# Extended Examples

# for the Basis of Discussion @ the Technical Session

**Data System Working Group**
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# 1.0 Array_Base – Homogeneous N-Dimensional Array Of Scalars

## 1.1 IMAGE_GRAYSCALE

This section describes the IMAGE_GRAYSCALE extension of the PDS4 Array_Base, (i.e., Homogeneous N-dimensional array of Scalars)  class where a contiguous stream of BINARY data, assembled as a two dimensional data structure, maps the "items" contained in a IMAGE_GRAYSCALE file.

This section identifies a mapping of the PDS3 IMAGE object to the PDS4 IMAGE_GRAYSCALE file construct and demonstrates how the byte stream (e.g., sequence of bits) can be described by both a PDS3 label and a PDS4 label.

### 1.1.1 IMAGE_GRAYSCALE Class Description and Schema

Figure 1.1-1 depicts a representation of the PDS4 IMAGE_GRAYSCALE class and the associated parent and child classes.  The figure additionally lists the required or optional status, and the cardinality of repeating structures.

```
OBJECT = TAGGED_IMAGE_GRAYSCALE_SET
                                                    Req/Opt     Cardinality

    OBJECT = DESCRIPTION_SECTION                    Optional        1
      DESCRIPTION                                   Required        1
    END_OBJECT = DESCRIPTION_SECTION


    OBJECT = HEADER                                 Optional        1
        DATA_LOCATION                               Required        1

        LOCAL_IDENTIFIER                            Required        1
        COMMENT                                     Optional        1
        BYTES                                       Required        1
        DESCRIPTION                                 Optional        1
        EXTERNAL_STANDARD                           Required        1
        FILE_TYPE                                   Required        1
        NAME                                        Optional        1
    END_OBJECT = HEADER


    OBJECT = IMAGE_GRAYSCALE                        Required        1
        DATA_LOCATION                               Required        1

        LOCAL_IDENTIFIER                            Required        1
        COMMENT                                     Optional        1
        AXES_ORDER                                  Required        1
        BYTE_ORDER                                  Required        1
        FIRST_ELEMENT                               Optional        1
        FILE_TYPE                                   Required        1
        MIN_INDEX                                   Optional        1
        NUMBER_OF_AXES                              Required        1
        ELEMENT_BYTES                               Optional        1
        ELEMENT_OFFSET                              Optional        1
        ELEMENT_SCALING_FACTOR                      Optional        1
        ELEMENT_TYPE                                Optional        1
        ELEMENT_UNIT                                Optional        1
        AXIS_NAME                                   Optional        1
        AXIS_LENGTH                                 Optional        1
        AXIS_SCALE_TYPE                             Optional        1
        AXIS_UNIT                                   Optional        1

    END_OBJECT = IMAGE_GRAYSCALE
```
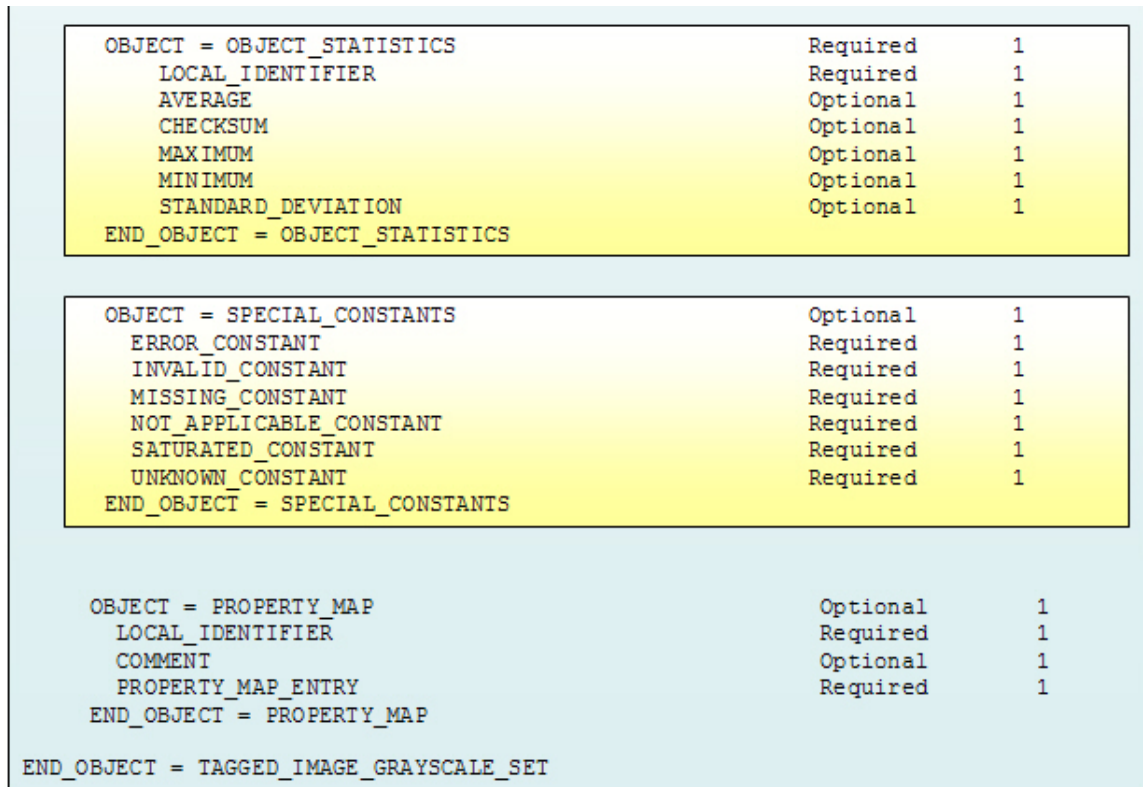
```
OBJECT = OBJECT_STATISTICS                          Required    1
    LOCAL_IDENTIFIER                                Required    1
    AVERAGE                                         Optional    1
    CHECKSUM                                        Optional    1
    MAXIMUM                                         Optional    1
    MINIMUM                                         Optional    1
    STANDARD_DEVIATION                              Optional    1
END_OBJECT = OBJECT_STATISTICS


OBJECT = SPECIAL_CONSTANTS                          Optional    1
    ERROR_CONSTANT                                  Required    1
    INVALID_CONSTANT                                Required    1
    MISSING_CONSTANT                                Required    1
    NOT_APPLICABLE_CONSTANT                         Required    1
    SATURATED_CONSTANT                              Required    1
    UNKNOWN_CONSTANT                                Required    1
END_OBJECT = SPECIAL_CONSTANTS


OBJECT = PROPERTY_MAP                               Optional    1
    LOCAL_IDENTIFIER                                Required    1
    COMMENT                                         Optional    1
    PROPERTY_MAP_ENTRY                              Required    1
END_OBJECT = PROPERTY_MAP

END_OBJECT = TAGGED_IMAGE_GRAYSCALE_SET
```

Figure 1.1-1.   Diagram of the IMAGE_GRAYSCALE Schema

From Figure 1.1-1, the overall structure of the IMAGE_GRAYSCALE data object description can be easily discerned and understood.

1.  The parent class, the TAGGED_IMAGE_GRAYSCALE_SET class, is comprised of six sub-classes:
    - DESCRIPTION_SECTION class
    - HEADER class
    - IMAGE_GRAYSCALE class
    - PROPERTY_MAP class
2.  The DESRIPTION_SECTION class may optionally exist once and only once within the context of the the TAGGED_IMAGE_GRAYSCALE_SET class.
3.  The DESCRIPTION_SECTION class consists of a single two required non-repeating data element.
4.  The HEADER class may optionally exist once and only once within the context of the the TAGGED_IMAGE_GRAYSCALE_SET class.
5.  The HEADER class consists of five required non-repeating data elements, and three optional non-repeating data elements..
6.  The IMAGE_GRAYSCALE class must exist once and only once within the context of the TAGGED_IMAGE GRAYSCALE_SET class.
7.  The IMAGE_GRAYSCALE class consists of six required non-repeating data elements and twelve optional non-repeating data elements.

8. The OBJECT_STATISTICS class may exist once and only once within the context of the TAGGED_IMAGE_GRAYSCALE_SET class.
9. The OBJECT_STATISTICS class is comprised of a single required non-repeating data element and five optional non-repeating data elements.
10. The SPECIAL_CONSTANTS class may optionally exist once and only once within the context of the the TAGGED_IMAGE_GRAYSCALE_SET class.
11. The SPECIAL_CONSTANTS class is comprised of six required non-repeating data elements.
12. The PROPERTY_MAP class may optionally exist once and only once within the context of the the TAGGED_IMAGE_GRAYSCALE_SET class.
13. The PROPERTY_MAP class consists of two required non-repeating data elements and a single optional non-repeating data element.

**1.1.2** IMAGE_GRAYSCALE Data Product Byte Stream

Figure 1.1-2 depicts a representation an IMAGE_GRAYSCALE byte-stream. The first two rows of the diagram are for the purposes of illustrating the byte positions relative to the IMAGE fields and would not normally be contained in a data object description file. The remaining twenty+ rows illustrate a typical IMAGE_GRAYSCALE data object description, where the data object fields are homogeneous in fixed-width ASCII across the rows in the file.

With respect to the data object:
1. There are 248 rows (lines) of data (of which 240+ rows have been omitted from the diagram for ease of reading)
2. There are 256 fields (samples) in each row / record in this example file (of which 240+ have been omitted from the diagram for ease of reading)
3. Each element is identical in type and represented by an identical storage format across all rows in this example file.
4. Each field is comprised of BINARY data formatted as 2-byte msb unsigned integers.
5. There are 512 bytes in each row / record in this example data object file.
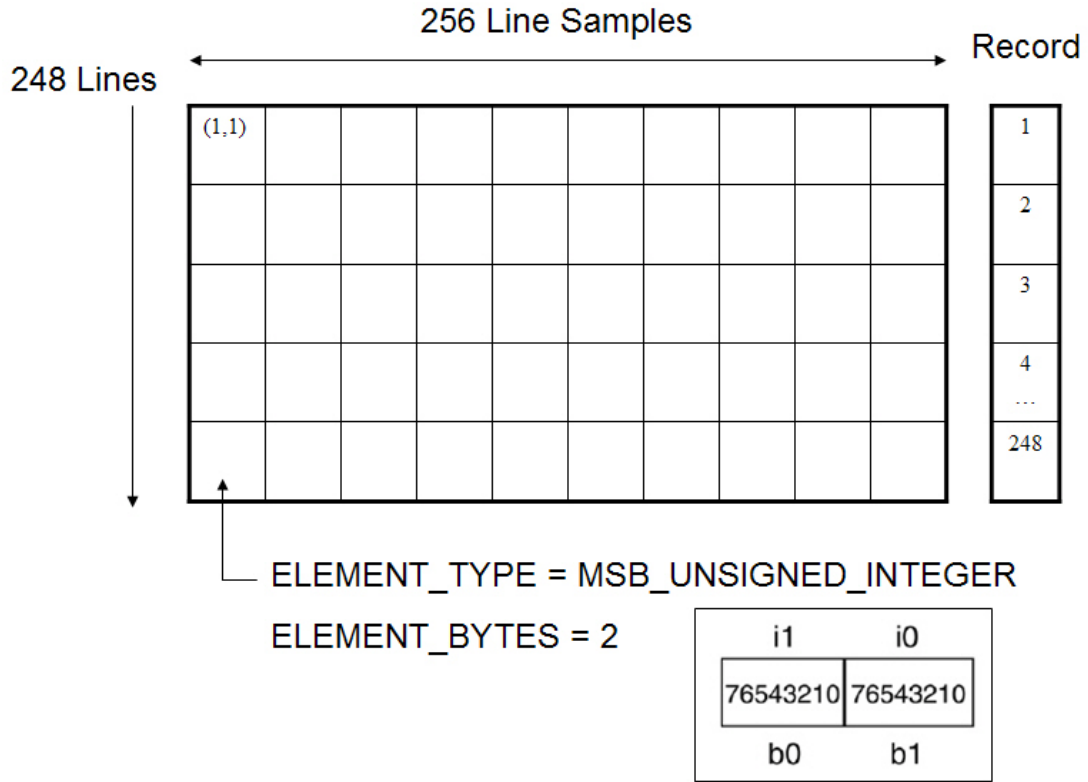
256 Line Samples

248 Lines

Record

(1,1)

