BepiColombo Annex to the PSA PDS4 Archiving Guide

BepiColombo SGS

30 January, 2026

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ISSUED 2.4 BCS-SGS-TN-043-BepiColombo_Annex_Archiving_Guide_2_4.pdf[1]

IN DRAFT 2.5

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1. https://s2e2.cosmos.esa.int/confluence/download/attachments/434615014/BCS-SGS-TN-043-BepiColombo_Annex_Archiving_Guide_2_4.pdf?api=v2&modificationDate=1710750880000&version=1

1 Introduction

1.1 Purpose and Scope

This document is the BepiColombo Annex to the PSA PDS4 Archiving Guide[2][AD.02]. These two documents together define the set of guidelines, rules, common terminologies and conventions to be followed by all BepiColombo Instrument Teams (and any other science data providers) when generating and submitting their science data and associated products to the Science Ground Segment (SGS) for archiving.

- The PSA PDS4 Archiving Guide [AD.02] is intended to cover all needs at the level of the PSA overall. It also serves as a quick introduction to the PDS4 standards (fully described in [AD.03], [AD.04] and [AD.05]).
- The present document defines specific rules and conventions at the level of the BepiColombo mission. These rules and conventions are defined and agreed at Data Handling and Archiving Working Group (DHAWG) level, following the recommendations of the PSA personnel, and are valid for all phases of the BepiColombo mission.

This is a living document that will be edited and updated throughout the mission lifetime to cover arising needs and requirements.

1.2 Applicable Documents

The following documents, of the issue given here-under, are pertinent to the extent specified herein and impose requirements to the SGS or the SGS schedule. They are referenced in the form [AD XX]:

- [AD.01] BC-SGS-PL-014, BepiColombo Science Data Generation, Validation and Archiving Plan
- [AD.02] ESDC-PSA-TN-0002, PSA PDS4 Archiving Guide (former SRE-OE-TN-00174)
- [AD.03] PDS4 Standards Reference (SR)
- [AD.04] PDS4 Data Dictionary (DDDB)
- [AD.05] PDS4 Information Model Specification (IM)

1.3 Reference Documents

The following documents, of the issue given hereunder, although not part of this document, amplify or clarify its contents. If no issue given, the most recent issue should be used. They are referenced in the form [RD.XX]:

- [RD.01] PDS4 Data Providers Handbook (DPH)
- [RD.02] PDS4 Concepts
- [RD.03] BC-SGS-LI-014, SGS Glossary

2. https://s2e2.cosmos.esa.int/confluence/display/PSAPUB1/PDS4+Archiving+Guide

1.4 Abbreviations and Acronyms

See BepiColombo online Glossary [RD.03].

2 PDS4 Information Model and Dictionary Versions

This section is a reference of the versions of the PDS4 information model (IM) and corresponding discipline, mission and project dictionaries that should be referenced in archive product development, and used in validation.

Since PDS is incrementally releasing new versions of the PDS4 standards as it matures, the PSA and the SGS are continuously monitoring the progress of the PDS4 releases and applying the required changes to this document and to the existing PSA and BepiColombo dictionaries. Progress reports are regularly provided through the DHAWG. Changes to the applicable versions of the standards and dictionaries might be required during the mission lifetime, and will be agreed with the DHAWG and documented in this table.

The following table also includes links to the applicable versions of the tools used in the production, validation and delivery of PDS4 products for BepiColombo.

Each relevant dictionary should be listed twice in each label, to point to the Schematron and schema. The following example shows how the start of a Product_Observational label would look when using dictionaries defined in stack number 6 in Table 1. Note that in this example the imaging and display dictionaries are not used. Be careful to note that the version numbers of some dictionaries are given with hex digits (e.g. 1A10)! Instrument specific dictionaries need to be added on top of this example, where relevant.

The SGS also provides a tool to allow validation and packaging of products for delivery, the PDS4 packager. This can be found online here: https://planetary.esac.esa.int/pds4-packager

This tool provides all of the relevant dictionaries listed in the "stacks" below and is configured to perform validation and packaging of products placed into a flat directory structure. This can be used for product testing during development (see the documentation for pds4-packager-validate) and for packaging for delivery to the SGS and archive.

Note that from stack 6 onward, reference to the schema and schematron (.xsd and .sch) files in the label headers should be made with https, but namespaces (e.g. ending in /v1) are still http!

Product_Observational snippet with dictionaries from stack 6

```
1  <?xml version="1.0" encoding="UTF-8"?>
2  <?xml-model href="https://pds.nasa.gov/pds4/pds/v1/PDS4_PDS_1B00.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
3  <?xml-model href="https://pds.nasa.gov/pds4/geom/v1/PDS4_GEOM_1A10.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
4  <?xml-model href="https://psa.esa.int/psa/v1/PDS4_PSA_1200.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
5  <?xml-model href="https://psa.esa.int/psa/bc/v1/PDS4_PSA_BC_1005.sch"
   schematypens="http://purl.oclc.org/dsdl/schematron"?>
6
7  <Product_Observational
8    xmlns="http://pds.nasa.gov/pds4/pds/v1"
9    xmlns:bc="http://psa.esa.int/psa/bc/v1"
10   xmlns:geom="http://pds.nasa.gov/pds4/geom/v1"
```

```
11    xmlns:psa="http://psa.esa.int/psa/v1"
12    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
13    xsi:schemaLocation="
14      http://pds.nasa.gov/pds4/pds/v1 https://pds.nasa.gov/pds4/pds/v1/
PDS4_PDS_1B00.xsd
15      http://pds.nasa.gov/pds4/geom/v1 https://pds.nasa.gov/pds4/geom/v1/
PDS4_GEOM_1A10.xsd
16      http://psa.esa.int/psa/v1 https://psa.esa.int/psa/v1/PDS4_PSA_1200.xsd
17      http://psa.esa.int/psa/bc/v1 https://psa.esa.int/psa/bc/v1/
PDS4_PSA_BC_1005.xsd">
```

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
22	unreleased	1.22.0.0	PDS4_GEOM_1M00_1970 PDS4_IMG_1M00_1900 PDS4_DISP_1M00_1510 PDS4_SP_1M00_1320 PDS4_PARTICLE_1M00_2020 PDS4_MULTI_1M00_2000	PDS4_PSA_1M00_1500	BC: PDS4_BC_1M00_2010 MAG: PDS4_BC_MPO_MAG_1M00_1002 BEL: PDS4_BC_MPO_BEL_1M00_1001 ISA: PDS4_BC_MPO_ISA_1M00_1001 SRN: PDS4_BC_MPO_SRN_1M00_1004 SIX: PDS4_BC_MPO_SIX_1M00_1100 MRE: PDS4_BC_MPO_MRE_1M00_1002 PHE: PDS4_BC_MPO_PHE_1M00_1020 SIM: PDS4_BC_MPO_SIM_1M00_1000 ?		• Added SIMBIO-SYS dictionary • Updated PHEBUS dictionary • added geometry class and attributes

