_ACC_ON_TIME	Accumulated ON time during the accumulation period for FL1 in milliseconds.
FL2_ACC_ON_TIME	Accumulated ON time during the accumulation period for FL2 in milliseconds.
FL3_ACC_ON_TIME	Accumulated ON time during the accumulation period for FL3 in milliseconds.
FL4_ACC_ON_TIME	Accumulated ON time during the accumulation period for FL4 in milliseconds.
FA1_ACC_ON_TIME	Accumulated ON time during the accumulation period for FA1 in milliseconds.
FA2_ACC_ON_TIME	Accumulated ON time during the accumulation period for FA2 in milliseconds.
RL1_ACC_ON_TIME	Accumulated ON time during the accumulation period for RL1 in milliseconds.
RL2_ACC_ON_TIME	Accumulated ON time during the accumulation period for RL2 in milliseconds.
RL3_ACC_ON_TIME	Accumulated ON time during the accumulation period for RL3 in milliseconds.
RL4_ACC_ON_TIME	Accumulated ON time during the accumulation period for RL4 in milliseconds.
RA1_ACC_ON_TIME	Accumulated ON time during the accumulation period for RA1 in milliseconds.
RA2_ACC_ON_TIME	Accumulated ON time during the accumulation period for RA2 in milliseconds.
ACS_MODE	ACS (or GN&C) Mode; for explanation of the enumerated ACS mode values see JUNO SFDF SIS (SPA002)
AK_LEVEL	Attitude Knowledge Level; for explanation of the enumerated AK level values see JUNO SFDF SIS (SPA002)

3.3.3.8 GRAIL Mission Additional Data

For the GRAIL mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

AVG_ATT_QUAT_Q1, AVG_ATT_QUAT_Q2, AVG_ATT_QUAT_Q3, AVG_ATT_QUAT_Q4, ACS1_ACC_ON_CMDS, ACS2_ACC_ON_CMDS, ACS3_ACC_ON_CMDS, ACS4_ACC_ON_CMDS, ACS5_ACC_ON_CMDS, ACS6_ACC_ON_CMDS, ACS7_ACC_ON_CMDS, ACS8_ACC_ON_CMDS, ACS1_ACC_ON_TIME, ACS2_ACC_ON_TIME, ACS3_ACC_ON_TIME, ACS4_ACC_ON_TIME, ACS5_ACC_ON_TIME, ACS6_ACC_ON_TIME, ACS7_ACC_ON_TIME, ACS8_ACC_ON_TIME, AVG_WARM_GAS_PLENUM_PRESSURE

Where

AVG_ATT_QUAT_Q1	Resultant attitude quaternion for the accumulation period – quaternion element 1; Earth centered inertial to body rotation
AVG_ATT_QUAT_Q2	Resultant attitude quaternion for the accumulation period – quaternion element 2; Earth centered inertial to body rotation
AVG_ATT_QUAT_Q3	Resultant attitude quaternion for the accumulation period – quaternion element 3; Earth centered inertial to body rotation
AVG_ATT_QUAT_Q4	Resultant attitude quaternion for the accumulation period – quaternion element 4; Earth centered inertial to body rotation
ACS1_ACC_ON_CMDS	number of firings for the ACS thruster 1 during the accumulation period
ACS2_ACC_ON_CMDS	number of firings for the ACS thruster 2 during the accumulation period
ACS3_ACC_ON_CMDS	number of firings for the ACS thruster 3 during the accumulation period
ACS4_ACC_ON_CMDS	number of firings for the ACS thruster 4 during the accumulation period
ACS5_ACC_ON_CMDS	number of firings for the ACS thruster 5 during the accumulation period
ACS6_ACC_ON_CMDS	number of firings for the ACS thruster 6 during the accumulation period
ACS7_ACC_ON_CMDS	number of firings for the ACS thruster 7 during the accumulation period
ACS8_ACC_ON_CMDS	number of firings for the ACS thruster 8 during the accumulation period
ACS1_ACC_ON_TIME	Accumulated ON time of the ACS thruster 1 during the accumulation period, in milliseconds