1
2
3
4
...
248

ELEMENT_TYPE = MSB_UNSIGNED_INTEGER

ELEMENT_BYTES = 2

| i1 | i0 |
|---|---|
| 76543210 | 76543210 |
| b0 | b1 |

Figure 1.1-2.   Diagram of the IMAGE_GRAYSCALE Byte Stream


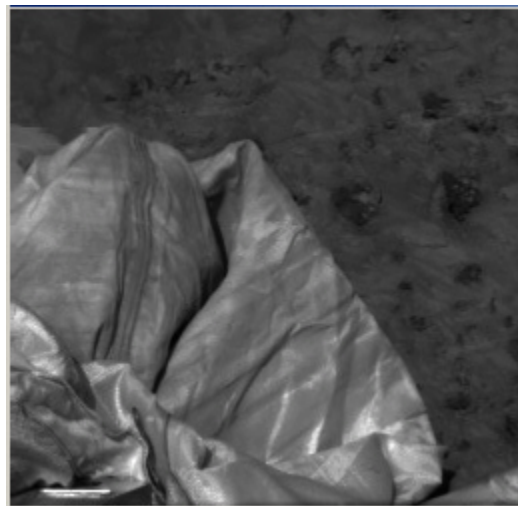
Figure 1.1-3.   Image as represented by IMAGE_GRAYSCALE Byte Stream

Figure 1.1-2 and Figure 1.1-3 depict the above IMAGE_GRAYSCALE byte-stream as it would be represented as a 2-dimensional array.   This representation

is helpful in understanding how the data object fields are represented in the data object description (e.g., PDS4 product label).  Specifically that the IMAGE_GRAYSCALE is comprised of two axes each of which have specific attributes that both identify and define the structure of the data object:

```
AXIS_NAME              = ("LINE", "SAMPLE")
NUMBER_OF_AXES         = 2
AXES_ORDER             = FAST2SLOW
AXIS_LENGTH            = (248, 256)
AXIS_SCALE_TYPE        = ("N/A", "N/A")
AXIS_UNIT              = ("N/A", "N/A")
```

Each of the two axes is further comprised of a set of homogeneous fields each identical in type, format, and structure:

```
ELEMENT_BYTES          = 2
ELEMENT_OFFSET         = "N/A"
ELEMENT_SCALING_FACTOR = "N/A"
ELEMENT_TYPE           = MSB_UNSIGNED_INTEGER
ELEMENT_UNIT           = "DATA NUMBER
```

### 1.1.3          IMAGE_GRAYSCALE Label Scheme

This section depicts how the IMAGE_GRAYSCALE byte-scheme, as illustrated above, can be described by both a PDS3 label and a PDS4 label.

The PDS4 IMAGE_GRAYSCALE class is the successor to the PDS3 IMAGE object.

#### 1.1.3.1    PDS3 IMAGE_GRAYSCALE  Label Scheme

The data product depicted in Figure 1.1-2 could be described in PDS3 by use of the IMAGE object:

```
PDS_VERSION_ID              = PDS3

/* FILE CHARACTERISTICS */

RECORD_TYPE                 = FIXED_LENGTH
RECORD_BYTES                = 512
FILE_RECORDS                = 270

/* POINTERS TO DATA OBJECTS */

^IMAGE                      = "I943630R.RAW"

/* IDENTIFICATION DATA ELEMENTS */
```

```
DATA_SET_ID                       = "MPFL-M-IMP-2-EDR-V1.0"
DATA_SET_NAME                     = "MPF LANDER MARS IMAGER FOR MARS
                                     PATHFINDER 2 EDR V1.0"
PRODUCER_ID                       = "MIPL OF JPL"
PRODUCER_FULL_NAME                = "ALLAN J. RUNKLE"
PRODUCER_INSTITUTION_NAME         = "MULTIMISSION IMAGE PROCESSING
                                     LABORATORY, JET PROPULSION LAB"
PRODUCT_ID                        = "IMP_EDR-1246943630-REGULAR-0074051101"
IMAGE_ID                          = 74051101
COMMAND_SEQUENCE_NUMBER           = 74
IMAGE_OBSERVATION_TYPE            = REGULAR
FRAME_ID                          = BOTH
MISSION_NAME                      = "MARS PATHFINDER"
INSTRUMENT_HOST_NAME              = "MARS PATHFINDER LANDER"
INSTRUMENT_NAME                   = "IMAGER FOR MARS PATHFINDER"
INSTRUMENT_ID                     = "IMP"
TARGET_NAME                       = "MARS"
OBSERVATION_NAME                  = "FILTER_5_IN_4_TIERS_FOURTH_Q_PAN.3CMD"
IMAGE_TIME                        = 1997-07-07T05:13:42.763Z
PLANET_DAY_NUMBER                 = 3
MPF_LOCAL_TIME                    = 13:39:12
SPACECRAFT_CLOCK_START_COUNT      = 1246943630
EARTH_RECEIVED_START_TIME         = 1997-07-07T23:48:33.442Z
EARTH_RECEIVED_STOP_TIME          = 1997-07-07T23:48:51.766Z
PRODUCT_CREATION_TIME             = 1998-07-14T00:36:08.000Z

/* DESCRIPTIVE DATA ELEMENTS */

EXPECTED_PACKETS                  = 17
RECEIVED_PACKETS                  = 17
APPLICATION_PACKET_ID             = 34
APPLICATION_PACKET_NAME           = "SCI_IMG_3"
EXPOSURE_DURATION                 = 46.0000
EXPOSURE_TYPE                     = AUTO
EXPOSURE_COUNT                    = 3
AUTO_EXPOSURE_DATA_CUT            = 3000
AUTO_EXPOSURE_PIXEL_FRACTION      = 1.0000
ERROR_PIXELS                      = 0
FILTER_NAME                       = "L670_R670"
FILTER_NUMBER                     = 5
INSTRUMENT_TEMPERATURE            = (-12.2836, -12.0856)
INSTRUMENT_TEMPERATURE_COUNT      = (162, 161)
INSTRUMENT_DEPLOYMENT_STATE       = "DEPLOYED"
DETECTOR_PIXEL_HEIGHT             = 23.0000
DETECTOR_PIXEL_WIDTH              = 23.0000
SOURCE_PRODUCT_ID                 = "SEQ_S0074E_IMPEK"
SOFTWARE_NAME                     = "MPFTELEMPROC_IMP"
SOFTWARE_VERSION_ID               = "V1.24.46"
PROCESSING_HISTORY_TEXT           = "CODMAC LEVEL 1 TO LEVEL 2 CONVERSION
                                     VIA JPL/MIPL MPFTELEMPROC"

/* GEOMETRY DATA ELEMENTS */

INSTRUMENT_AZIMUTH                = 265.3520
AZIMUTH_FOV                       = 14.0032
AZIMUTH_MOTOR_CLICKS              = 551
INSTRUMENT_AZIMUTH_METHOD         = "TELEMETRY"
INSTRUMENT_ELEVATION              = -43.0955
ELEVATION_FOV                     = 13.5656
ELEVATION_MOTOR_CLICKS            = 96
INSTRUMENT_ELEVATION_METHOD       = "TELEMETRY"
SURFACE_BASED_INST_AZIMUTH        = 61.6981
SURFACE_BASED_INST_ELEVATION      = -45.7609
```

```
SURFACE_BASED_INST_METHOD      = "L_FRAME-QUATERNION"
POSITIVE_ELEVATION_DIRECTION   = UP
SOLAR_AZIMUTH                  = 262.8440
SOLAR_ELEVATION                = 65.8379
LANDER_SURFACE_QUATERNION      = (0.2102, -0.0146, -0.0293, 0.9771)

/* IMP FLIGHT SOFTWARE COMMAND DATA ELEMENTS */

COMMAND_NAME                   = "IMP_IMAGE_AZ_EL"
COMMAND_DESC                   = "This is the image taken by the IMP
                                  Using absolute azimuth & elevation as
                                  the coordinate system"
TLM_CMD_DISCREPANCY_FLAG       = FALSE
DOWNLOAD_TYPE                  = IM
DARK_CURRENT_DOWNLOAD_FLAG     = "NULL"
DARK_CURRENT_CORRECTION_FLAG   = FALSE
FLAT_FIELD_CORRECTION_FLAG     = FALSE
BAD_PIXEL_REPLACEMENT_FLAG     = TRUE
SHUTTER_EFFECT_CORRECTION_FLAG = FALSE
SQRT_COMPRESSION_FLAG          = FALSE

/* COMPRESSION DATA ELEMENTS */

INST_CMPRS_BLK_SIZE            = (8, 8)
INST_CMPRS_BLOCKS              = 992
INST_CMPRS_MODE                = 8
INST_CMPRS_PARAM               = 250
INST_CMPRS_QUALITY             = 250
INST_CMPRS_QUANTZ_TBL_ID       = "INTERNAL_0"
INST_CMPRS_QUANTZ_TYPE         = TABULAR
INST_CMPRS_SYNC_BLKS           = 1024
INST_CMPRS_NAME                = "JPEG DISCRETE COSINE TRANSFORM (DCT);
                                  ARITHMETIC/RATIO/LCT"
INST_CMPRS_RATE                = 2.0187
INST_CMPRS_RATIO               = 5.9446
PIXEL_AVERAGING_HEIGHT         = 1
PIXEL_AVERAGING_WIDTH          = 1
RICE_START_OPTION              = -1
RICE_OPTION_VALUE              = -1
SQRT_MINIMUM_PIXEL             = 0
SQRT_MAXIMUM_PIXEL             = 0

/* IMAGE OBJECT DATA ELEMENTS */

OBJECT                         = IMAGE
  INTERCHANGE_FORMAT           = BINARY
  LINES                        = 248
  LINE_SAMPLES                 = 256
  BANDS                        = 1
  SAMPLE_TYPE                  = MSB_UNSIGNED_INTEGER
  SAMPLE_BITS                  = 16
  SAMPLE_BIT_MASK              = 2#0000111111111111#
  MAXIMUM                      = 4095
  MEAN                         = 1385.3000
  MEDIAN                       = 894
  MINIMUM                      = 145
  STANDARD_DEVIATION           = 538.0290
  FIRST_LINE                   = 3
  FIRST_LINE_SAMPLE            = 1
  CHECKSUM                     = 8427608
END_OBJECT                     = IMAGE
END
```