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change

21	05 Aug 2025	1.22.0.0	PDS4_GEOM_1M00_1970
			PDS4_IMG_1M00_1900
			PDS4_DISP_1M00_1510
			PDS4_SP_1M00_1320
			PDS4_PARTICLE_1M00_2020
			PDS4_MULTI_1M00_2000
				PDS4_PSA_1M00_1500	BC: PDS4_BC_1M00_2010
					
					MAG: PDS4_BC_MPO_MAG_1M00_1002
					BEL: PDS4_BC_MPO_BEL_1M00_1001
					ISA: PDS4_BC_MPO_ISA_1M00_1001
					SRN: PDS4_BC_MPO_SRN_1M00_1004
					SIX: PDS4_BC_MPO_SIX_1M00_1100
					MRE: PDS4_BC_MPO_MRE_1M00_1002
						PDS4 Packager >= 2.6	▪ Updated Bepi dictionary
							  ▪ added geometry class and attributes
							▪ Updated SERENA dictionary
							  ▪ changed units for ELENA voltage parameters

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change

20	06 Feb 2025	1.22.0.0	PDS4_GEOM_1M00_1970
			PDS4_IMG_1M00_1900
			PDS4_DISP_1M00_1510
			PDS4_SP_1M00_1320
			PDS4_PARTICLE_1M00_2020
			PDS4_MULTI_1M00_2000
				PDS4_PSA_1M00_1500	BC: PDS4_BC_1M00_2000
					MAG: PDS4_BC_MPO_MAG_1M00_1002
					BEL: PDS4_BC_MPO_BEL_1M00_1001
					ISA: PDS4_BC_MPO_ISA_1M00_1001
					SRN: PDS4_BC_MPO_SRN_1M00_1003
					SIX: PDS4_BC_MPO_SIX_1M00_1100
					MRE: PDS4_BC_MPO_MRE_1M00_1002
					PHE: PDS4_BC_MPO_PHE_1M00_1000
						PDS4 Packager >= 2.6	• Update to PDS4 IM 1.22.0.0 (1M00)
							  • **no further changes to the IM version are foreseen until the post-operations phase**
							• Update to corresponding discipline dictionaries
							• Update to PSA dictionary 1500
							  • enforces new version-in-filename rule
							• Update to Bepi dictionary 2.0.0.0
							  • enforces new mission phase class usage
							• Update of all instrument dictionaries to build against 1M00
							  • Updated SIXS dictionary to v1100 (added units)
							• Added new discipline dictionaries:
							  • particle
							  • multi-dimensional

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Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
18	**unreleased**	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1401	BC: PDS4_BC_1F00_1201 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1002 SIX: PDS4_BC_MPO_SIX_1F00_1100 MRE: PDS4_BC_MPO_MRE_1F00_1002 SIM: PDS4_BC_MPO_SIM_1F00_1000 PHE: PDS4_BC_MPO_PHE_1F00_1020	Multi-mission packager >= 2.2	▪ Updated PHEBUS dictionary • added geometry class and attributes ▪ Updated Bepi dictionary • added geometry class and attributes

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
17	09 Jan 2025	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1401	BC: PDS4_BC_1F00_1200 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1002 SIX: PDS4_BC_MPO_SIX_1F00_1100 MRE: PDS4_BC_MPO_MRE_1F00_1002 SIM: PDS4_BC_MPO_SIM_1F00_1000 PHE: PDS4_BC_MPO_PHE_1F00_1010	Multi-mission packager >= 2.2	Updated dictionaries: • SIXS (v1100, 1F00)

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
16	25 Sep 2024	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1401	BC: PDS4_BC_1F00_1200 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1002 SIX: PDS4_BC_MPO_SIX_1F00_1000 MRE: PDS4_BC_MPO_MRE_1F00_1002 SIM: PDS4_BC_MPO_SIM_1F00_1000 PHE: PDS4_BC_MPO_PHE_1F00_1010	Multi-mission packager >= 2.2	Updated dictionaries: • PHEBUS

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change

15	05 Aug 2024	1.15.0.0	PDS4_GEOM_1F00_1910
			PDS4_IMG_1F00_1810
			PDS4_DISP_1F00_1500
			PDS4_SP_1F00_1300
				PDS4_PSA_1F00_1401	BC: PDS4_BC_1F00_1200
					MAG: PDS4_BC_MPO_MAG_1F00_1002
					BEL: PDS4_BC_MPO_BEL_1F00_1001
					ISA: PDS4_BC_MPO_ISA_1F00_1001
					SRN: PDS4_BC_MPO_SRN_1F00_1002
					SIX: PDS4_BC_MPO_SIX_1F00_1000
					MRE: PDS4_BC_MPO_MRE_1F00_1002
					SIM: PDS4_BC_MPO_SIM_1F00_1000
					PHE: PDS4_BC_MPO_PHE_1F00_1000
						Multi-mission packager >= 2.2	Addition of new dictionaries:
							• SIMBIO-SYS
							• PHEBUS
							Updated dictionaries:
							• PSA
							  • adds checks for links to target context products
							  • moves some checks to mission dictionaries
							• BepiColombo
							  • adds checks removed from PSA dictionary

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
14	07 Mar 2024	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1301	BC: PDS4_BC_1F00_1101 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1002 SIX: PDS4_BC_MPO_SIX_1F00_1000 MRE: PDS4_BC_MPO_MRE_1F00_1002	Multi-mission packager >= 2.2	Addition of new dictionaries: • SIXS Updated dictionaries: • MORE
13	10 Aug 2023	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1301	BC: PDS4_BC_1F00_1101 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 MRE: PDS4_BC_MPO_MRE_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1002	Multi-mission packager >= 2.2	Updated dictionaries: • SERENA

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
12	08 May 2023	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1301	BC: PDS4_BC_1F00_1101 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 MRE: PDS4_BC_MPO_MRE_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1001	Multi-mission packager >= 2.2	Updated dictionaries: ▪ SERENA
11	17 Jan 2023	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1301	BC: PDS4_BC_1F00_1101 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 MRE: PDS4_BC_MPO_MRE_1F00_1001 SRN: PDS4_BC_MPO_SRN_1F00_1000	Multi-mission packager >= 2.2	Addition of SERENA dictionary