ACS2_ACC_ON_TIME	Accumulated ON time of the ACS thruster 2 during the accumulation period, in milliseconds
ACS3_ACC_ON_TIME	Accumulated ON time of the ACS thruster 3 during the accumulation period, in milliseconds
ACS4_ACC_ON_TIME	Accumulated ON time of the ACS thruster 4 during the accumulation period, in milliseconds
ACS5_ACC_ON_TIME	Accumulated ON time of the ACS thruster 5 during the accumulation period, in milliseconds
ACS6_ACC_ON_TIME	Accumulated ON time of the ACS thruster 6 during the accumulation period, in milliseconds
ACS7_ACC_ON_TIME	Accumulated ON time of the ACS thruster 7 during the accumulation period, in milliseconds
ACS8_ACC_ON_TIME	Accumulated ON time of the ACS thruster 8 during the accumulation period, in milliseconds
AVG_WARM_GAS_PLENUM_PRESSURE	Average ACS thruster warm gas plenum pressure over accumulation period, in psia

3.3.3.9 MAVEN Mission Additional Data

For the MAVEN mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

ATT_QUAT_Q1, ATT_QUAT_Q2, ATT_QUAT_Q3, ATT_QUAT_Q4, ACS1_ACC_ON_CMDS, ACS2_ACC_ON_CMDS, ACS3_ACC_ON_CMDS, ACS4_ACC_ON_CMDS, ACS5_ACC_ON_CMDS, ACS6_ACC_ON_CMDS, ACS7_ACC_ON_CMDS, ACS8_ACC_ON_CMDS, TCM1_ACC_ON_CMDS, TCM2_ACC_ON_CMDS, TCM3_ACC_ON_CMDS, TCM4_ACC_ON_CMDS, TCM5_ACC_ON_CMDS, TCM6_ACC_ON_CMDS, ACS1_ACC_ON_TIME, ACS2_ACC_ON_TIME, ACS3_ACC_ON_TIME, ACS4_ACC_ON_TIME, ACS5_ACC_ON_TIME, ACS6_ACC_ON_TIME, ACS7_ACC_ON_TIME, ACS8_ACC_ON_TIME, TCM1_ACC_ON_TIME, TCM2_ACC_ON_TIME, TCM3_ACC_ON_TIME, TCM4_ACC_ON_TIME, TCM5_ACC_ON_TIME, TCM6_ACC_ON_TIME

Where

ATT_QUAT_Q1	Imaginary element 1 of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the MMEJ2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.

ATT_QUAT_Q2	Imaginary element 2 of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the MMEJ2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ATT_QUAT_Q3	Imaginary element 3 of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the MMEJ2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ATT_QUAT_Q4	Real element of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the MMEJ2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ACS1_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 1
ACS2_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 2
ACS3_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 3
ACS4_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 4
ACS5_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 5
ACS6_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 6
ACS7_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 7
ACS8_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 8
TCM1_ACC_ON_CMDS	Number of firings during the accumulation period for TCM Thruster 1
TCM2_ACC_ON_CMDS	Number of firings during the accumulation period for TCM Thruster 2
TCM3_ACC_ON_CMDS	Number of firings during the accumulation period for TCM Thruster 3
TCM4_ACC_ON_CMDS	Number of firings during the accumulation period for TCM Thruster 4
TCM5_ACC_ON_CMDS	Number of firings during the accumulation period for TCM Thruster 5

TCM6_ACC_ON_CMDS	Number of firings during the accumulation period for TCM Thruster 6
ACS1_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 1, in milliseconds
ACS2_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 2, in milliseconds
ACS3_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 3, in milliseconds
ACS4_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 4, in milliseconds
ACS5_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 5, in milliseconds
ACS6_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 6, in milliseconds
ACS7_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 7, in milliseconds
ACS8_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 8, in milliseconds
TCM1_ACC_ON_TIME	Accumulated ON time during the accumulation period for the TCM Thruster 1, in milliseconds
TCM2_ACC_ON_TIME	Accumulated ON time during the accumulation period for the TCM Thruster 2, in milliseconds
TCM3_ACC_ON_TIME	Accumulated ON time during the accumulation period for the TCM Thruster 3, in milliseconds
TCM4_ACC_ON_TIME	Accumulated ON time during the accumulation period for the TCM Thruster 4, in milliseconds
TCM5_ACC_ON_TIME	Accumulated ON time during the accumulation period for the TCM Thruster 5, in milliseconds
TCM6_ACC_ON_TIME	Accumulated ON time during the accumulation period for the TCM Thruster 6, in milliseconds

3.3.3.10 ORX Mission Additional Data

For the ORX mission the additional data part of a small forces data record consists of the following parameters, occurring in the order in which they appear in the small forces APID. These data items are separated by commas and appear on the same line as, and after, the primary data.