## 1.1.3.2 PDS4 IMAGE_GRAYSCALE Label Scheme

The same data product can also be described in PDS4 by use of the IMAGE_GRAYSCALE class:

```
#PDS4#

/* ******* LABEL TEMPLATE - PRODUCT_IMAGE_GRAYSCALE ******* */

OBJECT = PRODUCT_IMAGE_GRAYSCALE;

  OBJECT = IDENTIFICATION_SECTION;
    DD_VERSION_ID        = "DD_VERSION_ID";
    IDENTIFIER           = "PDS4_IMG_IMAGE_GRAYSCALE_ID:V1.0";
    LABEL_REVISION_NOTE  = "20090101:1.0 - initial version;
                            20090102:1.1 - added another column";
    PDS_VERSION_ID       = "PDS4.0";
    PRODUCT_CREATION_TIME = 1998-07-14T00:36:08.000;
    TITLE                = "MARS PATHFINDER LANDER Experiment";
    URN                  = "http://URN:MPFL-M-IMP-2-EDR-V1.0:PDS4_IMG_GRAY-
SCALE_IMAGE_ODL.LBL:1.0";
    VERSION              = "1.0";
  END_OBJECT = IDENTIFICATION_SECTION;


  OBJECT = DESCRIPTION_SECTION;
    DESCRIPTION          = "ANNOTATION FOR THE PRODUCT GOES HERE.";
  END_OBJECT = DESCRIPTION_SECTION;


  OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;
    COMMENT                       = "Observation Intent";
    SPACECRAFT_CLOCK_START_COUNT = "1246943630";
    SPACECRAFT_CLOCK_STOP_COUNT  = "N/A";
    START_TIME                   = "N/A";
    STOP_TIME                    = "N/A";
  END_OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;

  OBJECT = DATASET_SECTION;
    DATA_SET_ID          = "MPFL-M-IMP-2-EDR-V1.0";
  END_OBJECT = DATASET_SECTION;


  OBJECT = MISSION_SECTION;
    MISSION_NAME         = "MARS PATHFINDER";
  END_OBJECT = MISSION_SECTION;


  OBJECT = INSTRUMENT_HOST_SECTION;
    INSTRUMENT_HOST_ID   = "MPFL";
  END_OBJECT = INSTRUMENT_HOST_SECTION;


  OBJECT = INSTRUMENT_SECTION;
    INSTRUMENT_ID_NEW    = "IMP";
  END_OBJECT = INSTRUMENT_SECTION;


  OBJECT = NODE_SECTION;
```

```
      NODE_NAME              = "IMAGING";
    END_OBJECT = NODE_SECTION;

  OBJECT = TARGET_SECTION;
      TARGET_NAME            = "MARS";
    END_OBJECT = TARGET_SECTION;


    OBJECT = TAGGED_IMAGE_GRAYSCALE_SET;

      OBJECT = IMAGE_GRAYSCALE;
        DATA_LOCATION         = ("MPFL_M_IMP_IMAGE_FILE",1);

        LOCAL_IDENTIFIER      = "MPFL_M_IMP_IMAGE";
        AXES_ORDER            = FAST2SLOW;
        BYTE_ORDER            = MSBF;
        FILE_TYPE             = BINARY;
        FIRST_ELEMENT         = TOPLEFT;
        MIN_INDEX             = 0;
        NUMBER_OF_AXES        = 2;
        ELEMENT_BYTES         = 2;
        ELEMENT_OFFSET        = "N/A";
        ELEMENT_SCALING_FACTOR = "N/A";
        ELEMENT_TYPE          = MSB_UNSIGNED_INTEGER;
        ELEMENT_UNIT          = "DATA NUMBER";
        AXIS_LENGTH           = (248, 256);
        AXIS_NAME             = ("LINE", "SAMPLE");
        AXIS_SCALE_TYPE       = ("N/A", "N/A");
        AXIS_UNIT             = ("N/A", "N/A");
      END_OBJECT = IMAGE_GRAYSCALE;

      OBJECT = OBJECT_STATISTICS;
        LOCAL_IDENTIFIER      = "MPFL_M_IMP_STATISTICS";
        AVERAGE               = 894;
        CHECKSUM              = 8427608;
        MAXIMUM               = 4095;
        MINIMUM               = 145;
        STANDARD_DEVIATION    = 538.0290;
      END_OBJECT = OBJECT_STATISTICS;

    END_OBJECT = TAGGED_IMAGE_GRAYSCALE_SET;


    OBJECT = PROPERTY_MAP;
      LOCAL_IDENTIFIER     = "MPFL_M_IMP_PROPMAP-1";
      COMMENT              = "IDENTIFICATION DATA ELEMENTS";

      PROPERTY_MAP_ENTRY   = (
        ("MPFL_M_IMP_IMAGE", PRODUCER_ID,               "MIPL OF JPL"),
        ("MPFL_M_IMP_IMAGE", PRODUCER_FULL_NAME,        "ALLAN J. RUNKLE"),
        ("MPFL_M_IMP_IMAGE", PRODUCER_INSTITUTION_NAME, "MULTIMISSION IMAGE
PROCESSING LABORATORY, JPL"),
        ("MPFL_M_IMP_IMAGE", PRODUCT_ID,                "IMP_EDR-1246943630-
REGULAR-0074051101"),
        ("MPFL_M_IMP_IMAGE", IMAGE_ID,                  74051101),
        ("MPFL_M_IMP_IMAGE", COMMAND_SEQUENCE_NUMBER,   74),
        ("MPFL_M_IMP_IMAGE", IMAGE_OBSERVATION_TYPE,    REGULAR),
        ("MPFL_M_IMP_IMAGE", FRAME_ID,                  BOTH),
        ("MPFL_M_IMP_IMAGE", OBSERVATION_NAME,
"FILTER_5_IN_4_TIERS_FOURTH_QUAD_MONSTER_PAN.3CMD"),
        ("MPFL_M_IMP_IMAGE", IMAGE_TIME,                1997-07-
07T05:13:42.763Z),
        ("MPFL_M_IMP_IMAGE", PLANET_DAY_NUMBER,         3),
```

```
        ("MPFL_M_IMP_IMAGE", MPF_LOCAL_TIME,              13:39:12),
        ("MPFL_M_IMP_IMAGE", EARTH_RECEIVED_START_TIME,  1997-07-
07T23:48:33.442Z),
        ("MPFL_M_IMP_IMAGE", EARTH_RECEIVED_STOP_TIME,   1997-07-
07T23:48:51.766Z)
                            );
    END_OBJECT = PROPERTY_MAP;

    OBJECT = PROPERTY_MAP;
      LOCAL_IDENTIFIER     = "MPFL_M_IMP_PROPMAP-2";
      COMMENT              = "IDENTIFICATION DATA ELEMENTS";

      PROPERTY_MAP_ENTRY   = (
        ("MPFL_M_IMP_IMAGE", EXPECTED_PACKETS,           17),
        ("MPFL_M_IMP_IMAGE", RECEIVED_PACKETS,           17),
        ("MPFL_M_IMP_IMAGE", APPLICATION_PACKET_ID,      34),
        ("MPFL_M_IMP_IMAGE", APPLICATION_PACKET_NAME,    "SCI_IMG_3"),
        ("MPFL_M_IMP_IMAGE", EXPOSURE_DURATION,          46.0000),
        ("MPFL_M_IMP_IMAGE", EXPOSURE_TYPE,              AUTO),
        ("MPFL_M_IMP_IMAGE", EXPOSURE_COUNT,             3),
        ("MPFL_M_IMP_IMAGE", AUTO_EXPOSURE_DATA_CUT,     3000),
        ("MPFL_M_IMP_IMAGE", AUTO_EXPOSURE_PIXEL_FRACTION, 1.0000),
        ("MPFL_M_IMP_IMAGE", ERROR_PIXELS,               0),
        ("MPFL_M_IMP_IMAGE", FILTER_NAME,                "L670_R670"),
        ("MPFL_M_IMP_IMAGE", FILTER_NUMBER,              5),
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_TEMPERATURE,     (-12.2836, -
12.0856)),
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_TEMPERATURE_COUNT, (162, 161)),
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_DEPLOYMENT_STATE, "DEPLOYED"),
        ("MPFL_M_IMP_IMAGE", DETECTOR_PIXEL_HEIGHT,      23.0000),
        ("MPFL_M_IMP_IMAGE", DETECTOR_PIXEL_WIDTH,       23.0000),
        ("MPFL_M_IMP_IMAGE", SOURCE_PRODUCT_ID,          "SEQ_S0074E_IMPEK"),
        ("MPFL_M_IMP_IMAGE", SOFTWARE_NAME,              "MPFTELEMPROC_IMP"),
        ("MPFL_M_IMP_IMAGE", SOFTWARE_VERSION_ID,        "V1.24.46"),
                            );
    END_OBJECT = PROPERTY_MAP;

    OBJECT = PROPERTY_MAP;
      LOCAL_IDENTIFIER     = "MPFL_M_IMP_PROPMAP-3";
      COMMENT              = "GEOMETRY & COMPRESSION DATA ELEMENTS";

      PROPERTY_MAP_ENTRY   = (
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_AZIMUTH,         265.3520),
        ("MPFL_M_IMP_IMAGE", AZIMUTH_FOV,                14.0032),
        ("MPFL_M_IMP_IMAGE", AZIMUTH_MOTOR_CLICKS,       551),
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_AZIMUTH_METHOD,  "TELEMETRY"),
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_ELEVATION,       -43.0955),
        ("MPFL_M_IMP_IMAGE", ELEVATION_FOV,              13.5656),
        ("MPFL_M_IMP_IMAGE", ELEVATION_MOTOR_CLICKS,     96),
        ("MPFL_M_IMP_IMAGE", INSTRUMENT_ELEVATION_METHOD, "TELEMETRY"),
        ("MPFL_M_IMP_IMAGE", SURFACE_BASED_INST_AZIMUTH, 61.6981),
        ("MPFL_M_IMP_IMAGE", SURFACE_BASED_INST_ELEVATION, -45.7609),
        ("MPFL_M_IMP_IMAGE", SURFACE_BASED_INST_METHOD,  "L_FRAME-
QUATERNION"),
        ("MPFL_M_IMP_IMAGE", POSITIVE_ELEVATION_DIRECTION, UP),
        ("MPFL_M_IMP_IMAGE", SOLAR_AZIMUTH,              262.8440),
        ("MPFL_M_IMP_IMAGE", SOLAR_ELEVATION,            65.8379),
        ("MPFL_M_IMP_IMAGE", LANDER_SURFACE_QUATERNION,  (0.2102, -0.0146,
-0.0293, 0.9771)),
        ("MPFL_M_IMP_IMAGE", COMMAND_NAME,
"IMP_IMAGE_AZ_EL"),
        ("MPFL_M_IMP_IMAGE", COMMAND_DESC,                "This is the image
taken by the IMP using
```

```
        ("MPFL_M_IMP_IMAGE",                                      absolute azimuth
& elevation as the
        ("MPFL_M_IMP_IMAGE",                                      coordinate
system"),
        ("MPFL_M_IMP_IMAGE", TLM_CMD_DISCREPANCY_FLAG,          FALSE),
        ("MPFL_M_IMP_IMAGE", DOWNLOAD_TYPE,                     IM),
        ("MPFL_M_IMP_IMAGE", DARK_CURRENT_DOWNLOAD_FLAG,        "NULL"),
        ("MPFL_M_IMP_IMAGE", DARK_CURRENT_CORRECTION_FLAG,      FALSE),
        ("MPFL_M_IMP_IMAGE", FLAT_FIELD_CORRECTION_FLAG,        FALSE),
        ("MPFL_M_IMP_IMAGE", BAD_PIXEL_REPLACEMENT_FLAG,        TRUE),
        ("MPFL_M_IMP_IMAGE", SHUTTER_EFFECT_CORRECTION_FLAG,    FALSE),
        ("MPFL_M_IMP_IMAGE", SQRT_COMPRESSION_FLAG,             FALSE),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_BLK_SIZE,               (8, 8)),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_BLOCKS,                 992),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_MODE,                   8),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_PARAM,                  250),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_QUALITY,                250),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_QUANTZ_TBL_ID,          "INTERNAL_0"),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_QUANTZ_TYPE,            TABULAR),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_SYNC_BLKS,              1024),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_NAME,                   "JPEG DISCRETE
COSINE TRANSFORM (DCT);
        ("MPFL_M_IMP_IMAGE",
ARITHMETIC/RATIO/LCT"),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_RATE,                   2.0187),
        ("MPFL_M_IMP_IMAGE", INST_CMPRS_RATIO,                  5.9446),
        ("MPFL_M_IMP_IMAGE", PIXEL_AVERAGING_HEIGHT,            1),
        ("MPFL_M_IMP_IMAGE", PIXEL_AVERAGING_WIDTH,             1),
        ("MPFL_M_IMP_IMAGE", RICE_START_OPTION,                 -1),
        ("MPFL_M_IMP_IMAGE", RICE_OPTION_VALUE,                 -1),
        ("MPFL_M_IMP_IMAGE", SQRT_MINIMUM_PIXEL,                0),
        ("MPFL_M_IMP_IMAGE", SQRT_MAXIMUM_PIXEL,                0)
                          );
    END_OBJECT = PROPERTY_MAP;


    OBJECT = FILE_SECTION;

     OBJECT = FILE_BINARY_FIXED;
        LOCAL_IDENTIFIER    = "MPFL_M_IMP_IMAGE_FILE";
        CHECKSUM            = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
        FILE_SIZE           = 12345;
        FILE_NAME           = "N2075WE02R.FIT";
        FILE_TYPE           = BINARY;
        MAX_RECORD_BYTES    = 512;
        RECORD_TYPE         = FIXED;
     END_OBJECT = FILE_BINARY_FIXED;

    END_OBJECT = FILE_SECTION;

  END_OBJECT = PRODUCT_IMAGE_GRAYSCALE;
```

### 1.1.4     PDS4 IMAGE_GRAYSCALE and PDS3 IMAGE PARALLELISMS

This section provides a high level discussion of the parallelisms between the
PDS3 IMAGE Data Object Description (DoD) and the PDS4
IMAGE_GRAYSCALE class.

The PDS3 IMAGE (DoD) by definition was very flexible in that the DoD could define both simple Images and very complex types of Images depending on the representation of the data product byte stream. An example of a simple image is where the data product byte stream is represented as a 2-dimensional, single-banded, non-interleaved, no prefix or suffix byte construct. A more complex example of an image is where the data product byte stream is represented by any of the following:

    a. Line or Sample interleaved data
    b. Row prefix and/or suffix bytes
    c. Multi-banded data
    d. Line and Sample display counter direction

The PDS4 IMAGE_GRAYSCALE class has been specifically designed to be more restrictive in the permissible representations of the data object byte stream. And as such, these restrictions ensure a more rigorous set of archival quality image constructs. The PDS4 IMAGE_GRAYSCALE class supports the following variations:

1. Axis order – the default, FAST2SLOW, indicates that each axis on the left varies faster than the axis to the right (i.e., the leftmost axis varies the fastest; with the axis to the most right varying the slowest).
2. Byte order – the default, MSBF, indicates that the bytes are represented as most-significant-byte-first.
3. First element – the default, TOPLEFT, indicates that the first element of the byte stream is the top leftmost element.
4. Minimum index – the default, 0, indicates that the bytes are numbered sequentially starting from 0.

## 2.0 Table_Base – Heterogeneous Repeating Record of Scalars

### 2.1 TABLE_CHARACTER

This section describes the TABLE_CHARACTER extension of the PDS4 Table_Base (i.e., Heterogeneous repeating record of Scalars) class where a contiguous stream of ASCII characters, assembled as fixed-width fields, maps the "items" contained in a TABLE_CHARACTER file.

This section identifies a mapping of the PDS3 TABLE object to the PDS4 TABLE_CHARACTER file construct and demonstrates how the byte stream (e.g., sequence of bits) can be described by both a PDS3 label and a PDS4 label.