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
10	20 May 2022	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1301	BC: PDS4_BC_1F00_1101 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1001 MRE: PDS4_BC_MPO_MRE_1F00_1001	Multi-mission packager >= 2.0	Updated Bepi and PSA dictionaries. Changes include: • addition of PHEBUS NUV sub-instrument • enforce inclusion of psa:processing_software_version • check for modification history with VID=product VID Updated ISA dictionary to version 1.0.0.1
9	May 2021	1.15.0.0	PDS4_GEOM_1F00_1910 PDS4_IMG_1F00_1810 PDS4_DISP_1F00_1500 PDS4_SP_1F00_1300	PDS4_PSA_1F00_1300	BC: PDS4_BC_1F00_1100 MAG: PDS4_BC_MPO_MAG_1F00_1002 BEL: PDS4_BC_MPO_BEL_1F00_1001 ISA: PDS4_BC_MPO_ISA_1F00_1000 MRE: PDS4_BC_MPO_MRE_1F00_1001	PDS Packager[3] >= 1.4.4	• Upgrade to Information Model 1F00 and associated discipline, PSA, mission and instrument dictionaries • Included spectral discipline dictionary. • Added ISA dictionary Import notes: ▪ Primary_Results_Summary/ Science_Facets/ wavelength_range must be included (it can be nilled) ▪ /Product_Observational/ Observation_Area/ Observing_System/ Observing_System_Component referencing the host spacecraft must have type "Host" not "Spacecraft"

3. http://bepicolombo.esac.esa.int/bscs-pds4-packager/doc/

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
8	November 2020	1.11.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.2.0.0	BC: 1.0.0.5 MAG: 1.0.0.1 BEL: 1.0.0.0 MRE: 1.0.0.0	PDS Packager[4] >=1.3.2	Added MORE dictionary
7	August 2020	1.11.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.2.0.0	BC: 1.0.0.5 MAG: 1.0.0.1 BEL: 1.0.0.0	PDS Packager[5] >=1.3.2	Updated MPO-MAG dictionary
6	July 2020	1.11.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.2.0.0	BC: 1.0.0.5 MAG: 1.0.0.0 BEL: 1.0.0.0	PDS Packager[6] >=1.3.2	Updates to PSA and Bepi dictionaries Addition of BELA and MPO-MAG dictionaries
5	September 2019	1.11.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.1.0.1	BC: 1.0.0.4	PDS Packager[7] v1.0.0 validate: 1.14 (zip[8], tar.gz[9])	Upgrades to the PSA dictionary Upgraded product packager.

4. http://bepicolombo.esac.esa.int/bscs-pds4-packager/doc/
5. http://bepicolombo.esac.esa.int/bscs-pds4-packager/doc/
6. http://bepicolombo.esac.esa.int/bscs-pds4-packager/doc/
7. http://bepicolombo.esac.esa.int/bscs-pds4-packager/doc/
8. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.14.0-bin.zip
9. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.14.0-bin.tar.gz

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
4	May 2019	1.11.1.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.1.0.0	BC: 1.0.0.4	BSCS 1.11.0 (zip[10], tar.gz[11]) validate: 1.14 (zip[12], tar.gz[13])	Upgrades to the PSA and BepiColombo dictionaries. Upgraded product packager.
3	January 2019	1.11.1.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.0.0.0	BC: 1.0.0.2	BSCS 1.7.0 (zip[14], tar.gz[15]) validate: 1.14 (zip[16], tar.gz[17]	Upgrade to latest PDS4 validate tool. Additional validation rules added BepiColombo dictionaries.

10. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/1.11.0/bscs-dps-packager-1.11.0.zip
11. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/1.11.0/bscs-dps-packager-1.11.0.tar.gz
12. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.14.0-bin.zip
13. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.14.0-bin.tar.gz
14. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/1.7.0/bscs-dps-packager-1.7.0.zip
15. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/1.7.0/bscs-dps-packager-1.7.0.tar.gz
16. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.14.0-bin.zip
17. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.14.0-bin.tar.gz

Stack #	Applicable since	PDS4 IM	Discipline Dictionaries	PSA Dictionary	BepiColombo Dictionaries	PDS4 Product Packager *with PDS4 validate tool*	Reason for Change
2	November 2018	1.11.1.0.0	Geometry: 1.10.1.0 Imaging: 1.10.1.0 Display: 1.11.0.0	1.0.0.0	BC: 1.0.0.0	BSCS 1.5.0 (zip[18], tar.gz[19]) validate: 1.11 (zip[20], tar.gz[21]	Upgrade to latest PDS information model.
1	June 2017	1.8.0.0	Geometry: 1.6.0.0 Imaging: n/a Display: n/a	1.0.0.0	BC: 1.0.0.0	BSCS 0.5.4 (zip[22], tar.gz[23]) validate: 1.11 (zip[24], tar.gz[25])	Upgrade to latest PDS information model.

Table 1: Change record for applicable PDS4 information model and dictionary versions

Please note the following resources when preparing to use the appropriate dictionaries:

- Entries marked as "unreleased" should not be used, since these are under active development

18. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/1.5.0/bscs-dps-packager-1.5.0.zip
19. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/1.5.0/bscs-dps-packager-1.5.0.tar.gz
20. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.11.0-bin.zip
21. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.11.0-bin.tar.gz
22. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/0.5.4/bscs-dps-packager-0.5.4.zip
23. https://bepicolombo.esac.esa.int/nexus/repository/releases/esa/bscs/dps/packager/bscs-dps-packager/0.5.4/bscs-dps-packager-0.5.4.tar.gz
24. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.11.0-bin.zip
25. ftp://pds.nasa.gov/pub/toplevel/2010/preparation/validate-1.11.0-bin.tar.gz

- PDS4 Information Model (IM) schemas and Discipline Dictionaries can be found at: https://pds.nasa.gov/datastandards/schema/released/
  - A copy of the applicable schemas is available in the PSA git repository for convenience: https://s2e2.cosmos.esa.int/bitbucket/projects/PSAAS/repos/psa.pds4/browse/pds/xml_schema
- PSA PDS4 Dictionaries are available in the following PSA PDS git repository: https://s2e2.cosmos.esa.int/bitbucket/projects/PSAAS/repos/psa.pds4/browse/psa/psa_bundle/xml_schema
- BepiColombo PDS4 Dictionaries are available in the BepiColombo PDS git repository: https://s2e2.cosmos.esa.int/bitbucket/projects/PDS4XML/repos/bepi.pds4/browse

3 Data organisation

See chapter 3 of the PSA PDS4 Archiving Guide [AD.2] for the requirements on data organisation. Based on those requirements, the following bundles are defined for the BepiColombo mission:

- 1 bundle for the BepiColombo mission
- 1 bundle for SPICE information
- 1 MTM bundle
  - 1 bundle for the monitoring camera (MCAM)
- 12 MPO bundles
  - 11 bundles, 1 for each instrument
  - 1 bundle for the radiation monitor (BERM)
- 6 MMO bundles
  - 5 instrument bundles, 1 for each instrument
  - 1 bundle for the radiation monitor (SPM)

Details on the structure and logical identifiers for the BepiColombo bundles are detailed in the following sub-sections. Note that the monitoring camera system (MCAM) is included with MPO instruments here, but in fact it is associated in the archive with the Mercury Transfer Module (MTM), on which it is physically installed.