ATT_QUAT_Q1, ATT_QUAT_Q2, ATT_QUAT_Q3, ATT_QUAT_Q4, ACS1_ACC_ON_CMDS, ACS2_ACC_ON_CMDS, ACS3_ACC_ON_CMDS, ACS4_ACC_ON_CMDS, ACS5_ACC_ON_CMDS, ACS6_ACC_ON_CMDS, ACS7_ACC_ON_CMDS, ACS8_ACC_ON_CMDS, ACS9_ACC_ON_CMDS, ACS10_ACC_ON_CMDS, ACS11_ACC_ON_CMDS, ACS12_ACC_ON_CMDS, ACS13_ACC_ON_CMDS, ACS14_ACC_ON_CMDS, ACS15_ACC_ON_CMDS, ACS16_ACC_ON_CMDS, ACS1_ACC_ON_TIME, ACS2_ACC_ON_TIME, ACS3_ACC_ON_TIME, ACS4_ACC_ON_TIME, ACS5_ACC_ON_TIME, ACS6_ACC_ON_TIME,

ACS7_ACC_ON_TIME, ACS8_ACC_ON_TIME, ACS9_ACC_ON_TIME, ACS10_ACC_ON_TIME, ACS11_ACC_ON_TIME, ACS12_ACC_ON_TIME, ACS13_ACC_ON_TIME, ACS14_ACC_ON_TIME, ACS15_ACC_ON_TIME, ACS16_ACC_ON_TIME

Where

ATT_QUAT_Q1	Imaginary element 1 of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the EME2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ATT_QUAT_Q2	Imaginary element 2 of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the EME2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ATT_QUAT_Q3	Imaginary element 3 of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the EME2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ATT_QUAT_Q4	Real element of the attitude quaternion at packet creation time. The quaternion, q, performs the transformation of a vector representation, v, from the EME2000 frame to the spacecraft body frame via the operation (q*)(v)(q), where q* is the conjugate of the quaternion.
ACS1_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 1
ACS2_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 2
ACS3_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 3
ACS4_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 4
ACS5_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 5
ACS6_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 6
ACS7_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 7

ACS8_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 8
ACS9_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 9
ACS10_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 10
ACS11_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 11
ACS12_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 12
ACS13_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 13
ACS14_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 14
ACS15_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 15
ACS16_ACC_ON_CMDS	Number of firings during the accumulation period for ACS Thruster 16
ACS1_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 1, milliseconds
ACS2_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 2, milliseconds
ACS3_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 3, milliseconds
ACS4_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 4, milliseconds
ACS5_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 5, milliseconds
ACS6_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 6, milliseconds
ACS7_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 7, milliseconds
ACS8_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 8, milliseconds
ACS9_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 9, milliseconds
ACS10_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 10, milliseconds
ACS11_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 11, milliseconds
ACS12_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 12, milliseconds
ACS13_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 13, milliseconds

ACS14_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 14, milliseconds
ACS15_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 15, milliseconds
ACS16_ACC_ON_TIME	Accumulated ON time during the accumulation period for the ACS Thruster 16, milliseconds

4. Sample Small Forces Files

Shown here are made-up examples of SFF data for all missions. The first two and the last two examples are for a “reconstruction” period with velocity data, as indicated by the “R” in the second field. A “P” would appear in this location for a “predict” velocity SFF. The third example is for a Stardust predict accelerations file.

Note that the data records do not have a fixed width format; rather, each data item is simply comma delimited from the previous item.

Note that in SDU predict files for both delta-V and acceleration the last four data items are given in scientific notation.