#### 2.1.1 TABLE_BASE Class Description and Schema

Figure 2.1-1 depicts a representation of the PDS4 TABLE_BASE class and the associated parent and child classes. The figure additionally lists the required or optional status, and the cardinality of repeating structures.

```
OBJECT = TAGGED_TABLE_CHARACTER_SET
                                             Req/Opt    Cardinality

   OBJECT = DESCRIPTION_SECTION              Optional       1
     DESCRIPTION                             Required       1
   END_OBJECT = DESCRIPTION_SECTION


   OBJECT = HEADER                           Optional       1
      DATA_LOCATION                          Required       1

      LOCAL_IDENTIFIER                       Required       1
      COMMENT                                Optional       1
      BYTES                                  Required       1
      DESCRIPTION                            Optional       1
      EXTERNAL_STANDARD                      Required       1
      FILE_TYPE                              Required       1
      NAME                                   Optional       1
   END_OBJECT = HEADER


   OBJECT = TABLE_CHARACTER                  Required       1
      DATA_LOCATION                          Required       1

      LOCAL_IDENTIFIER                       Required       1
      COMMENT                                Optional       1
      FILE_TYPE                              Required       1
      NUMBER_OF_FIELDS                       Required       1
      NUMBER_OF_ROWS                         Required       1
      ROW_BYTES                              Required       1

      OBJECT = TABLE_CHARACTER_FIELD         Required      1..*
        FIELD_NAME                           Required       1
        FIELD_DATA_TYPE                      Required       1
        FIELD_DESCRIPTION                    Optional       1
        FIELD_FORMAT                         Optional       1
        FIELD_LENGTH                         Required       1
        FIELD_LOCATION                       Required       1
        FIELD_MAX_LOGICAL                    Optional       1
        FIELD_MAX_PHYSICAL                   Optional       1
        FIELD_MIN_LOGICAL                    Optional       1
        FIELD_MIN_PHYSICAL                   Optional       1
        FIELD_NUMBER                         Optional       1
        FIELD_SCALING_FACTOR                 Optional       1
        FIELD_UNIT                           Optional       1
        FIELD_VALUE_OFFSET                   Optional       1
```
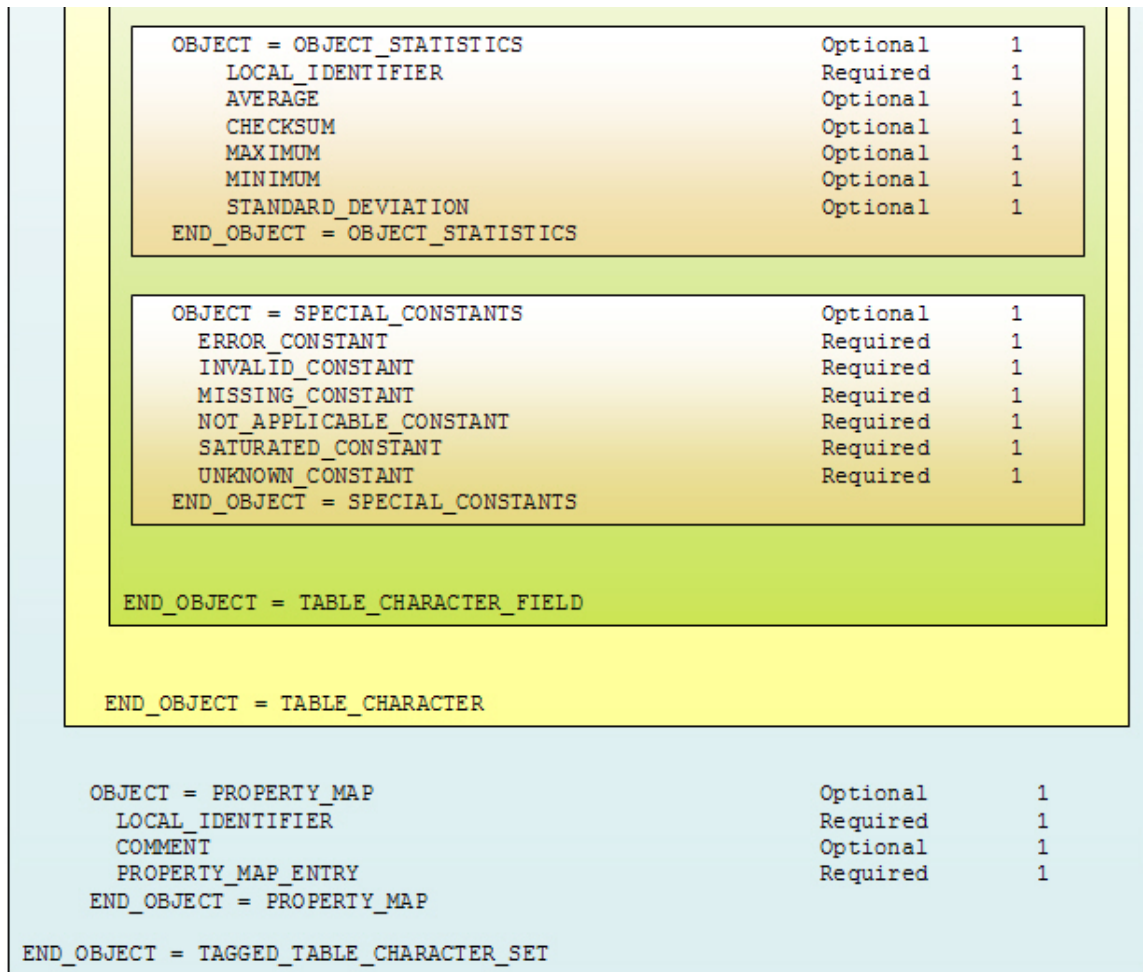
```
        OBJECT = OBJECT_STATISTICS                    Optional      1
            LOCAL_IDENTIFIER                          Required      1
            AVERAGE                                   Optional      1
            CHECKSUM                                  Optional      1
            MAXIMUM                                   Optional      1
            MINIMUM                                   Optional      1
            STANDARD_DEVIATION                        Optional      1
        END_OBJECT = OBJECT_STATISTICS


        OBJECT = SPECIAL_CONSTANTS                    Optional      1
          ERROR_CONSTANT                              Required      1
          INVALID_CONSTANT                            Required      1
          MISSING_CONSTANT                            Required      1
          NOT_APPLICABLE_CONSTANT                     Required      1
          SATURATED_CONSTANT                          Required      1
          UNKNOWN_CONSTANT                            Required      1
        END_OBJECT = SPECIAL_CONSTANTS



    END_OBJECT = TABLE_CHARACTER_FIELD



  END_OBJECT = TABLE_CHARACTER


    OBJECT = PROPERTY_MAP                             Optional          1
      LOCAL_IDENTIFIER                                Required          1
      COMMENT                                         Optional          1
      PROPERTY_MAP_ENTRY                              Required          1
    END_OBJECT = PROPERTY_MAP

END_OBJECT = TAGGED_TABLE_CHARACTER_SET
```

Figure 2.1-1.   Diagram of the TABLE_CHARACTER Schema


From Figure 2.1-1, the overall structure of the TABLE_CHARACTER data object description can be easily discerned and understood.

1. The parent class, the TAGGED_TABLE_CHARACTER_SET class, is comprised of four sub-classes:
   - DESCRIPTION_SECTION class
   - HEADER class
   - TABLE_CHARACTER class
   - PROPERTY_MAP class
2. The DESRIPTION_SECTION class may optionally exist once and only once within the context of the the TAGGED_TABLE_CHARACTER_SET class.
3. The DESCRIPTION_SECTION class consists of a single required non-repeating data element.
4. The HEADER class may optionally exist once and only once within the context of the the TAGGED_TABLE_CHARACTER_SET class.

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5. The HEADER class consists of five required non-repeating data elements, and three optional non-repeating data elements..
6. The TABLE_CHARACTER class must exist once and only once within the context of the TAGGED_TABLE_CHARACTER_SET class.
7. The TABLE_CHARACTER class is comprised of six required non-repeating data elements, a single optional non-repeating data element, and a single required repeating sub-class, the TABLE_CHARACTER_FIELD sub-class
8. The TABLE_CHARACTER_FIELD class must exist once but may exist many times within the context of the TABLE_CHARACTER class.
9. The TABLE_CHARACTER_FIELD class is comprised of five required non-repeating data elements, ten optional non-repeating data elements, and two optional non-repeating sub-classes, the OBJECT_STATISTICS sub-class and the SPECIAL_CONSTANTS sub-class.
10. The OBJECT_STATISTICS class may optionally exist once and only once within the context of the the TABLE_CHARACTER_FIELD class.
11. The OBJECT_STATISTICS class is comprised of a single required non-repeating data element, and five optional non-repeating data elements.
12. The SPECIAL_CONSTANTS class may optionally exist once and only once within the context of the the TABLE_CHARACTER_FIELD class.
13. The SPECIAL_CONSTANTS class is comprised of six required non-repeating data elements.
14. The PROPERTY_MAP class may optionally exist once and only once within the context of the the TAGGED_TABLE_CHARACTER_SET class.
15. The PROPERTY_MAP class consists of two required non-repeating data elements and a single optional non-repeating data element.

**2.1.2**         TABLE_CHARACTER Data Product Byte Stream

Figure 2.1-2 depicts a representation a TABLE_CHARACTER byte-stream. The first two rows of the diagram are for the purposes of illustrating the byte positions relative to the TABLE fields and would not normally be contained in a data product file. The remaining twenty+ rows illustrate a typical TABLE_CHARACTER data product where the fields are fixed-width ASCII across the rows in the file.

With respect to the data product:
1. There are 3727 rows of data (of which 3700+ rows have been omitted from the diagram for ease of reading)
2. There are 10 fields in each row / record in this example file.
3. Each field is fixed-width across all rows in this example file.
4. Each field is comprised of ASCII characters.
5. There are 88 bytes in each row / record in this example file.

```
              1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890123456 7    8
 91,0.088, 91.06951,5.156,0.42,0.42656,125.547152,   4.7691,15300.0,"SS091A990R6M1.IMG"<CR><LF>
 91,0.088, 91.06951,5.156,0.42,0.42656,125.547152,   4.7691,15300.0,"SS091A990R6M1.IMG"<CR><LF>
 91,0.088, 91.07029,5.155,0.42,0.42652,125.550546,   4.7692,15300.0,"SS091A990R6M1.IMG"<CR><LF>
 91,0.089, 91.07105,5.155,0.42,0.42657,125.550344,   4.7692,15300.0,"SS091A990R6M1.IMG"<CR><LF>
 91,0.377, 91.35854,2.225,0.72,0.56432,147.854445, 19.1305, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.377, 91.35919,2.010,0.64,0.51506,197.022189, 18.7507, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.378, 91.35978,1.928,0.70,0.52962,199.881316, 21.4121, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.379, 91.36042,1.366,1.71,0.71758,185.232248,180.0000, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.379, 91.36104,1.494,1.47,0.69841,179.932613, 81.2461, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.380, 91.36165,1.908,0.83,0.58457,171.164927, 25.8445, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.380, 91.36229,1.677,1.13,0.65682,169.245035, 42.4206, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.381, 91.36289,1.720,0.87,0.57686,237.047264, 30.6785, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.382, 91.36415,2.645,0.49,0.40090,323.650451, 10.7665, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.383, 91.36477,4.752,0.40,0.39856, 10.696469,  4.8413, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.384, 91.36543,4.521,0.40,0.39494,358.661558,  5.1823, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.384, 91.36604,3.427,0.39,0.38187, 13.809568,  6.6027, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.385, 91.36663,3.239,0.39,0.37979,  4.907225,  7.0238, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.385, 91.36729,2.826,0.42,0.39259,317.423490,  8.7466, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.386, 91.36792,2.840,0.42,0.39058,321.608207,  8.6859, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.387, 91.36851,3.124,0.39,0.37922,339.039685,  7.3389, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 91,0.387, 91.36917,3.317,0.39,0.37703,352.720837,  6.7690, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
 <omitted 3700+ lines>
151,0.229,151.20464,2.980,0.43,0.40324,293.965171,  8.3952, 7140.0,"SS1520900R6M1.IMG"<CR><LF>
151,0.230,151.20527,3.072,0.46,0.41565,268.822094,  8.6166, 7140.0,"SS1520900R6M1.IMG"<CR><LF>
```

Figure 2.1-2.   Diagram of the TABLE_CHARACTER Byte Stream

Figure 2.1.1-3 depicts the above TABLE_CHARACTER byte-stream as it would be represented as an Excel spreadsheet.   This representation is helpful in understanding how the fields are represented in the data product label. Specifically that the TABLE_CHARACTER schema is compatible with most database management and spreadsheet applications. Note that the first three rows are for purposes of illustrating how the data relates to the TABLE_CHARACTER fields defined in the data product label.  These first three rows would not normally be present in a data product file.  The remaining twenty+ rows illustrate a typical TABLE_CHARACTER data product where the number of

fields Is fixed across the rows in the file, each field has a fixed-width, each field is comprised of ASCII characters, and where each row is delimited by a row delimiter (e.g., <CR><LF>).