3.1 Mission Bundle

The mission bundle (bundle_bc) has the following data:

- Bundle identifier: bc
- Description: Master Bundle for BepiColombo metadata
- Logical Identifier (LID): urn:esa:psa:bc

The corresponding bundle structure is shown below:

BC master bundle

```
<bc>
    bundle_bc.xml
    readme_bc.txt
    <context>
        collection_context.xml
        collection_context.tab
    <document>
        collection_document.xml
        collection _document.tab
        [ documents ]
    <miscellaneous>
        collection_miscellaneous.csv
        collection_miscellaneous.xml
```

```
        clock_partition.tab
        clock_partition.xml
        mission_phases.tab
        mission_phases.xml
        observation_log.tab
        observation_log.xml
        target_visibility_windows.csv
        target_visibility_windows.xml

        <spacecraft_housekeeping>
            <mission_phase>
                [ spacecraft houskeeping products ]
    <xml_schema>
        collection _xml_schema.xml
        collection _xml_schema.tab
        [ schemas ]
```

3.1.1 Mission context collection

The <context> collection in the BepiColombo mission bundle contains an inventory listing (as secondary members) the applicable context products for the BepiColombo mission. These describe the instruments, instrument hosts (i.e. spacecraft) and investigation (i.e. the BepiColombo mission). These are used in PDS4 internal references to associate products to instruments and missions, for example. References are always made via the logical identifier (LID). These products are physically contained in a PSA-wide context bundle (where they are primary members). This can be access via the PSA FTP: https://psaftp.esac.esa.int/#/context/

All of the context items in the mission context collection are summarised below.

Context Area Section	Name	Type	LID	Reference Type
Investigation_Area	BepiColombo	Mission	urn:esa:psa:context:investigation:mission.bc	data_to_investigation
Observing_System	MTM	Spacecraft (IM < 1F00) Host (IM >= 1F00)	urn:esa:psa:context:instrument_host:spacecraft.mtm	is_instrument_host
Observing_System	MCAM	Instrument	urn:esa:psa:context:instrument:mcam.mtm (< 1F00) urn:esa:psa:context:instrument:mtm.mcam (>= 1F00)	is_instrument

Context Area Section	Name	Type	LID	Reference Type
Observing_System	MPO	Spacecraft (IM < 1F00) Host (IM >= 1F00)	urn:esa:psa:context:instrument_host:spacecraft.mpo	is_instrument_host
Observing_System	BELA	Instrument	urn:esa:psa:context:instrument:bela.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.bela (>= 1F00)	is_instrument
Observing_System	BERM	Instrument	urn:esa:psa:context:instrument:berm.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.berm (>= 1F00)	is_instrument
Observing_System	ISA	Instrument	urn:esa:psa:context:instrument:isa.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.isa (>= 1F00)	is_instrument
Observing_System	MPO-MAG	Instrument	urn:esa:psa:context:instrument:mag.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.mag (>= 1F00)	is_instrument
Observing_System	MERTIS	Instrument	urn:esa:psa:context:instrument:mertis.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.mertis (>= 1F00)	is_instrument
Observing_System	MGNS	Instrument	urn:esa:psa:context:instrument:mgns.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.mgns (>= 1F00)	is_instrument
Observing_System	MIXS	Instrument	urn:esa:psa:context:instrument:mixs.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.mixs (>= 1F00)	is_instrument
Observing_System	MORE	Instrument	urn:esa:psa:context:instrument:more.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.more (>= 1F00)	is_instrument

Context Area Section	Name	Type	LID	Reference Type
Observing_System	PHEBUS	Instrument	urn:esa:psa:context:instrument:phebus.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.phebus (>= 1F00)	is_instrument
Observing_System	SERENA	Instrument	urn:esa:psa:context:instrument:serena.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.serena (>= 1F00)	is_instrument
Observing_System	SIMBIO-SYS	Instrument	urn:esa:psa:context:instrument:simbio-sys.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.simbio-sys (>= 1F00)	is_instrument
Observing_System	SIXS	Instrument	urn:esa:psa:context:instrument:sixs.mpo (< 1F00) urn:esa:psa:context:instrument:mpo.sixs (>= 1F00)	is_instrument
Observing_System	MMO	Spacecraft (IM < 1F00) Host (IM >= 1F00)	urn:esa:psa:context:instrument_host:spacecraft.mmo	is_instrument_host
Observing_System	MSASI	Instrument	urn:jaxa:darts:context:instrument:mmo.msasi	is_instrument
Observing_System	PWI	Instrument	urn:jaxa:darts:context:instrument:mmo.pwi	is_instrument
Observing_System	MGF	Instrument	urn:jaxa:darts:context:instrument:mmo.mgf	is_instrument
Observing_System	MDM	Instrument	urn:jaxa:darts:context:instrument:mmo.mdm	is_instrument
Observing_System	SPM	Instrument	urn:jaxa:darts:context:instrument:mmo.spm	is_instrument

Table 2: Context products in the BepiColombo mission bundle

These context products contain information about the entities to which they refer (e.g. instruments, spacecraft and mission) and should be kept up-to-date. Data products link to these products to give the end user context and important information, and they may automatically be served in downloads alongside requested data.

These products contain fundamental information about each instrument in particular (description, references to papers, citation information, instrument type). For updates, please send revised labels or information to the Archive Scientist.

3.2 MPO Instrument Bundles

The following table includes the list of data bundles containing the science data resulting from the instruments on-board MPO. Details of the content, organisation and format of each of these bundles can be found in the corresponding EAICD (see Reference Document).

Instrument	Bundle LID	Reference Document
bela	urn:esa:psa:bc_mpo_bela	BELA EAICD
berm	urn:esa:psa:bc_mpo_berm	BERM EAICD
isa	urn:esa:psa:bc_mpo_isa	ISA EAICD
mpo-mag	urn:esa:psa:bc_mpo_mag	MPO-MAG EAICD
mcam	urn:esa:psa:bc_mtm_mcam	MCAM EAICD
mertis	urn:esa:psa:bc_mpo_mertis	MERTIS EAICD
mgns	urn:esa:psa:bc_mpo_mgns	MGNS EAICD
mixs	urn:esa:psa:bc_mpo_mixs	MIXS EAICD
more	urn:esa:psa:bc_mpo_more	MORE EAICD
phebus	urn:esa:psa:bc_mpo_phebus	PHEBUS EAICD
serena	urn:esa:psa:bc_mpo_serena	SERENA EAICD
simbio-sys	urn:esa:psa:bc_mpo_simbio-sys	SIMBIO-SYS EAICD