The data portion of each file begins with data record number one.

4.1 Example Reconstruction Small Forces File for Mars Polar Lander

```
MISSION_NAME = M98
SPACECRAFT_NAME = M98
DSN_SPACECRAFT_ID = 116
PRODUCTION_TIME = 1999-03-13 14:01:18
PRODUCER_ID = NAIF/JPL
$$EOH
1, R, ... etc.
2, R, ... etc.
...
2161, R, 1999-03-10 12:22:36, 1999-03-06 13:00:00.000, 1999-03-06 13:00:02.008, 2.008, 0, 0.002, 0.000, 0.000
2162, R, 1999-03-10 12:22:36, 1999-03-07 01:00:43.560, 1999-03-07 01:00:44.061, 0.500, 0, 0.000, 0.003, 0.000
2163, R, 1999-03-10 12:22:36, 1999-03-07 13:01:27.120, 1999-03-07 13:01:28.121, 1.001, 0, 0.002, 0.001, 0.000
2164, R, 1999-03-10 12:22:36, 1999-03-08 01:02:10.680, 1999-03-08 01:02:12.182, 1.501, 0, 0.000, 0.000, 0.004
2165, R, 1999-03-10 12:22:36, 1999-03-08 13:02:54.240, 1999-03-08 13:02:56.242, 2.002, 0, 0.002, 0.000, 0.001
2166, R, 1999-03-10 12:22:36, 1999-03-09 01:03:37.800, 1999-03-09 01:03:40.303, 2.502, 0, 0.000, 0.003, 0.000
2167, R, 1999-03-10 12:22:36, 1999-03-09 13:04:21.360, 1999-03-09 13:04:24.363, 3.003, 0, 0.000, 0.002, 0.002
2168, R, 1999-03-10 12:22:36, 1999-03-10 01:05:04.920, 1999-03-10 01:05:08.424, 3.503, 0, 0.003, 0.000, 0.000
2169, R, 1999-03-10 12:22:36, 1999-03-10 13:05:48.480, 1999-03-10 13:05:51.484, 3.004, 0, 0.003, 0.000, 0.000
2170, R, 1999-03-13 14:01:18, 1999-03-11 01:06:32.040, 1999-03-11 01:06:36.545, 4.504, 0, 0.001, 0.001, 0.000
2171, R, 1999-03-13 14:01:18, 1999-03-11 13:07:15.600, 1999-03-11 13:07:18.605, 3.000, 0, 0.000, 0.002, 0.000
2172, R, 1999-03-13 14:01:18, 1999-03-12 01:07:59.160, 1999-03-12 01:08:01.666, 3.505, 0, 0.000, 0.000, 0.005
2173, R, 1999-03-13 14:01:18, 1999-03-12 13:08:42.720, 1999-03-12 13:08:44.726, 2.006, 0, 0.001, 0.002, 0.001
...
etc.
```

4.2 Example Reconstruction Small Forces File for Stardust

This example is for a SFF containing delta-V information. In this example the “additional data” portion of each record is not shown due to the length of the data.

```
MISSION_NAME = Stardust
SPACECRAFT_NAME = Sdu
DSN_SPACECRAFT_ID = 29
PRODUCTION_TIME = 2001-11-10 13:04:21
PRODUCER_ID = NAIF/JPL
$$EOH
1, R, ...
...
7821, R, 2001-11-07 13:00:00, 2001-11-06 13:00:00.000, 2001-11-07 01:00:00.000, 43200.000, 0.003, 0.012, 0.006, 0.002
7822, R, 2001-11-08 01:00:43, 2001-11-07 01:00:43.560, 2001-11-07 13:00:43.560, 43200.000, 0.002, 0.002, 0.009, 0.001
7823, R, 2001-11-08 13:01:27, 2001-11-07 13:01:27.120, 2001-11-08 01:01:27.120, 43200.000, 0.004, 0.021, 0.009, 0.009
7824, R, 2001-11-09 01:02:10, 2001-11-08 01:02:10.680, 2001-11-08 13:02:10.680, 43200.000, 0.003, 0.001, 0.023, 0.001
7825, R, 2001-11-09 13:02:54, 2001-11-08 13:02:54.240, 2001-11-09 01:02:54.240, 43200.000, 0.001, 0.003, 0.002, 0.001
7826, R, 2001-11-10 01:03:37, 2001-11-09 01:03:37.800, 2001-11-09 13:03:37.800, 43200.000, 0.002, 0.009, 0.002, 0.003
7827, R, 2001-11-10 13:04:21, 2001-11-09 13:04:21.360, 2001-11-10 01:04:21.360, 43200.000, 0.004, 0.000, 0.011, 0.009
...
etc.
```