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | Field | Field 2 | Field 3 | Field 4 | Field 5 | Field 6 | Field 7 | Field 8 | Field 9 | Field 10 |
| 3 | | | | | | | | | | |
| 4 | 91 | 0.088 | 91.06951 | 5.156 | 0.42 | 0.42656 | 125.5472 | 4.7691 | 15300 | SS091A990R6M1.IMG |
| 5 | 91 | 0.088 | 91.06951 | 5.156 | 0.42 | 0.42656 | 125.5472 | 4.7691 | 15300 | SS091A990R6M1.IMG |
| 6 | 91 | 0.088 | 91.07029 | 5.155 | 0.42 | 0.42652 | 125.5505 | 4.7692 | 15300 | SS091A990R6M1.IMG |
| 7 | 91 | 0.089 | 91.07105 | 5.155 | 0.42 | 0.42657 | 125.5503 | 4.7692 | 15300 | SS091A990R6M1.IMG |
| 8 | 91 | 0.377 | 91.35854 | 2.225 | 0.72 | 0.56432 | 147.8544 | 19.1305 | 4314.6 | SS091AA00R6M1.IMG |
| 9 | 91 | 0.377 | 91.35919 | 2.01 | 0.64 | 0.51506 | 197.0222 | 18.7507 | 4314.6 | SS091AA00R6M1.IMG |
| 10 | 91 | 0.378 | 91.35978 | 1.928 | 0.7 | 0.52962 | 199.8813 | 21.4121 | 4314.6 | SS091AA00R6M1.IMG |
| 11 | 91 | 0.379 | 91.36042 | 1.366 | 1.71 | 0.71758 | 185.2322 | 180 | 4314.6 | SS091AA00R6M1.IMG |
| 12 | 91 | 0.379 | 91.36104 | 1.494 | 1.47 | 0.69841 | 179.9326 | 81.2461 | 4314.6 | SS091AA00R6M1.IMG |
| 13 | 91 | 0.38 | 91.36165 | 1.908 | 0.83 | 0.58457 | 171.1649 | 25.8445 | 4314.6 | SS091AA00R6M1.IMG |
| 14 | 91 | 0.38 | 91.36229 | 1.677 | 1.13 | 0.65682 | 169.245 | 42.4206 | 4314.6 | SS091AA00R6M1.IMG |
| 15 | 91 | 0.381 | 91.36289 | 1.72 | 0.87 | 0.57686 | 237.0473 | 30.6785 | 4314.6 | SS091AA00R6M1.IMG |
| 16 | 91 | 0.382 | 91.36415 | 2.645 | 0.49 | 0.4009 | 323.6505 | 10.7665 | 4314.6 | SS091AA00R6M1.IMG |
| 17 | 91 | 0.383 | 91.36477 | 4.752 | 0.4 | 0.39856 | 10.69647 | 4.8413 | 4314.6 | SS091AA00R6M1.IMG |
| 18 | 91 | 0.384 | 91.36543 | 4.521 | 0.4 | 0.39494 | 358.6616 | 5.1823 | 4314.6 | SS091AA00R6M1.IMG |
| 19 | 91 | 0.384 | 91.36604 | 3.427 | 0.39 | 0.38187 | 13.80957 | 6.6027 | 4314.6 | SS091AA00R6M1.IMG |
| 20 | 91 | 0.385 | 91.36663 | 3.239 | 0.39 | 0.37979 | 4.907225 | 7.0238 | 4314.6 | SS091AA00R6M1.IMG |
| 21 | 91 | 0.385 | 91.36729 | 2.826 | 0.42 | 0.39259 | 317.4235 | 8.7466 | 4314.6 | SS091AA00R6M1.IMG |
| 22 | 91 | 0.386 | 91.36792 | 2.84 | 0.42 | 0.39058 | 321.6082 | 8.6859 | 4314.6 | SS091AA00R6M1.IMG |
| 23 | 91 | 0.387 | 91.36851 | 3.124 | 0.39 | 0.37922 | 339.0397 | 7.3389 | 4314.6 | SS091AA00R6M1.IMG |
| 24 | 91 | 0.387 | 91.36917 | 3.317 | 0.39 | 0.37703 | 352.7208 | 6.769 | 4314.6 | SS091AA00R6M1.IMG |
| 25 | | <omitted 3700+ lines> | | | | | | | | |
| 26 | 151 | 0.229 | 151.2046 | 2.98 | 0.43 | 0.40324 | 293.9652 | 8.3952 | 7140 | SS1520900R6M1.IMG |
| 27 | 151 | 0.23 | 151.2053 | 3.072 | 0.46 | 0.41565 | 268.8221 | 8.6166 | 7140 | SS1520900R6M1.IMG |

Figure 2.1-3.   Excel Spreadsheet Representation of the TABLE_CHARACTER Byte Stream

**2.1.3          TABLE_CHARACTER Label Scheme**

This section depicts how the TABLE_CHARACTER byte-scheme, as illustrated above, can be described by both a PDS3 label and a PDS4 label.

The PDS4 TABLE_CHARACTER class is the successor to the PDS3 TABLE object.

2.1.3.1     PDS3 TABLE_CHARACTER Label Scheme

The data product depicted in Figure 2.1-2 could be described in PDS3 by use of the TABLE and COLUMN objects:

```
PDS_VERSION_ID                    = PDS3
```

```
RECORD_TYPE                     = FIXED_LENGTH
RECORD_BYTES                    = 88
FILE_RECORDS                    = 3727
^TABLE                          = "CHAR_TABLE_COLLAPSED.TAB"

DATA_SET_ID                     = "PHX-M-TT-5-WIND-VEL-DIR-V1.0"
MISSION_NAME                    = "PHOENIX"
INSTRUMENT_HOST_NAME            = "PHOENIX"
INSTRUMENT_NAME                 = "TELLTALE"
PRODUCT_ID                      = "TELLTALE_91_151"
TARGET_NAME                     = "MARS"
SPACECRAFT_CLOCK_START_COUNT    = "904250279.448"
SPACECRAFT_CLOCK_STOP_COUNT     = "909588864.598"
START_TIME                      = 2008-08-26T20:36:36.856
STOP_TIME                       = 2008-10-27T15:32:50.952
PRODUCT_CREATION_TIME           = 2009-04-15

OBJECT                          = TABLE
  INTERCHANGE_FORMAT            = ASCII
  ROW_BYTES                     = 88
  ROWS                          = 3727
  COLUMNS                       = 10

  OBJECT                        = COLUMN
    NAME                        = "SOL"
    DATA_TYPE                   = ASCII_INTEGER
    START_BYTE                  = 1
    BYTES                       = 3
    FORMAT                      = "I3"
    UNIT                        = "N/A"
    DESCRIPTION                 = "PHOENIX Sol number"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "LTST"
    DATA_TYPE                   = ASCII_REAL
    START_BYTE                  = 5
    BYTES                       = 5
    FORMAT                      = "F5.3"
    UNIT                        = "N/A"
    DESCRIPTION                 = "Local True Solar Time"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "LMST"
    DATA_TYPE                   = ASCII_REAL
    START_BYTE                  = 11
    BYTES                       = 9
    FORMAT                      = "F9.5"
    UNIT                        = "N/A"
    DESCRIPTION                 = "Local Mean Solar Time"
  END_OBJECT                    = COLUMN

  OBJECT                        = COLUMN
    NAME                        = "V"
    DATA_TYPE                   = ASCII_REAL
    START_BYTE                  = 21
    BYTES                       = 5
    FORMAT                      = "F5.3"
    UNIT                        = "METERS/SECOND"
    DESCRIPTION                 = "Wind speed in meters per second"
  END_OBJECT                    = COLUMN
```

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```
OBJECT                          = COLUMN
  NAME                          = "DV+"
  DATA_TYPE                     = ASCII_REAL
  START_BYTE                    = 27
  BYTES                         = 4
  FORMAT                        = "F4.2"
  UNIT                          = "METERS/SECOND"
  DESCRIPTION                   = "Error in wind speed (positive)"
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
  NAME                          = "DV-"
  DATA_TYPE                     = ASCII_REAL
  START_BYTE                    = 32
  BYTES                         = 7
  FORMAT                        = "F7.5"
  UNIT                          = "METERS/SECOND"
  DESCRIPTION                   = "Error in wind speed (negative)"
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
  NAME                          = "DIR"
  DATA_TYPE                     = ASCII_REAL
  START_BYTE                    = 40
  BYTES                         = 10
  FORMAT                        = "F10.6"
  UNIT                          = "DEGREES"
  DESCRIPTION                   = "Wind direction in degrees given in
                                   meteorological convention (0 = from N,
                                   90 = from E, 180 = from S, 270 = from
                                   W)"
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
  NAME                          = "DDIR"
  DATA_TYPE                     = ASCII_REAL
  START_BYTE                    = 51
  BYTES                         = 8
  FORMAT                        = "F8.4"
  UNIT                          = "DEGREES"
  DESCRIPTION                   = "Error in direction (given in degrees).
                                   If dv+ is larger than v, then this is
                                   set to 180"
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
  NAME                          = "EXPOSURE TIME"
  DATA_TYPE                     = ASCII_REAL
  START_BYTE                    = 60
  BYTES                         = 7
  FORMAT                        = "F7.1"
  UNIT                          = "MILLISECONDS"
  DESCRIPTION                   = "Exposure time by SSI in milliseconds"
END_OBJECT                      = COLUMN

OBJECT                          = COLUMN
  NAME                          = "FILE NAME"
  DATA_TYPE                     = CHARACTER
  START_BYTE                    = 69
  BYTES                         = 17
  FORMAT                        = "A17"
  UNIT                          = "N/A"
  DESCRIPTION                   = "Image filename used for the analysis"
```

```
        END_OBJECT                    = COLUMN

      END_OBJECT                      = TABLE
      END
```

## 2.1.3.2    PDS4 TABLE_CHARACTER Label Scheme

The same data product can also be described in PDS4 by use of the
TABLE_CHARACTER and the TABLE_FIELD_CHARACTER classes.

```
        #PDS4#

        /* ******* LABEL TEMPLATE - PRODUCT_TABLE_CHARACTER ******* */

        OBJECT = PRODUCT_TABLE_CHARACTER;

          OBJECT = IDENTIFICATION_SECTION;
            DD_VERSION_ID       = "DD_VERSION_ID";
            IDENTIFIER          = "PDS4_ATM_PRODUCT_TABLE_CHARACTER_ID:V1.0";
            LABEL_REVISION_NOTE = "20090101:1.0 - initial version;
                                   20090102:1.1 - added another column";
            PDS_VERSION_ID      = "PDS4.0";
            PRODUCT_CREATION_TIME = 2009-04-15;
            TITLE               = "PHOENIX Mars Wind Experiment";
            URN                 = "http://URN:PHX-M-TT-5-WIND-VEL-DIR-
        V1.0:PDS4_ATM_PRODUCT_TABLE_CHARACTER_ID:1.0";
            VERSION             = "1.0";
          END_OBJECT = IDENTIFICATION_SECTION;


          OBJECT = DESCRIPTION_SECTION;
            DESCRIPTION           = "ANNOTATION FOR THE PRODUCT GOES HERE.";
          END_OBJECT = DESCRIPTION_SECTION;


          OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;
            COMMENT                      = "Observation Intent";
            SPACECRAFT_CLOCK_START_COUNT = "904250279.448";
            SPACECRAFT_CLOCK_STOP_COUNT  = "909588864.598";
            START_TIME                   = 2008-08-26T20:36:36.856;
            STOP_TIME                    = 2008-10-27T15:32:50.952;
          END_OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;


          OBJECT = DATASET_SECTION;
            DATA_SET_ID         = "PHX-M-TT-5-WIND-VEL-DIR-V1.0";
          END_OBJECT = DATASET_SECTION;


          OBJECT = INSTRUMENT_SECTION;
            INSTRUMENT_ID_NEW   = "TELLTALE";
          END_OBJECT = INSTRUMENT_SECTION;


          OBJECT = MISSION_SECTION;
            MISSION_NAME        = "PHOENIX";
          END_OBJECT = MISSION_SECTION;


          OBJECT = NODE_SECTION;
```

```
      NODE_NAME              = "PLANETARY ATMOSPHERES";
END_OBJECT = NODE_SECTION;

OBJECT = TARGET_SECTION;
   TARGET_NAME            = MARS;
END_OBJECT = TARGET_SECTION;


OBJECT = INSTRUMENT_HOST_SECTION;
   INSTRUMENT_HOST_ID   = PHX;
END_OBJECT = INSTRUMENT_HOST_SECTION;


OBJECT = TAGGED_TABLE_CHARACTER_SET;

   OBJECT = TABLE_CHARACTER;
     DATA_LOCATION            = ("PHX_M_TT_TABLE_FILE",1);

     LOCAL_IDENTIFIER         = "PHX_M_TT_TABLE";
     FILE_TYPE                = CHARACTER;
     NUMBER_OF_FIELDS         = 10;
     NUMBER_OF_ROWS           = 3727;
     ROW_BYTES                = 88;