Instrument	Bundle LID	Reference Document
sixs	urn:esa:psa:bc_mpo_sixs	SIXS EAICD

Table 3: MPO Instrument bundles

Products inside the collections are organised in sub-directories according to the rules described in the PSA PDS4 Archiving Guide [AD.2], following the criteria:

- Mission phase
- Sub-Instrument or Sub-Unit (when applicable / convenient) [optional]
- Other criteria e.g. experiment type, observation type, product type, instrument mode or purpose of the data [optional]
- Range of days or orbits

Exceptions may be made for collections containing only a few products, in which case the products can be stored directly in the collection sub-directory (this is typically the case in a “document” collection). Similarly, products which are cumulative (i.e. they are incrementally expanded to include new data) may be placed in the root of a collection. Concrete guidelines are provided in the following table:

Collection	Folder structure

data_<$processing_level_id>	data_<$processing_level_id>/
	  <$mission_phase_id>/
	  [<$sub-instrument_id> or [<$sub-unit_id>]
	
	[<$experiment_type> or <$observation_id> or <$product_type>]
	  Range of days (e.g. YYYYMMDD_YYYYMMDD)
	  Range of orbits (e.g. ORBIT_NNNNN_MMMMM)

Collection	Folder structure
browse[_$processing_level_id]	Typically this follows the same folder structure as the data collections. If browse products are produced for multiple processing levels, browse collection names should mirror the data collections (e.g. browse_raw for browse products corresponding to data_raw data products). If browse products are provided for only one level, a simple browse folder may be used.
calibration_<$processing_level_id>	Calibration observations (e.g. observations of an internal calibration source, or of a star) should be stored in a calibration collection at either raw or partially_processed level.
calibration_files	If one-to-one mapping with data products, this typically follows the same folder structure as the data collections; otherwise to be defined case-by-case. See the PSA PDS4 Archiving Guide [AD.2] for more details on the organisation of the calibration files / data.
geometry	If one-to-one mapping with data products, this typically follows the same folder structure as the data collections; otherwise to be defined case-by-case.
document	Typically flat structure (no sub-folders needed), but they can be used (e.g. for instruments with multiple sub-units).

Table 4: Typical folder organisation per collection

The following shows an example of such a structure for a raw data collection from the SIXS instrument:

Collection LID: urn:esa:psa:bc_mpo_sixs:data_raw

Directory structure:

```
bc_mpo_sixs
    data_raw
        collection_mpo_sixs_data_raw.xml
        collection_mpo_sixs_data_raw.tab
```

```
cruise
sixs-x
    <YYYYMMDD_ YYYYMMDD>
        six_raw_sc_sixs-x_spectra_<YYYYMMDD>.xml
        six_raw_sc_sixs-x_spectra_<YYYYMMDD>.fit
sixs-p
    <YYYYMMDD _ YYYYMMDD>
        six_raw_sc_sixs-x_spectra_<YYYYMMDD>.xml
        six_raw_sc_sixs-x_spectra_<YYYYMMDD>.fit
housekeeping
    <YYYYMMDD _ YYYYMMDD>
        six_raw_hk_<YYYYMMDD>.xml
        six_raw_hk_<YYYYMMDD>.fit
```

3.3 MMO Instrument Bundles

The following table will include the list of science data bundles containing the science data resulting from the instruments on-board MMO. To be included for completeness when the information becomes available.

Instrument	Bundle LID	Reference Document
msasi	urn:jaxa:darts:bc_mmo_msasi	TBD
pwi	urn:jaxa:darts:bc_mmo_pwi	TBD
mgf	urn:jaxa:darts:bc_mmo_mgf	TBD
mppe	urn:jaxa:darts:bc_mmo_mppe	TBD
mdm	urn:jaxa:darts:bc_mmo_mdm	TBD
spm	urn:jaxa:darts:bc_mmo_spm	TBD

Table 5: MMO Instrument bundles

4 Metadata conventions and requirements

4.1 Label and filename conventions

4.1.1 Versions in filenames

As of stack 20 and PDS information model version 1M00 the PSA file naming convention has been updated so that versions (major and minor) are included in label and data filenames. This change has been made to allow muliple versions of the same product to be stored in he same physical directory without filesystem name conflicts. Note that the logical identifier (LID) should **never** include the version (VID).

The following rules should be followed:

- versions should be added to both label and data filenames
- versions will follow the product ID and be separated by a double-underscore
    - hence the sequence "__" should not appear anywhere else in the filename
- the major and minor versions will be separated by a single underscore

For example in this LIDVID:

```
urn:esa:psa:bc_mpo_mixs:data_raw:mix_raw_hk_mixs-c_report_20240410::0.1
```

the old filenames were:

- `mix_raw_hk_mixs-c_report_20240410.xml`
- `mix_raw_hk_mixs-c_report_20240410.tab`

and these will become

- `mix_raw_hk_mixs-c_report_20240410__0_1.xml`
  `mix_raw_hk_mixs-c_report_20240410__0_1.tab`

The PSA dictionary referenced in stack 20 (PDS4_PSA_1M00_1500) and above will apply checks to ensure that this format is followed and that the VID referenced in the Identification_Area matches that in the filenames.

4.1.2 Label extension

From stack 20 (Information model version 1M00) the PDS4 label extension to be used is .lblx (instead of .xml). This provides a unique way of identifying the label, and allows XML documents to be archived without software having to parse the XML to decide if a file is a PDS4 label or not.

4.2 Mission and Instrument Hosts

The information about the mission and its instrument hosts (spacecraft) is located in the <Investigation> and <Instrument_Host> classes of the corresponding “context” products as described in Mission context collection (see page 23).

4.3 Instruments

The name, type, description and additional information about each instrument are stored in a context product (in Mission context collection (see page 23)). This collection is under control of the SGS and any instrument wanting to change these products should contact the BepiColombo Archive Scientist. As described in [AD.02] the PSA is using an IPDA-agreed list of instrument types, as shown in the table below. These can be further qualified by a sub-type in the corresponding context file. For example, if the top-level type "Magnetometer" is used, the sub-type may be used to specify "dual fluxgate" or similar.

These context products should then be linked to each instrument product by referencing the LID of the appropriate context file in the Investigation_Area within the Observation_Area or Context_Area. A data product is related to an instrument by including an <Observing_System><Observing_System_Component> entry of type "Instrument".

Note that as of IM 1F00 (stack 9 and above) the LID for instrument context products has been changed. The last part of the instrument context product LID used to be "<instrument>.<host>" but has been updated to the more logical "<host>.<instrument>". A concrete example would be:

```
 <Internal_Reference>
    <lid_reference>urn:esa:psa:context:instrument:mcam.mtm</lid_reference>
    <reference_type>is_instrument</reference_type>
</Internal_Reference>
```

becomes

```
<Internal_Reference>
    <lid_reference>urn:esa:psa:context:instrument:mtm.mcam</lid_reference>
    <reference_type>is_instrument</reference_type>
</Internal_Reference>
```

Thus Table 2 contains both of these format.