4.3 Example Predict Small Forces File with Acceleration Data for Stardust

This example is for a SFF containing acceleration information, as indicated by the use of the RECTYPE values of X and A (for discontinuous and continuous data, respectively).

```
MISSION_NAME = Stardust
SPACECRAFT_NAME = Sdu
DSN_SPACECRAFT_ID = 29
PRODUCTION_TIME = 1998-04-22 13:22:52
PRODUCER_ID = MD/JPL
$$EOH
1, X, 1998-04-22 13:22:52, 1999-02-06 21:43:04.000, 1999-02-07 21:43:04.000,  86400.000, -0.20006298E-07,  0.28752638E-08, -
0.46155846E-07, -0.19802151E-07
2, A, 1998-04-22 13:22:52, 1999-02-07 21:43:04.000, 1999-02-08 21:43:04.000,  86400.000, -0.20014215E-07,  0.39173617E-08, -
0.46038776E-07, -0.19946570E-07
3, A, 1998-04-22 13:22:52, 1999-02-08 21:43:04.000, 1999-02-09 21:43:04.000,  86400.000, -0.20017264E-07,  0.49553662E-08, -
0.45947732E-07, -0.19945546E-07
4, A, 1998-04-22 13:22:52, 1999-02-09 21:43:04.000, 1999-02-10 21:43:04.000,  86400.000, -0.20015754E-07,  0.59894216E-08, -
0.45834364E-07, -0.19913633E-07
5, A, 1998-04-22 13:22:52, 1999-02-10 21:43:04.000, 1999-02-11 21:43:04.000,  86400.000, -0.20009746E-07,  0.70185717E-08, -
0.45693879E-07, -0.19862674E-07
6, A, 1998-04-22 13:22:52, 1999-02-11 21:43:04.000, 1999-02-12 21:43:04.000,  86400.000, -0.19999274E-07,  0.80416247E-08, -
0.45525137E-07, -0.19796065E-07
7, A, 1998-04-22 13:22:52, 1999-02-12 21:43:04.000, 1999-02-13 21:43:04.000,  86400.000, -0.19984370E-07,  0.90573241E-08, -
0.45327907E-07, -0.19715219E-07
8, A, 1998-04-22 13:22:52, 1999-02-13 21:43:04.000, 1999-02-14 21:43:04.000,  86400.000, -0.19965066E-07,  0.10064401E-07, -
0.45102311E-07, -0.19620898E-07
```

...

etc.

4.4 Example Reconstruction Small Forces File for Genesis

This example is for a reconstructed Genesis SFF file. It contains both “primary” and “additional” data portions of each record.

```
MISSION_NAME = GNS
SPACECRAFT_NAME = Gns
DSN_SPACECRAFT_ID = 47
PRODUCTION_TIME = 2002-12-06 16:54:47
```

PRODUCER_ID = GNS_DMA/JPL
$$EOH
1, R, …
…
271, R, 2000-12-06 16:54:47, 2001-02-10 23:47:51.794, 2001-02-10 23:50:01.341, 129.547, 0.000000, 0.23491000, -0.16578500, -0.07240200, 635.812000, 480.234540, SPIN_CONTROL, CLOSED, CLOSED, CLOSED, CLOSED, STOWED, UNKNOWN, STOWED, UNKNOWN,STOWED, UNKNOWN, STOWED, UNKNOWN, 0.792290, -0.559148, -0.244192, 0.547001, 0.792329, -0.559102, -0.244172, 0.953446, 12, 14, TRUE, 170576934440
272, R, 2000-12-06 16:54:47, 2001-02-11 04:48:31.794, 2001-02-11 04:48:31.341, -0.453, 0.000000, 0.23491000, -0.16578500, -0.07240200, 635.812000, 480.234540, SPIN_CONTROL, CLOSED, CLOSED, CLOSED, CLOSED, STOWED, UNKNOWN, STOWED, UNKNOWN, STOWED, UNKNOWN, STOWED, UNKNOWN, 0.792290, -0.559148, -0.244192, 0.547001, 0.792329, -0.559102, -0.244172, 0.953446, 14, 16, TRUE, 170581934555
…