     OBJECT = TABLE_CHARACTER_FIELD;
       FIELD_NAME             = "SOL";
       FIELD_NUMBER           = 1;
       FIELD_DATA_TYPE        = ASCII_INTEGER;
       FIELD_LOCATION         = 1;
       FIELD_LENGTH           = 3;
       FIELD_FORMAT           = "I3";
       FIELD_MIN_PHYSICAL     = 91;
       FIELD_MAX_PHYSICAL     = 151;
       FIELD_UNIT             = "N/A";
       FIELD_DESCRIPTION      = "PHOENIX Sol number";
     END_OBJECT = TABLE_CHARACTER_FIELD;

     OBJECT = TABLE_CHARACTER_FIELD;
       FIELD_NAME             = "LTST";
       FIELD_NUMBER           = 2;
       FIELD_DATA_TYPE        = ASCII_REAL;
       FIELD_LOCATION         = 5;
       FIELD_LENGTH           = 5;
       FIELD_FORMAT           = "F5.3";
       FIELD_MIN_PHYSICAL     = 0.088078704;
       FIELD_MAX_PHYSICAL     = 0.230243056;
       FIELD_UNIT             = "N/A";
       FIELD_DESCRIPTION      = "Local True Solar Time";
     END_OBJECT = TABLE_CHARACTER_FIELD;

     OBJECT = TABLE_CHARACTER_FIELD;
       FIELD_NAME             = "LMST";
       FIELD_NUMBER           = 3;
       FIELD_DATA_TYPE        = ASCII_REAL;
       FIELD_LOCATION         = 11;
       FIELD_LENGTH           = 9;
       FIELD_FORMAT           = "F9.5";
       FIELD_MIN_PHYSICAL     = 91.0695122;
       FIELD_MAX_PHYSICAL     = 151.2052778;
       FIELD_UNIT             = "N/A";
       FIELD_DESCRIPTION      = "Local Mean Solar Time";
     END_OBJECT = TABLE_CHARACTER_FIELD;
```

```
OBJECT = TABLE_CHARACTER_FIELD;
  FIELD_NAME               = "V";
  FIELD_NUMBER             = 4;
  FIELD_DATA_TYPE          = ASCII_REAL;
  FIELD_LOCATION           = 21;
  FIELD_LENGTH             = 5;
  FIELD_FORMAT             = "F5.3";
  FIELD_MIN_PHYSICAL       = 3.072451472;
  FIELD_MAX_PHYSICAL       = 5.15605715;
  FIELD_UNIT               = "METERS/SECOND";
  FIELD_DESCRIPTION        = "Wind speed in meters per second";
END_OBJECT = TABLE_CHARACTER_FIELD;

OBJECT = TABLE_CHARACTER_FIELD;
  FIELD_NAME               = "DV+";
  FIELD_NUMBER             = 5;
  FIELD_DATA_TYPE          = ASCII_REAL;
  FIELD_LOCATION           = 27;
  FIELD_LENGTH             = 4;
  FIELD_FORMAT             = "F4.2";
  FIELD_MIN_PHYSICAL       = 0.428682136;
  FIELD_MAX_PHYSICAL       = 0.46032408;
  FIELD_UNIT               = "METERS/SECOND";
  FIELD_DESCRIPTION        = "Error in wind speed (positive)";
END_OBJECT = TABLE_CHARACTER_FIELD;

OBJECT = TABLE_CHARACTER_FIELD;
  FIELD_NAME               = "DV-";
  FIELD_NUMBER             = 6;
  FIELD_DATA_TYPE          = ASCII_REAL;
  FIELD_LOCATION           = 32;
  FIELD_LENGTH             = 7;
  FIELD_FORMAT             = "F7.5";
  FIELD_MIN_PHYSICAL       = 0.415653998;
  FIELD_MAX_PHYSICAL       = 0.42656498;
  FIELD_UNIT               = "METERS/SECOND";
  FIELD_DESCRIPTION        = "Error in wind speed (negative)";
END_OBJECT = TABLE_CHARACTER_FIELD;

OBJECT = TABLE_CHARACTER_FIELD;
  FIELD_NAME               = "DIR";
  FIELD_NUMBER             = 7;
  FIELD_DATA_TYPE          = ASCII_REAL;
  FIELD_LOCATION           = 40;
  FIELD_LENGTH             = 10;
  FIELD_FORMAT             = "F10.6";
  FIELD_MIN_PHYSICAL       = 125.5471521;
  FIELD_MAX_PHYSICAL       = 268.8220941;
  FIELD_UNIT               = "DEGREES";
  FIELD_DESCRIPTION        = "Wind direction in degrees given in
                              meteorological convention (0 = from N,
                              90 = from E, 180 = from S, 270 = from
                              W)";
END_OBJECT = TABLE_CHARACTER_FIELD;

OBJECT = TABLE_CHARACTER_FIELD
  FIELD_NAME               = "DDIR";
  FIELD_NUMBER             = 8;
  FIELD_DATA_TYPE          = ASCII_REAL;
  FIELD_LOCATION           = 51;
  FIELD_LENGTH             = 8;
  FIELD_FORMAT             = "F8.4";
  FIELD_MIN_PHYSICAL       = 4.769160219;
```

```
          FIELD_MAX_PHYSICAL     = 8.616672754;
          FIELD_UNIT             = "DEGREES";
          FIELD_DESCRIPTION      = "Error in direction (given in degrees).
                                    If dv+ is larger than v, then this is
                                    set to 180";
      END_OBJECT = TABLE_CHARACTER_FIELD;

      OBJECT = TABLE_CHARACTER_FIELD;
          FIELD_NAME             = "EXPOSURE TIME";
          FIELD_NUMBER           = 9;
          FIELD_DATA_TYPE        = ASCII_REAL;
          FIELD_LOCATION         = 60;
          FIELD_LENGTH           = 7;
          FIELD_FORMAT           = "F7.1";
          FIELD_MIN_PHYSICAL     = 7140;
          FIELD_MAX_PHYSICAL     = 15300;
          FIELD_UNIT             = "MILLISECONDS";
          FIELD_DESCRIPTION      = "Exposure time by SSI in milliseconds";
      END_OBJECT = TABLE_CHARACTER_FIELD;

      OBJECT = TABLE_CHARACTER_FIELD;
          FIELD_NAME             = "FILE NAME";
          FIELD_NUMBER           = 10;
          FIELD_DATA_TYPE        = CHARACTER;
          FIELD_LOCATION         = 69;
          FIELD_LENGTH           = 17;
          FIELD_FORMAT           = "A17";
          FIELD_UNIT             = "N/A";
          FIELD_DESCRIPTION      = "Image filename used for the analysis";
      END_OBJECT = TABLE_CHARACTER_FIELD;

    END_OBJECT = TABLE_CHARACTER;

  END_OBJECT = TAGGED_TABLE_CHARACTER_SET;

  OBJECT = PROPERTY_MAP;
    PROPERTY_MAP_ENTRY   = (
      ("PHX_M_TT_WIND_VEL", PRODUCT_ID,               "TELLTALE_91_151"),
      ("PHX_M_TT_WIND_VEL", PRODUCT_VERSION_ID,       "V1.0"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_HOST_NAME,     "PHOENIX"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_HOST_ID,       "PHX"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_NAME,          "TELLTALE"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_ID,            "TELLTALE"),
      ("PHX_M_TT_WIND_VEL", MISSION_NAME,             "PHOENIX"),
      ("PHX_M_TT_WIND_VEL", PRODUCT_CREATION_TIME,    2009-04-15)
                          );
  END_OBJECT = PROPERTY_MAP;


  OBJECT = FILE_SECTION;

    OBJECT = FILE_CHARACTER_FIXED;
      LOCAL_IDENTIFIER  = "PHX_M_TT_TABLE_FILE";
      CHECKSUM          = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
      FILE_SIZE         = 111;
      FILE_NAME         = "PDS4_ATM_TABLE_CHAR.TAB";
      FILE_TYPE         = CHARACTER;
      MAX_RECORD_BYTES  = 3727;
      RECORD_TYPE       = FIXED;
    END_OBJECT = FILE_CHARACTER_FIXED;

  END_OBJECT = FILE_SECTION;
```

```
END_OBJECT = PRODUCT_TABLE_CHARACTER;
```

## 2.1.4        PDS4 TABLE_CHARACTER and PDS3 TABLE PARALLELISMS

This section provides a high level discussion of the parallelisms between the PDS3 TABLE Data Object Description (DoD) and the PDS4 TABLE_CHARACTER class.

The PDS3 TABLE (DoD) by definition was very flexible in that the DoD could define both simple Tables and very complex types of Tables depending on the representation of the data product byte stream.  An example of a simple table is where the data product byte stream is represented as a 2-dimensional construct where neither dimension has either prefix or suffix bytes.  A more complex example of a table is where the data product byte stream is represented by any of the following:

  a.  Row prefix and/or suffix bytes
  b.  The data is represented as row major storage
  c.  The data does not contain any contiguous unused or spare bytes

The PDS4 TABLE_CHARACTER class has been specifically designed to be more restrictive in the permissible representations of the data object byte stream. And as such, these restrictions ensure a more rigorous set of archival quality table constructs.   In fact, the PDS4 TABLE_CHARACTER class is so rigid that there are variants to the TABLE_BASE class.

## 2.2        TABLE_BINARY

This section describes the TABLE_BINARY extension of the PDS4 Table_Base (i.e., Heterogeneous repeating record of Scalars) class where a contiguous stream of BINARY data, assembled as fixed-width fields, maps the "items" contained in a TABLE_BINARY file.

This section identifies a mapping of the PDS3 TABLE object to the PDS4 TABLE_BINARY file construct and demonstrates how the byte stream (e.g., sequence of bits) can be described by both a PDS3 label and a PDS4 label.

### 2.2.1        TABLE_BASE Class Description and Schema

Figure 2.2-1 depicts a representation of the PDS4 TABLE_BASE class and the associated parent and child classes. The figure additionally lists the required or optional status, and the cardinality of repeating structures.

```
OBJECT = TAGGED_TABLE_BINARY_SET
                                               Req/Opt    Cardinality

    OBJECT = DESCRIPTION_SECTION               Optional       1
     DESCRIPTION                               Required       1
    END_OBJECT = DESCRIPTION_SECTION


    OBJECT = HEADER                            Optional       1
        DATA_LOCATION                          Required       1

        LOCAL_IDENTIFIER                       Required       1
        COMMENT                                Optional       1
        BYTES                                  Required       1
        DESCRIPTION                            Optional       1
        EXTERNAL_STANDARD                      Required       1
        FILE_TYPE                              Required       1
        NAME                                   Optional       1
    END_OBJECT = HEADER


    OBJECT = TABLE_BINARY                      Required       1
        DATA_LOCATION                          Required       1

        LOCAL_IDENTIFIER                       Required       1
        COMMENT                                Optional       1
        FILE_TYPE                              Required       1
        NUMBER_OF_FIELDS                       Required       1
        NUMBER_OF_ROWS                         Required       1
        ROW_BYTES                              Required       1