Those instruments with sub-instruments or sub-units that should be identified within the label can use the psa:Sub-Instrument class in the <Mission_Area> class. These are shown in Table 6.

In addition, observational products are required to include the cass Observation_Area/ Primary_Result_Summary which includes Science_Facets. The proposed values for the attributes within this class are also shown in the following table, including the discipline name and wavelength range. Note that as of stack 9 wavelength_range is **required** but should be "nilled" if not required (listed as N/A in the table), for example:

```
<wavelength_range xsi:nil="true" nilReason="inapplicable"/>
```

4.3.1 MPO instruments

Instrument Host ID	Instrument ID	Instrument Acronym	Instrument Name	Instrument Type	Sub-Instrument IDs	Sub-Unit IDs	Discipline name	Wavelength
mpo	bela	bel	BepiColombo Laser Altimeter	Altimeter			Geosciences	Infrared
mpo	berm	ber	BepiColombo Radiation Monitor	Particle analyser Spectrometer			Particles	N/A
mpo	isa	isa	Italian Spring Accelerometer	Accelerometer			Radio Science	N/A
mtm	mcam	cam	BepiColombo monitoring camera	Imager		cam1 cam2 cam3	Imaging	Visible
mpo	mpo-mag	mag	MPO Mercury Magnetometer	Magnetometer		ib ob	Fields	N/A
mpo	mertis	mer	Mercury Thermal Infrared Spectrometer	Radiometer	tir		Imaging	Infrared
				Spectrometer	tis		Imaging	Infrared
mpo	mgns	mgn	Mercury Gamma Ray and Neutron Spectrometer	Neutron detector Gamma ray Detector			Spectroscopy	Gamma Ray

Instrument Host ID	Instrument ID	Instrument Acronym	Instrument Name	Instrument Type	Sub-Instrument IDs	Sub-Unit IDs	Discipline name	Wavelength
mpo	mixs	mix	Mercury Imaging X-Ray Spectrometer	Spectrometer	mixs-c		Spectroscopy	X-ray
				Imaging spectrometer	mixs-t		Spectroscopy	X-ray
mpo	more	mre	Mercury Orbiter Radio Science Experiment	Radio science			Radio Science	Radio
mpo	phebus	phe	Probing of Hermean Exosphere by Ultraviolet Spectroscopy	Ultraviolet spectrometer		fuv euv nuv	Spectroscopy	Ultraviolet
mpo	serena	srn	Search for Exosphere Refilling and Emitted Neutral Abundances	Mass spectrometer Particle analyser	picam		Particles	N/A
				Mass spectrometer Gas analyser	strofio		Particles	N/A
				Particle analyser Imager	elena		Particles	N/A
				Particle analyser	mipa		Particles	N/A
mpo	simbio-sys	sim	Spectrometers and Imagers for MPO BepiColombo Integrated Observatory System	Imaging spectrometer	vihi		Imaging	Visible Infrared
				Imager	stc		Imaging	Visible

Instrument Host ID	Instrument ID	Instrument Acronym	Instrument Name	Instrument Type	Sub-Instrument IDs	Sub-Unit IDs	Discipline name	Wavelength
				Imager	hric		Imaging	Visible
mpo	sixs	six	Solar Intensity X-Ray Spectrometer	Spectrometer	sixs-x		Spectroscopy	X-ray
				Particle analyser Spectrometer	sixs-p		Particles	Gamma Ray

Table 6: Permissible values for MPO Instruments

4.3.2 MMO instruments

Instrument Host ID	Instrument ID	Instrument Acronym	Instrument Name	Instrument Type	Sub-Instruments	Sub-units
mmo	msasi		Mercury Sodium Atmospheric Spectral Imager	Spectrometer Imager		
mmo	pwi		Mercury Plasma Wave Instrument	Electric Field Instrument Magnetometer	efd	

Instrument Host ID	Instrument ID	Instrument Acronym	Instrument Name	Instrument Type	Sub-Instruments	Sub-units
				Electric Field Instrument Magnetometer	wfc	
				Electric Field Instrument Magnetometer	ofa	
				Electric Field Instrument Magnetometer	sorbet	
mmo	mgf		MMO Magnetic Field Investigation	Magnetometer		
mmo	mpe		Mercury Plasma Particle Experiment	Particle analyzer Charged Particle Detector	mia	
				Particle analyzer Charged Particle Detector	mea	(2 sensors, not split in meta-data)

Instrument Host ID	Instrument ID	Instrument Acronym	Instrument Name	Instrument Type	Sub-Instruments	Sub-units
				Mass Spectrometer Charged Particle Detector	msa	
				Particle analyzer Charged Particle Detector	hep	(ele and ion channels, not split in meta-data)
				Neutral Particle Detector Particle analyzer	ena	
mmo	mdm		Mercury Dust Monitor	Dust Analyzer		
mmo	spm		Solar Particle Monitor	Charged Particle Detector		

Table 7: Permissible values for MMO Instruments

4.4 Mission Phases

The <mission_phase_name> and <mission_phase_id> attributes are located in the <Mission_Area> class.

A PDS product with the details on the mission phases is available in the BepiColombo master bundle (and also in the corresponding Git repository: https://repos.cosmos.esa.int/bepicolombo/projects/PDS4XML/repos/bepi.pds4/browse/bc_bundle/miscellaneous see mission_phases.[xml/tab]) to be used by the BepiColombo data providers in order to properly add relevant information into the metadata of their products.

Mission Phase ID	Mission Phase Name	Folder structure	Start date	Start orbit
necp	Near-Earth Commissioning Phase	near_earth_commissioning	2018-10-20T01:45:00.000	N/A
cruise	Cruise	cruise	2018-12-15T00:00:00.000	N/A
ega	Earth Gravity Assist	flybys/earth_flyby	2020-04-07T00:00:00.000	N/A
cruise	Cruise	cruise	2020-04-13T00:00:00.000	N/A
vga1	Venus Gravity Assist 1	flybys/venus_flyby_1	2020-10-12T00:00:00.000	N/A
cruise	Cruise	cruise	2020-10-18T00:00:00.000	N/A
vga2	Venus Gravity Assist 2	flybys/venus_flyby_2	2021-08-07T00:00:00.000	N/A
cruise	Cruise	cruise	2021-08-13T00:00:00.000	N/A
mga1	Mercury Gravity Assist 1	flybys/mercury_flyby_1	2021-09-30T00:00:00.000	N/A
cruise	Cruise	cruise	2021-10-05T00:00:00.000	N/A