4.5 Example Reconstruction Small Forces File for Mars Odyssey 2001

This example is for a SFF containing delta-V information. In this example the “additional data” portion of each record is not shown due to the length of the data.

MISSION_NAME = M01
SPACECRAFT_NAME = Or1
DSN_SPACECRAFT_ID = 53
PRODUCTION_TIME = 2001-04-12 00:18:57
PRODUCER_ID = M01NAV
$$EOH
1, R, …
…
324, R, 2001-04-12 00:18:57, 2001-04-07 15:14:45.461, 2001-04-07 15:24:45.846, 600.385, 0.000000, -0.00415154, -0.00172720, -0.03472536, 0.11045263708,-0.32217410207, -0.94020485878, 0.00434873765, 171807857430
325, R, 2001-04-12 00:18:57, 2001-04-07 15:24:45.459, 2001-04-07 15:34:45.852, 600.393, 0.000000, 0.00069324, -0.01533687, 0.01435403, 0.61095130444, 0.74198502302, 0.24058885872, 0.13532844186, 171808011032
326, R, 2001-04-12 00:18:57, 2001-04-07 15:34:45.458, 2001-04-07 15:44:45.858, 600.401, 0.000000, -0.00143774, -0.00837084, 0.00414622, 0.96132498980, 0.13071690500, 0.15366849303, 0.18749238551, 171808164634
…

4.6 Example Reconstruction Small Forces File for Deep Impact Flyby Spacecraft

This example is for a reconstructed DIF delta-V SFF file. It contains both “primary” and “additional” data portions of each record.

MISSION_NAME = Di
SPACECRAFT_NAME = Dif
DSN_SPACECRAFT_ID = 140
PRODUCTION_TIME = 2004-11-24 18:11:16
PRODUCER_ID = NAIF/JPL
$$EOH
…
2, R, 2004-11-24 18:11:16, 2005-01-19 16:13:32.051, 2005-01-19 16:13:36.051, 4.000, 0.000000, 0.00048518, 0.00620842, 0.00014332, 0.000000, 0.000000, 0.000000, 0.000000, 2.346500, 0.000000, 0.000000, 2.364000, -1.67082179, -8.91650486, 0.27610654, -1.67059493, -8.91652870, 0.27610868, 740, 65405, 64459, 65338, 0.0000000000000000, 0.0000000000000000, 0.0000000000000000, 509, 506, 40812326878
3, R, 2004-11-24 18:11:16, 2005-01-19 16:13:36.051, 2005-01-19 16:13:40.051, 4.000, 0.000000, 0.00039268, 0.00327969, 0.00006500, 0.000000, 0.000000, 0.000000, 0.000000, 2.903500, 0.000000, 0.000000, 2.924500, -1.67072034, -8.91319656, 0.27616903, -1.67020226, -8.91324902, 0.27617368, 935, 65331, 64086, 65244, 0.0000000000000000, 0.0000000000000000, 0.0000000000000000, 512, 509, 40812327902
4, R, 2004-11-24 18:11:16, 2005-01-19 16:13:40.051, 2005-01-19 16:13:44.051, 4.000, 0.000000, 0.00021136, 0.00115871, 0.00003761, 0.000000, 0.000000, 0.000000, 0.000000, 3.102500, 0.000000, 0.000000, 3.127500, -1.67068875, -8.91201496,

0.27620521, -1.66999090, -8.91209030, 0.27621129, 1014, 65257, 63839, 65164, 0.0000000000000000, 0.0000000000000000, 0.0000000000000000, 515, 512, 40812328926
…