        OBJECT = TABLE_BINARY_FIELD            Required       1..*
         FIELD_NAME                            Required       1
         FIELD_DATA_TYPE                       Required       1
         FIELD_DESCRIPTION                     Optional       1
         FIELD_FORMAT                          Optional       1
         FIELD_LENGTH                          Required       1
         FIELD_LOCATION                        Required       1
         FIELD_MAX_LOGICAL                     Optional       1
         FIELD_MAX_PHYSICAL                    Optional       1
         FIELD_MIN_LOGICAL                     Optional       1
         FIELD_MIN_PHYSICAL                    Optional       1
         FIELD_NUMBER                          Optional       1
         FIELD_SCALING_FACTOR                  Optional       1
         FIELD_UNIT                            Optional       1
         FIELD_VALUE_OFFSET                    Optional       1
```
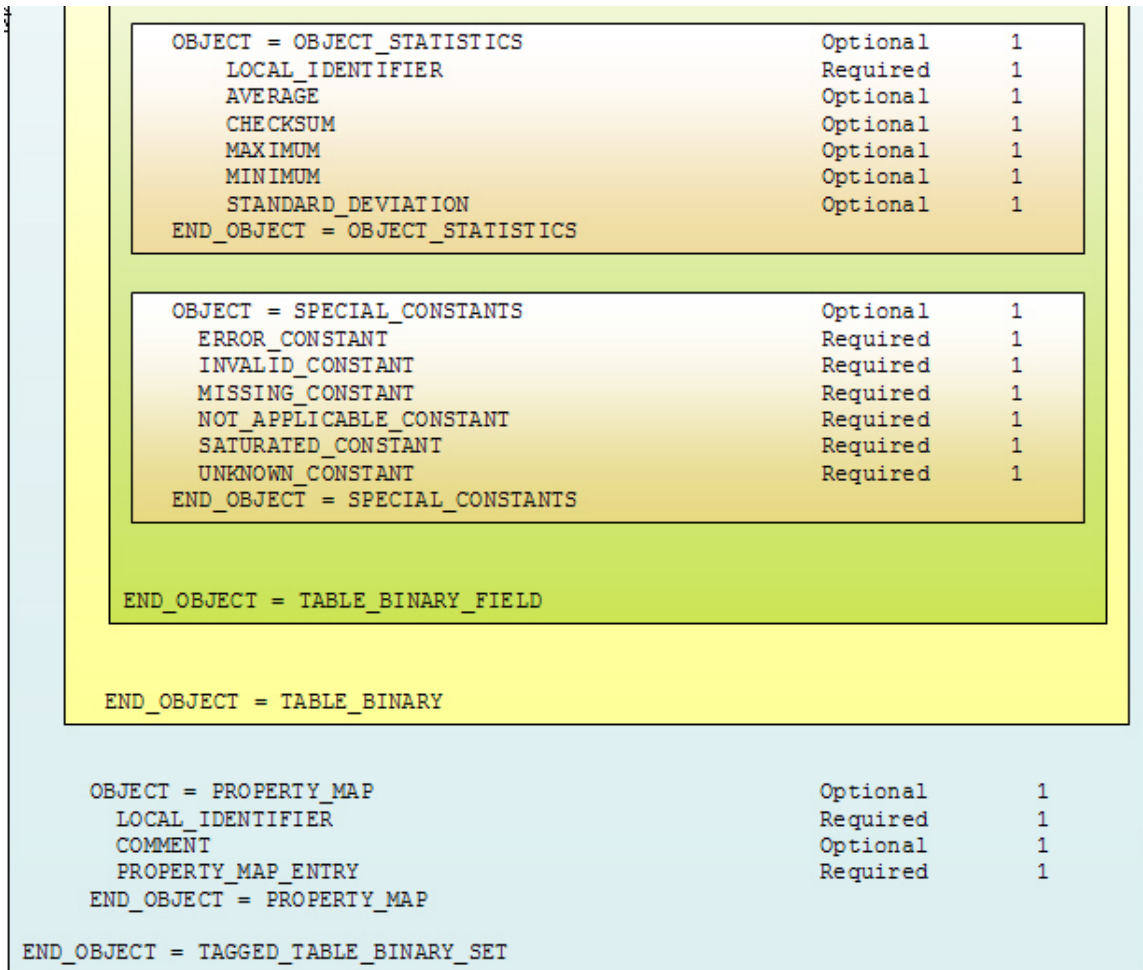
29

```
      OBJECT = OBJECT_STATISTICS                  Optional      1
          LOCAL_IDENTIFIER                        Required      1
          AVERAGE                                 Optional      1
          CHECKSUM                                Optional      1
          MAXIMUM                                 Optional      1
          MINIMUM                                 Optional      1
          STANDARD_DEVIATION                      Optional      1
      END_OBJECT = OBJECT_STATISTICS


      OBJECT = SPECIAL_CONSTANTS                   Optional      1
        ERROR_CONSTANT                            Required      1
        INVALID_CONSTANT                          Required      1
        MISSING_CONSTANT                          Required      1
        NOT_APPLICABLE_CONSTANT                   Required      1
        SATURATED_CONSTANT                        Required      1
        UNKNOWN_CONSTANT                          Required      1
      END_OBJECT = SPECIAL_CONSTANTS



    END_OBJECT = TABLE_BINARY_FIELD



  END_OBJECT = TABLE_BINARY


    OBJECT = PROPERTY_MAP                          Optional      1
      LOCAL_IDENTIFIER                            Required      1
      COMMENT                                     Optional      1
      PROPERTY_MAP_ENTRY                          Required      1
    END_OBJECT = PROPERTY_MAP

END_OBJECT = TAGGED_TABLE_BINARY_SET
```

Figure 2.2-1.   Diagram of the TABLE_BINARY Schema


From Figure 2.2-1, the overall structure of the TABLE_BINARY data object description can be easily discerned and understood.

1.  The parent class, the TAGGED_TABLE_BINARY_SET class, is comprised of four sub-classes:
    - DESCRIPTION_SECTION class
    - HEADER class
    - TABLE_BINARY class
    - PROPERTY_MAP class
2.  The DESRIPTION_SECTION class may optionally exist once and only once within the context of the the TAGGED_TABLE_BINARY_SET class.
3.  The DESCRIPTION_SECTION class consists of a single required non-repeating data element.
4.  The HEADER class may optionally exist once and only once within the context of the the TAGGED_TABLE_BINARY_SET class.

5. The HEADER class consists of five required non-repeating data elements, and three optional non-repeating data elements..
6. The TABLE_BINARY class must exist once and only once within the context of the TAGGED_TABLE_BINARY_SET class.
7. The TABLE_BINARY class is comprised of six required non-repeating data elements, a single optional non-repeating data element, and a single required repeating sub-class, the TABLE_BINARY_FIELD sub-class
8. The TABLE_BINARY_FIELD class must exist once but may exist many times within the context of the TABLE_BINARY class.
9. The TABLE_BINARY_FIELD class is comprised of five required non-repeating data elements, ten optional non-repeating data elements, and two optional non-repeating sub-classes, the OBJECT_STATISTICS sub-class and the SPECIAL_CONSTANTS sub-class.
10. The OBJECT_STATISTICS class may optionally exist once and only once within the context of the the TABLE_BINARY_FIELD class.
11. The OBJECT_STATISTICS class is comprised of a single required non-repeating data element, and five optional non-repeating data elements.
12. The SPECIAL_CONSTANTS class may optionally exist once and only once within the context of the the TABLE_BINARY_FIELD class.
13. The SPECIAL_CONSTANTS class is comprised of six required non-repeating data elements.
14. The PROPERTY_MAP class may optionally exist once and only once within the context of the the TAGGED_TABLE_BINARY_SET class.
15. The PROPERTY_MAP class consists of two required non-repeating data elements and a single optional non-repeating data element.

**2.2.2**        TABLE_BINARY Data Product Byte Stream

Figure 2.2-2 depicts a representation a TABLE_BINARY byte-stream.  The first two rows of the diagram are for the purposes of illustrating the byte positions relative to the TABLE fields and would not normally be contained in a data product file.  The remaining twenty+ rows illustrate a typical TABLE_BINARY data product where the fields are fixed-width BINARY data across the rows in the file.

Note that in the following figures, for purposes of representing the binary data in a "readable" format, the data are represented using ASCII characters.  For example, in a binary data stream "<CR><LF>" would be represented as "0D0A" hexadecimal, as "1310" decimal, and as "11011010" MSB_INTEGER_1_BYTE.

With respect to the data product:
1. There are 3727 rows of data (of which 3700+ rows have been omitted from the diagram for ease of reading)

2. There are 10 fields in each row / record in this example file.
3. Each field is fixed-width across all rows in this example file.
4. Each field is comprised of BINARY data.
5. There are 88 bytes in each row / record in this example file.



```
                1         2         3         4         5         6         7         8
       12345678901234567890123456789012345678901234567890123456789012345678901234567890123456 7    8
        91,0.088, 91.06951,5.156,0.42,0.42656,125.547152,  4.7691,15300.0,"SS091A990R6M1.IMG"<CR><LF>
        91,0.088, 91.06951,5.156,0.42,0.42656,125.547152,  4.7691,15300.0,"SS091A990R6M1.IMG"<CR><LF>
        91,0.088, 91.07029,5.155,0.42,0.42652,125.550546,  4.7692,15300.0,"SS091A990R6M1.IMG"<CR><LF>
        91,0.089, 91.07105,5.155,0.42,0.42657,125.550344,  4.7692,15300.0,"SS091A990R6M1.IMG"<CR><LF>
        91,0.377, 91.35854,2.225,0.72,0.56432,147.854445, 19.1305, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.377, 91.35919,2.010,0.64,0.51506,197.022189, 18.7507, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.378, 91.35978,1.928,0.70,0.52962,199.881316, 21.4121, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.379, 91.36042,1.366,1.71,0.71758,185.232248,180.0000, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.379, 91.36104,1.494,1.47,0.69841,179.932613, 81.2461, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.380, 91.36165,1.908,0.83,0.58457,171.164927, 25.8445, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.380, 91.36229,1.677,1.13,0.65682,169.245035, 42.4206, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.381, 91.36289,1.720,0.87,0.57686,237.047264, 30.6785, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.382, 91.36415,2.645,0.49,0.40090,323.650451, 10.7665, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.383, 91.36477,4.752,0.40,0.39856, 10.696469,  4.8413, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.384, 91.36543,4.521,0.40,0.39494,358.661558,  5.1823, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.384, 91.36604,3.427,0.39,0.38187, 13.809568,  6.6027, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.385, 91.36663,3.239,0.39,0.37979,  4.907225,  7.0238, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.385, 91.36729,2.826,0.42,0.39259,317.423490,  8.7466, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.386, 91.36792,2.840,0.42,0.39058,321.608207,  8.6859, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.387, 91.36851,3.124,0.39,0.37922,339.039685,  7.3389, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
        91,0.387, 91.36917,3.317,0.39,0.37703,352.720837,  6.7690, 4314.6,"SS091AA00R6M1.IMG"<CR><LF>
         <omitted 3700+ lines>
       151,0.229,151.20464,2.980,0.43,0.40324,293.965171,  8.3952, 7140.0,"SS1520900R6M1.IMG"<CR><LF>
       151,0.230,151.20527,3.072,0.46,0.41565,268.822094,  8.6166, 7140.0,"SS1520900R6M1.IMG"<CR><LF>
```

Figure 2.2-2.   Diagram of the TABLE_BINARY Byte Stream

**2.2.3**         TABLE_BINARY Label Scheme

This section depicts how the TABLE_BINARY byte-scheme, as illustrated above, can be described by both a PDS3 label and a PDS4 label.

The PDS4 TABLE_BINARY class is the successor to the PDS3 TABLE object.

## 2.2.3.1    PDS3 TABLE_BINARY Label Scheme

The data product depicted in Figure 2.2-2 could be described in PDS3 by use of the TABLE and COLUMN objects:

```
PDS_VERSION_ID                = PDS3

RECORD_TYPE                   = FIXED_LENGTH
RECORD_BYTES                  = 88
FILE_RECORDS                  = 3727
^TABLE                        = "BIN_TABLE_COLLAPSED.TAB"

DATA_SET_ID                   = "PHX-M-TT-5-WIND-VEL-DIR-V1.0"
MISSION_NAME                  = "PHOENIX"
INSTRUMENT_HOST_NAME          = "PHOENIX"
INSTRUMENT_NAME               = "TELLTALE"
PRODUCT_ID                    = "TELLTALE_91_151"
TARGET_NAME                   = "MARS"
SPACECRAFT_CLOCK_START_COUNT  = "904250279.448"
SPACECRAFT_CLOCK_STOP_COUNT   = "909588864.598"
START_TIME                    = 2008-08-26T20:36:36.856
STOP_TIME                     = 2008-10-27T15:32:50.952
PRODUCT_CREATION_TIME         = 2009-04-15

OBJECT                        = TABLE
  INTERCHANGE_FORMAT          = BINARY
  ROW_BYTES                   = 88
  ROWS                        = 3727
  COLUMNS                     = 10

  OBJECT                      = COLUMN
    NAME                      = "SOL"
    DATA_TYPE                 = MSB_INTEGER
    START_BYTE                = 1
    BYTES                     = 3
    FORMAT                    = "I3"
    UNIT                      = "N/A"
    DESCRIPTION               = "PHOENIX Sol number"
  END_OBJECT                  = COLUMN

  OBJECT                      = COLUMN
    NAME                      = "LTST"
    DATA_TYPE                 = MSB_REAL
    START_BYTE                = 5
    BYTES                     = 5
    FORMAT                    = "F5.3"
    UNIT                      = "N/A"
    DESCRIPTION               = "Local True Solar Time"
  END_OBJECT                  = COLUMN

  OBJECT                      = COLUMN
    NAME                      = "LMST"
    DATA_TYPE                 = MSB_REAL
    START_BYTE                = 11
    BYTES                     = 9
    FORMAT                    = "F9.5"
```

```
  UNIT                      = "N/A"
  DESCRIPTION               = "Local Mean Solar Time"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
  NAME                      = "V"
  DATA_TYPE                 = MSB_REAL
  START_BYTE                = 21
  BYTES                     = 5
  FORMAT                    = "F5.3"
  UNIT                      = "METERS/SECOND"
  DESCRIPTION               = "Wind speed in meters per second"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
  NAME                      = "DV+"
  DATA_TYPE                 = MSB_REAL
  START_BYTE                = 27
  BYTES                     = 4
  FORMAT                    = "F4.2"
  UNIT                      = "METERS/SECOND"
  DESCRIPTION               = "Error in wind speed (positive)"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
  NAME                      = "DV-"
  DATA_TYPE                 = MSB_REAL
  START_BYTE                = 32
  BYTES                     = 7
  FORMAT                    = "F7.5"
  UNIT                      = "METERS/SECOND"
  DESCRIPTION               = "Error in wind speed (negative)"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
  NAME                      = "DIR"
  DATA_TYPE                 = MSB_REAL
  START_BYTE                = 40
  BYTES                     = 10
  FORMAT                    = "F10.6"
  UNIT                      = "DEGREES"
  DESCRIPTION               = "Wind direction in degrees given in
                               meteorological convention (0 = from N,
                               90 = from E, 180 = from S, 270 = from
                               W)"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
  NAME                      = "DDIR"
  DATA_TYPE                 = MSB_REAL
  START_BYTE                = 51
  BYTES                     = 8
  FORMAT                    = "F8.4"
  UNIT                      = "DEGREES"
  DESCRIPTION               = "Error in direction (given in degrees).
                               If dv+ is larger than v, then this is
                               set to 180"
END_OBJECT                  = COLUMN

OBJECT                      = COLUMN
  NAME                      = "EXPOSURE TIME"
  DATA_TYPE                 = MSB_REAL
  START_BYTE                = 60
```

```
      BYTES                     = 7
      FORMAT                    = "F7.1"
      UNIT                      = "MILLISECONDS"
      DESCRIPTION               = "Exposure time by SSI in milliseconds"
    END_OBJECT                  = COLUMN

    OBJECT                      = COLUMN
      NAME                      = "FILE NAME"
      DATA_TYPE                 = CHARACTER
      START_BYTE                = 69
      BYTES                     = 17
      FORMAT                    = "A17"
      UNIT                      = "N/A"
      DESCRIPTION               = "Image filename used for the analysis"
    END_OBJECT                  = COLUMN

  END_OBJECT                    = TABLE
  END
```

## 2.2.3.2    PDS4 TABLE_BINARY Label Scheme

The same data product can also be described in PDS4 by use of the
TABLE_BINARY and the TABLE_FIELD_BINARY classes.