Mission Phase ID	Mission Phase Name	Folder structure	Start date	Start orbit
mga2	Mercury Gravity Assist 2	flybys/mercury_flyby_2	2022-06-20T00:00:00.000	N/A
cruise	Cruise	cruise	2022-06-26T00:00:00.000	N/A
mga3	Mercury Gravity Assist 3	flybys/mercury_flyby_3	2023-06-17T00:00:00.000	N/A
cruise	Cruise	cruise	2023-06-23T00:00:00.000	N/A
mga4	Mercury Gravity Assist 4	flybys/mercury_flyby_4	2024-09-02T00:00:00.000	N/A
cruise	Cruise	cruise	2024-09-08T00:00:00.000	N/A
mga5	Mercury Gravity Assist 5	flybys/mercury_flyby_5	2024-11-29T00:00:00.000	N/A
cruise	Cruise	cruise	2024-12-05T00:00:00.000	N/A
mga6	Mercury Gravity Assist 6	flybys/mercury_flyby_6	2025-01-06T00:00:00.000	N/A
cruise	Cruise	cruise	2025-01-12T00:00:00.000	N/A
mocp	Mercury Orbit Commissioning Phase	mercury_commissioning	2025-12-05T00:00:00.000	N/A
msp	Mercury Science Phase	mercury_science_orbit	2026-01-05T00:00:00.000	00001

Table 8: Mission phases

Note that Table 8 is only provided for convenience, and the most up-to-date values are in the PDS4 product mentioned, and this should be used! The PDS4 Packager provides an additional check in

product labels by flagging if the product start time and mission phase do not match according to the mission phases product.

4.5 Mission Area

This information is located in the label under the <Mission_Area> class.

4.5.1 Mission Information

The following attributes are required in all Observational Products (Product_Observational):

- <spacecraft_clock_start_count>
  - with format P/SSSSSSSSSS:FFFFF
    - P is the partition - this is 1 until specified. If it has to increase, a configuration file will be provided with the times for each transition
      - either one or two digits are supported; for Mio the clock count requires two digits
    - S is the coarse clock count coming from telemetry and should be 10 digits in length, zero padded if needs be
    - F is the fine clock count coming from telemetry. It should be 5 digits (zero padded where necessary) and can never be greater than 65535
    - **note that from stack 7 on this format will be validated in product labels - please ensure you use the correct number of digits and separator (:)**
  - examples of **valid** clock counts include:
    - 1/0653072215.26664
  - examples of **invalid** counts include:
    - 1/653072215:26664 (coarse time is only 9 digits, must be 10, zero padded)
    - 1/0653072215:0 (fine time is only 1 digit, it must be 5, zero padded)
    - 1/0653072215:123 (fine time is only 3 digits)
    - 1/0653072215:67890 (fine time is > 65535)
    - 1/0653072215.26664 (wrong separator)
- <spacecraft_clock_stop_count>
  - as per start count
- MIssion phase information:
  - prior to stack 20:
    - <mission_phase_name>, as per Table 5: Permissible values for Mission Phases
    - <mission_phase_identifier>, as per Table 5: Permissible values for Mission Phases
  - in stack 20 and above use of the Mission_Phase class is required, with attributes
    - <name>, as per Table 5: Permissible values for Mission Phases
    - <id>, as per Table 5: Permissible values for Mission Phases
  - the phase name and identifier are checked by rules in the BepiColombo dictionary

    - the PDS4 Packager additionally checks that the given mission phases matches that expected from the product start time
- <orbit_number>, when in orbit phase as per ORBNUM file in the SPICE repository, otherwise, this attribute should not be included.

An example of Mission_Information used in a label is given below:

Example Mission_Information class

```
<psa:Mission_Information>
    <psa:spacecraft_clock_start_count>1/0605966473:13023</
psa:spacecraft_clock_start_count>
    <psa:spacecraft_clock_stop_count>1/0605966473:18023</
psa:spacecraft_clock_stop_count>
    <psa:mission_phase_name>Cruise</psa:mission_phase_name>
    <psa:mission_phase_identifier>cruise</psa:mission_phase_identifier>
</psa:Mission_Information>
```

4.5.2 Data Quality Information

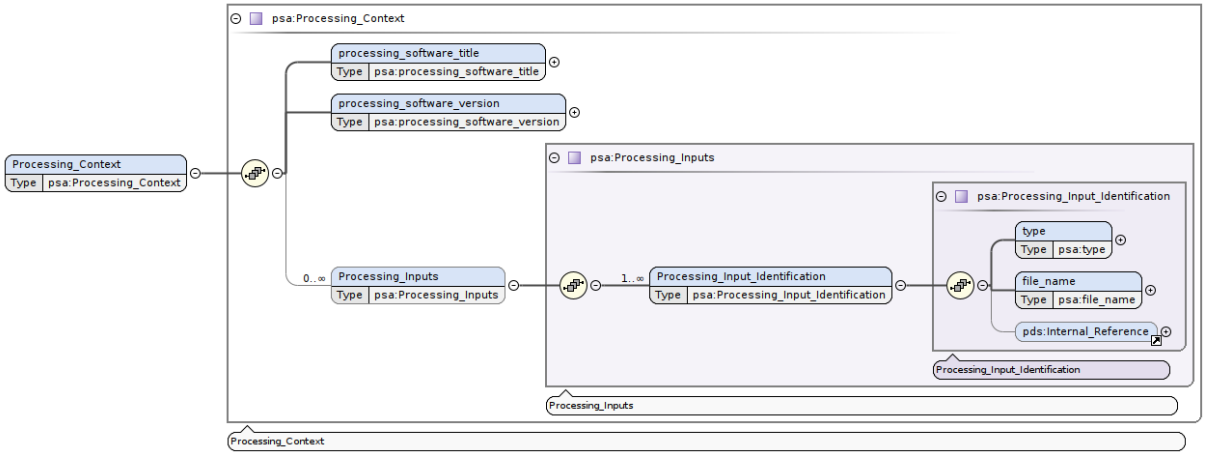
This is under definition; to be completed in a future version of the document.

4.5.3 Observation Context Information

This is under definition; to be completed in a future version of the document. This is only applicable to the Mercury Science Phase.

4.5.4 Processing Context Information

The psa:Processing_Context class provides additional information about the processing pipeline (name and version number) and the inputs used (telemetry, TCH etc.). The following graphics shows an excerpt from the PSA dictionary:



If the Processing_Context class is included, the attributes processing_software_title and processing_software_version are mandatory. The presence of this class will be enforced in BepiColombo Product_Observational products from Bepi dictionary version 1005 (stack 6) and upward. An example of this used in a label is given below:

Example Processing_Context

```
1  <psa:Processing_Context>
2      <psa:processing_software_title>mcam_tm2raw</
   psa:processing_software_title>
3      <psa:processing_software_version>1.0</psa:processing_software_version>
4  </psa:Processing_Context>
```

5 Annex A: MPO data structures

The following table includes a list of the different PDS4 data structures that are used in the MPO data products. PDS4 data structures are under definition; this is a preliminary list of data structures.