4.7 Example Reconstruction Small Forces File for Mars Reconnaissance Orbiter

This example is for a reconstructed MRO delta-V SFF file. It contains both "primary" and "additional" data portions of each record.

```
MISSION_NAME = MRO
SPACECRAFT_NAME = Mro
DSN_SPACECRAFT_ID = 74
PRODUCTION_TIME = 2005-07-06 19:54:49
PRODUCER_ID = MRONAV/JPL
$$EOH
1, R, 2005-07-06 19:54:49, 2005-09-08 19:03:56.182, 2005-09-08 19:05:37.596, 101
.414, 0.000000, 0.000000006570, -0.000000035506, 0.000000069052, 0.84754568338,
0.15530408919, -0.36973485351, 0.34762489796, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0
, 0, 0, 0, 100, 0, 100, 0, 100, 0, 100, 0, 0, 0, 0, 0, 0, 207532412522
2, R, 2005-07-06 19:54:49, 2005-09-08 19:05:37.182, 2005-09-08 19:05:37.698, 0.5
16, 0.000000, 0.000000006570, -0.000000035506, 0.000000069052, 0.84754562378, 0.
15530416369, -0.36973488331, 0.34762495756, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0,
0, 0, 0, 100, 0, 100, 0, 100, 0, 100, 0, 0, 0, 0, 0, 0, 207532412548
3, R, 2005-07-06 19:54:49, 2005-09-08 19:05:37.182, 2005-09-08 19:05:37.795, 0.6
13, 0.000000, 0.000000006570, -0.000000035506, 0.000000069052, 0.84754109383, 0.
15530833602, -0.36974099278, 0.34762775898, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0,
0, 0, 0, 100, 0, 100, 0, 100, 0, 100, 0, 0, 0, 0, 0, 0, 207532412573
4, R, 2005-07-06 19:54:49, 2005-09-08 19:05:37.182, 2005-09-08 19:05:37.897, 0.7
15, 0.000000, 0.000000009258, 0.000000028167, -0.000000067489, 0.84754055738, 0.
15530809760, -0.36974206567, 0.34762799740, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0,
0, 0, 0, 72, 0, 84, 0, 96, 0, 80, 0, 0, 0, 0, 0, 0, 207532412599
…
```

4.8 Example Predicted Small Forces File for Mars Reconnaissance Orbiter

This example is for a predicted MRO delta-V SFF file. Predicted MRO SFF files contain either only "primary" data items or both "primary" and "additional" data items. This example shows a predicted SFF with only "primary" data items.

```
MISSION_NAME = MRO
SPACECRAFT_NAME = Mro
DSN_SPACECRAFT_ID = 74
PRODUCTION_TIME = 2005-07-06 20:10:20
PRODUCER_ID = NAIF/JPL
$$EOH
1, P, 2005-07-06 20:10:20, 2007-12-05 17:00:12.784, 2007-12-05 17:00:12.886, 0.1
02, 0.000000, 0.000000673258, 0.000000739408, -0.000000000000, 225623337396
2, P, 2005-07-06 20:10:20, 2007-12-05 17:00:32.585, 2007-12-05 17:00:32.687, 0.1
02, 0.000000, 0.000000673258, 0.000000739408, -0.000000000000, 225623342465
3, P, 2005-07-06 20:10:20, 2007-12-05 17:00:42.784, 2007-12-05 17:00:42.886, 0.1
02, 0.000000, 0.000000673258, 0.000000739408, -0.000000000000, 225623345076
4, P, 2005-07-06 20:10:20, 2007-12-05 17:01:02.487, 2007-12-05 17:01:02.585, 0.0
98, 0.000000, 0.000000673258, 0.000000739408, -0.000000000000, 225623350119
…
```

4.9 Example Reconstruction Small Forces File for Phoenix

This example is for a reconstructed PHX delta-V SFF file. It contains both "primary" and "additional" data portions of each record.

```
MISSION_NAME = PHX
SPACECRAFT_NAME = Phx
DSN_SPACECRAFT_ID = 84
PRODUCTION_TIME = 2005-10-17 11:40:04
PRODUCER_ID = NAV
$$EOH
1, R, 2005-10-17 11:40:04, 2007-09-01 00:00:51.182, 2007-09-01 00:01:06.077, 14.895, 0.000000, -0.00571154,
-0.00841510, -0.00386997, 0.26526051760, 0.61763763428, 0.52138632536, 0.52565854788, 256, 271, 289, 269,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4441, 5400, 4779, 4283, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 223506435813
…
```