Instrument ID	Sub-unit	Product Identifier	PDS4 Extension(s)	External Standard
bela	--	Raw – Calibrated (SC, HK)	Table_Binary	
berm	--	Raw – Calibrated (SC, HK)	Table_Character	FITS
isa	--	Raw – Calibrated (SC, HK)	Table_Delimited	
mcam	cam1, cam2, cam3	Raw (SC)	Header + Array_2D_Image	FITS
mpo-mag	ib, ob	Raw – Derived (SC, HK)	Table_Character	
mertis	tis	Raw (SC)	Table_Binary + Array_3D (binary version) Table_Delimited + Table_Character (ASCII version)	FITS
	tir	Raw (SC)	Table_Binary + Array_2D (binary version) Table_Delimited + Table_Character (ASCII version)	FITS
	--	Raw – Calibrated (HK)	Table_Character	
mgns	--	Raw – Calibrated (SC)	Array_1D_Spectrum(s) *TBC*	
	--	Raw – Calibrated (HK)	Table_Character *TBC*	

Instrument ID	Sub-unit	Product Identifier	PDS4 Extension(s)	External Standard
mixs	mixs-c, mixs-t	Raw – Derived	Table_Character Table_Delimited Array_2D_Image Array_2D_Map	
more	--	Open-loop	Table_Character, Table Binary	TTCP
	--	Closed-loop	Table_Character, Table Binary	TTCP
		Meteo	Table_Character	CSP
phebus	euv	Raw (SC)	Header + (2) Array_2D_Image	FITS
	fuv	Raw (SC)	Header + (2) Array_2D_Image	FITS
	nuv	Raw (SC)	Header + Table_Binary	
	--	Raw (HK)	Header + Table_Character	FITS
serena	elena		Table_Delimited	
	mipa	Raw - Calibrated (SC, HK)	Table_Delimited	
	picam		Table_Delimited	
	strofio		Array	CDF
simbio-sys	hric	Raw – Calibrated (SC)	Array_2D_Image	
	vihi	Raw – Calibrated (SC)	Array_3D_Image	ISIS or VICAR *(TBC)*
	stc	Raw – Calibrated (SC)	Array_2D_Image	
sixs	sixs-x	Raw – Calibrated (SC)	Header + Table_Binary	FITS

Instrument ID	Sub-unit	Product Identifier	PDS4 Extension(s)	External Standard
	sixs-p	Raw – Calibrated (SC)	Header + Table_Binary	FITS

6 Annex B: MMO data structures

The following table will include the list of the different PDS4 data structures that are used in the MMO data products. To be included for completeness when the information becomes available.

Instrument ID	Subunit	Product Identifier	PDS4 Extension(s)	External Standard
msasi				FITS
pwi		efd wfc ofa sorbet		CDF
mgf				CDF
mppe	mia mea msa hep ena			CDF
mdm				ASCII table (delimited or fixed width?)
spm				CDF

7 Annex C: BepiColombo PDS4 Schemas

All PDS, PSA and BepiColombo PDS4 schemas required for BepiColombo, including any templates and label examples developed for the mission, are maintained under version control in the following Git repositories:

- PDS and PSA: https://s2e2.cosmos.esa.int/bitbucket/projects/PSAAS/repos/psa.pds4/browse
- BepiColombo: https://s2e2.cosmos.esa.int/bitbucket/projects/PDS4XML/repos/bepi.pds4/browse
- BepiColombo Instruments:
  - repositories can be found on BitBucket (web interface to Git): https://s2e2.cosmos.esa.int/bitbucket/projects/PDS4XML
  - under each repository the "clone" button will provide the address of the repository
  - SSH keys can be managed under account settings: https://s2e2.cosmos.esa.int/bitbucket/plugins/servlet/ssh/account/keys

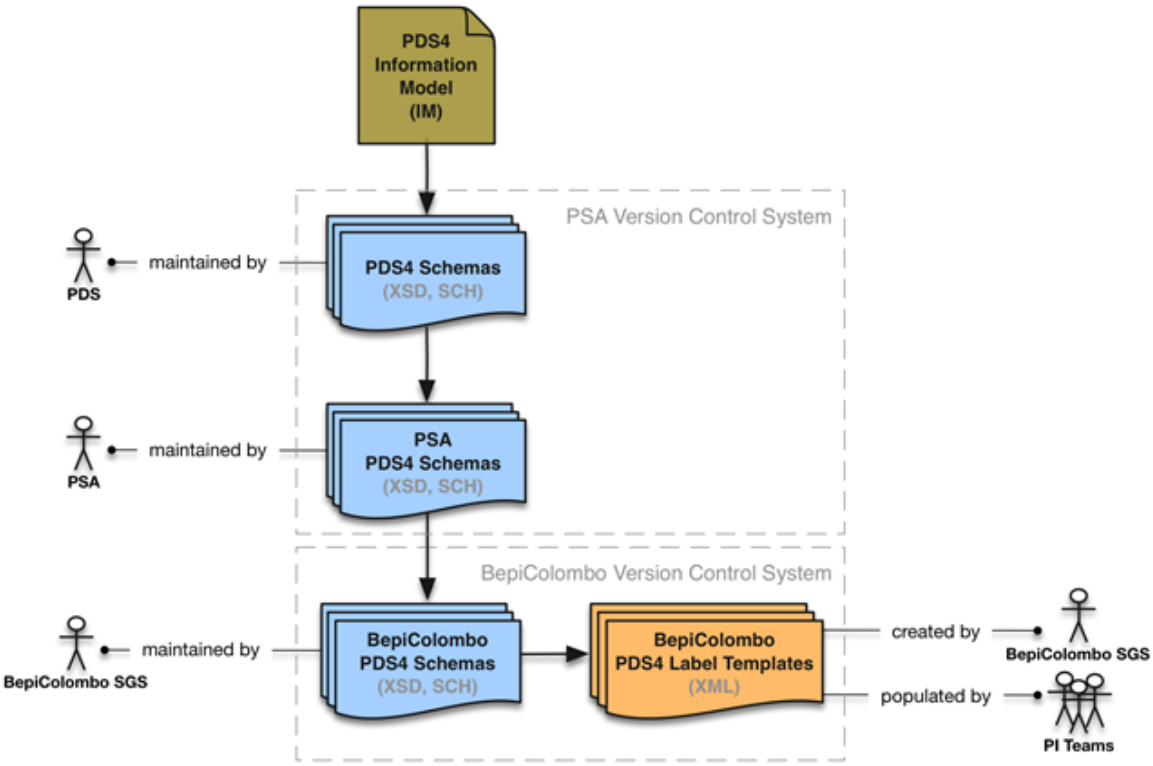


Figure 1: BepiColombo PDS4 Schemas Repository