4.10 Example Reconstruction Small Forces File for Juno

This example is for a reconstructed Juno delta-V SFF file. It contains both "primary" and "additional" data portions of each record.

```
MISSION_NAME = JUNO
SPACECRAFT_NAME = Juno
DSN_SPACECRAFT_ID = 61
PRODUCTION_TIME = 2009-01-21 12:59:58
PRODUCER_ID = NAV
$$EOH
1, R, 2009-01-21 12:59:58, 2010-09-14 01:21:06.182, 2010-09-14 01:21:07.076, 0.895, 0.000000,
-0.010067529050, -0.003485348310, -0.002215722580, 0.26526051760, 0.61763763428, 0.52138632536,
0.52565854788, 256, 271, 289, 269, 256, 271, 0, 0, 0, 0, 0, 0, 4441, 5400, 4779, 4283, 4441, 5400,
0, 0, 0, 0, 0, 0, 4, 3, 86450995941
…
```

4.11 Example Reconstruction Small Forces File for GRAIL-A

This example is for a reconstructed GRAIL-A delta-V SFF file. It contains both "primary" and "additional" data portions of each record.

```
MISSION_NAME = GRL
SPACECRAFT_NAME = Gra
DSN_SPACECRAFT_ID = 177
PRODUCTION_TIME = 2010-05-05 16:45:13
PRODUCER_ID = NAV
$$EOH
1, R, 2010-05-05 16:45:13, 2010-12-29 12:01:04.184, 2010-12-29 12:01:05.079, 0.895, 0.000000, -0.010067529050, -0.003485348310,
-0.002215722580, 0.26526051760, 0.61763763428, 0.52138632536, 0.52565854788, 256, 271, 289, 269, 0, 0, 0, 0, 4441, 5400, 4779,
4283, 0, 0, 0, 0, 105, 88805376229
```

4.12 Example Reconstruction Small Forces File for MAVEN

This example is for a reconstructed MAVEN delta-V SFF file. It contains both “primary” and “additional” data portions of each record.

```
MISSION_NAME = MAVEN
SPACECRAFT_NAME = Mvn
DSN_SPACECRAFT_ID = 202
PRODUCTION_TIME = 2012-10-04 10:35:35
PRODUCER_ID = NAIF
$$EOH
1, R, 2012-10-04 10:35:35, 2014-01-01 12:24:17.183, 2014-01-01 12:24:19.078, 1.895, 0.000000, -0.005711453572, -0.008415163091,
-0.003869954627, 0.26526051760, 0.61763763428, 0.52138632536, 0.52565854788, 256, 271, 289, 269, 256, 271, 271, 271, 0, 0, 0, 0,
0, 0, 4441, 5400, 4779, 4283, 4441, 5400, 0, 0, 0, 0, 0, 0, 0, 0, 28957146801407
```

4.13 Example Reconstruction Small Forces File for ORX

This example is for a reconstructed ORX delta-V SFF file. It contains both “primary” and “additional” data portions of each record.

```
MISSION_NAME = ORX
SPACECRAFT_NAME = Orx
DSN_SPACECRAFT_ID = 64
PRODUCTION_TIME = 2015-03-04 09:03:21
PRODUCER_ID = NAIF
$$EOH
1, R, 2015-03-04 09:03:21, 2014-01-01 12:24:17.183, 2014-01-01 12:24:19.078, 1.895, 0.000000, -0.010067529050, -0.003485348310,
-0.002215722580, 0.26526051760, 0.61763763428, 0.52138632536, 0.52565854788, 256, 271, 289, 269, 256, 271, 271, 271, 256, 271,
289, 269, 256, 271, 271, 271, 4441, 5400, 4779, 4283, 4441, 5400, 0, 0, 4441, 5400, 4779, 4283, 4441, 5400, 0, 0, 28957146801407
```