```
    #PDS4#

    /* ******* LABEL TEMPLATE - PRODUCT_TABLE_BINARY ******* */

    OBJECT = PRODUCT_TABLE_BINARY;

      OBJECT = IDENTIFICATION_SECTION;
        DD_VERSION_ID        = "DD_VERSION_ID";
        IDENTIFIER           = "PDS4_ATM_PRODUCT_TABLE_BINARY_ID:V1.0";
        LABEL_REVISION_NOTE  = "20090101:1.0 - initial version;;
                                20090102:1.1 - added another column";
        PDS_VERSION_ID       = "PDS4.0";
        PRODUCT_CREATION_TIME = 2009-04-15;
        TITLE                = "PHOENIX Mars Wind Experiment";
        URN                  = "http://URN:PHX-M-TT-5-WIND-VEL-DIR-
V1.0:PDS4_ATM_PRODUCT_TABLE_BINARY_ID:1.0";
        VERSION              = "1.0";
      END_OBJECT = IDENTIFICATION_SECTION;


      OBJECT = DESCRIPTION_SECTION;
        DESCRIPTION          = "ANNOTATION FOR THE PRODUCT GOES HERE.";
      END_OBJECT = DESCRIPTION_SECTION;


      OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;
        COMMENT                       = "Observation Intent";
        SPACECRAFT_CLOCK_START_COUNT = "904250279.448";
        SPACECRAFT_CLOCK_STOP_COUNT  = "909588864.598";
        START_TIME                    = 2008-08-26T20:36:36.856;
        STOP_TIME                     = 2008-10-27T15:32:50.952;
      END_OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;


      OBJECT = DATASET_SECTION;
```

```
      DATA_SET_ID          = "PHX-M-TT-5-WIND-VEL-DIR-V1.0";
END_OBJECT = DATASET_SECTION;


OBJECT = INSTRUMENT_SECTION;
  INSTRUMENT_ID_NEW    = "TELLTALE";
END_OBJECT = INSTRUMENT_SECTION;


OBJECT = MISSION_SECTION;
  MISSION_NAME         = "PHOENIX";
END_OBJECT = MISSION_SECTION;


OBJECT = NODE_SECTION;
  NODE_NAME            = "PLANETARY ATMOSPHERES";
END_OBJECT = NODE_SECTION;

OBJECT = TARGET_SECTION;
  TARGET_NAME          = MARS;
END_OBJECT = TARGET_SECTION;


OBJECT = INSTRUMENT_HOST_SECTION;
  INSTRUMENT_HOST_ID   = PHX;
END_OBJECT = INSTRUMENT_HOST_SECTION;


OBJECT = TAGGED_TABLE_BINARY_SET;

  OBJECT = TABLE_BINARY;
    DATA_LOCATION             = ("PHX_M_TT_TABLE_FILE",1);

    LOCAL_IDENTIFIER          = "PHX_M_TT_TABLE";
    NUMBER_OF_FIELDS          = 10;
    NUMBER_OF_ROWS            = 3727;
    ROW_BYTES                 = 88;

      OBJECT = TABLE_BINARY_FIELD;
        FIELD_NAME              = "SOL";
        FIELD_NUMBER            = 1;
        FIELD_DATA_TYPE         = MSB_INTEGER;
        FIELD_LOCATION          = 1;
        FIELD_LENGTH            = 3;
        FIELD_FORMAT            = "I3";
        FIELD_MIN_PHYSICAL      = 91;
        FIELD_MAX_PHYSICAL      = 151;
        FIELD_UNIT              = "N/A";
        FIELD_DESCRIPTION       = "PHOENIX Sol number";
      END_OBJECT = TABLE_BINARY_FIELD;

      OBJECT = TABLE_BINARY_FIELD;
        FIELD_NAME              = "LTST";
        FIELD_NUMBER            = 2;
        FIELD_DATA_TYPE         = MSB_REAL;
        FIELD_LOCATION          = 5;
        FIELD_LENGTH            = 5;
        FIELD_FORMAT            = "F5.3";
        FIELD_MIN_PHYSICAL      = 0.088078704;
        FIELD_MAX_PHYSICAL      = 0.230243056;
        FIELD_UNIT              = "N/A";
        FIELD_DESCRIPTION       = "Local True Solar Time";
      END_OBJECT = TABLE_BINARY_FIELD;
```

```
OBJECT = TABLE_BINARY_FIELD;
  FIELD_NAME              = "LMST";
  FIELD_NUMBER            = 3;
  FIELD_DATA_TYPE         = MSB_REAL;
  FIELD_LOCATION          = 11;
  FIELD_LENGTH            = 9;
  FIELD_FORMAT            = "F9.5";
  FIELD_MIN_PHYSICAL      = 91.0695122;
  FIELD_MAX_PHYSICAL      = 151.2052778;
  FIELD_UNIT              = "N/A";
  FIELD_DESCRIPTION       = "Local Mean Solar Time";
END_OBJECT = TABLE_BINARY_FIELD;

OBJECT = TABLE_BINARY_FIELD;
  FIELD_NAME              = "V";
  FIELD_NUMBER            = 4;
  FIELD_DATA_TYPE         = MSB_REAL;
  FIELD_LOCATION          = 21;
  FIELD_LENGTH            = 5;
  FIELD_FORMAT            = "F5.3";
  FIELD_MIN_PHYSICAL      = 3.072451472;
  FIELD_MAX_PHYSICAL      = 5.15605715;
  FIELD_UNIT              = "METERS/SECOND";
  FIELD_DESCRIPTION       = "Wind speed in meters per second";
END_OBJECT = TABLE_BINARY_FIELD;

OBJECT = TABLE_BINARY_FIELD;
  FIELD_NAME              = "DV+";
  FIELD_NUMBER            = 5;
  FIELD_DATA_TYPE         = MSB_REAL;
  FIELD_LOCATION          = 27;
  FIELD_LENGTH            = 4;
  FIELD_FORMAT            = "F4.2";
  FIELD_MIN_PHYSICAL      = 0.428682136;
  FIELD_MAX_PHYSICAL      = 0.46032408;
  FIELD_UNIT              = "METERS/SECOND";
  FIELD_DESCRIPTION       = "Error in wind speed (positive)";
END_OBJECT = TABLE_BINARY_FIELD;

OBJECT = TABLE_BINARY_FIELD;
  FIELD_NAME              = "DV-";
  FIELD_NUMBER            = 6;
  FIELD_DATA_TYPE         = MSB_REAL;
  FIELD_LOCATION          = 32;
  FIELD_LENGTH            = 7;
  FIELD_FORMAT            = "F7.5";
  FIELD_MIN_PHYSICAL      = 0.415653998;
  FIELD_MAX_PHYSICAL      = 0.42656498;
  FIELD_UNIT              = "METERS/SECOND";
  FIELD_DESCRIPTION       = "Error in wind speed (negative)";
END_OBJECT = TABLE_BINARY_FIELD;

OBJECT = TABLE_BINARY_FIELD;
  FIELD_NAME              = "DIR";
  FIELD_NUMBER            = 7;
  FIELD_DATA_TYPE         = MSB_REAL;
  FIELD_LOCATION          = 40;
  FIELD_LENGTH            = 10;
  FIELD_FORMAT            = "F10.6";
  FIELD_MIN_PHYSICAL      = 125.5471521;
  FIELD_MAX_PHYSICAL      = 268.8220941;
  FIELD_UNIT              = "DEGREES";
```

```
            FIELD_DESCRIPTION        = "Wind direction in degrees given in
                                        meteorological convention (0 = from
                                        N, 90 = from E, 180 = from S, 270 =
                                        from W)";
        END_OBJECT = TABLE_BINARY_FIELD;

        OBJECT = TABLE_BINARY_FIELD;
          FIELD_NAME               = "DDIR";
          FIELD_NUMBER             = 8;
          FIELD_DATA_TYPE          = MSB_REAL;
          FIELD_LOCATION           = 51;
          FIELD_LENGTH             = 8;
          FIELD_FORMAT             = "F8.4";
          FIELD_MIN_PHYSICAL       = 4.769160219;
          FIELD_MAX_PHYSICAL       = 8.616672754;
          FIELD_UNIT               = "DEGREES";
          FIELD_DESCRIPTION        = "Error in direction (given in
                                       degrees). If dv+ is larger than v,
                                       then this is set to 180";
        END_OBJECT = TABLE_BINARY_FIELD;

        OBJECT = TABLE_BINARY_FIELD;
          FIELD_NAME               = "EXPOSURE TIME";
          FIELD_NUMBER             = 9;
          FIELD_DATA_TYPE          = MSB_REAL;
          FIELD_LOCATION           = 60;
          FIELD_LENGTH             = 7;
          FIELD_FORMAT             = "F7.1";
          FIELD_MIN_PHYSICAL       = 7140;
          FIELD_MAX_PHYSICAL       = 15300;
          FIELD_UNIT               = "MILLISECONDS";
          FIELD_DESCRIPTION        = "Exposure time by SSI in
                                       milliseconds";
        END_OBJECT = TABLE_BINARY_FIELD;

       OBJECT = TABLE_BINARY_FIELD;
          FIELD_NAME               = "FILE NAME";
          FIELD_NUMBER             = 10;
          FIELD_DATA_TYPE          = CHARACTER;
          FIELD_LOCATION           = 69;
          FIELD_LENGTH             = 17;
          FIELD_FORMAT             = "A17";
          FIELD_UNIT               = "N/A";
          FIELD_DESCRIPTION        = "Image filename used for the
                                       analysis";
        END_OBJECT = TABLE_BINARY_FIELD;

    END_OBJECT = TABLE_BINARY;

  END_OBJECT = TAGGED_TABLE_BINARY_SET;


  OBJECT = PROPERTY_MAP;
    PROPERTY_MAP_ENTRY   = (
      ("PHX_M_TT_WIND_VEL", PRODUCT_ID,                "TELLTALE_91_151"),
      ("PHX_M_TT_WIND_VEL", PRODUCT_VERSION_ID,        "V1.0"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_HOST_NAME,      "PHOENIX"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_HOST_ID,        "PHX"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_NAME,           "TELLTALE"),
      ("PHX_M_TT_WIND_VEL", INSTRUMENT_ID,             "TELLTALE"),
      ("PHX_M_TT_WIND_VEL", MISSION_NAME,              "PHOENIX"),
      ("PHX_M_TT_WIND_VEL", PRODUCT_CREATION_TIME,     2009-04-15)
                         );
```

```
        END_OBJECT = PROPERTY_MAP;


    OBJECT = FILE_SECTION;

      OBJECT = FILE_BINARY_FIXED;
        LOCAL_IDENTIFIER     = "PHX_M_TT_TABLE_FILE";
        CHECKSUM             = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
        FILE_SIZE            = 111;
        FILE_NAME            = "PDS4_ATM_TABLE_BIN.TAB";
        FILE_TYPE            = BINARY;
        MAX_RECORD_BYTES     = 3727;
        RECORD_TYPE          = FIXED;
      END_OBJECT = FILE_BINARY_FIXED;

    END_OBJECT = FILE_SECTION;

  END_OBJECT = PRODUCT_TABLE_BINARY;
```

## 2.2.4      PDS4 TABLE_BINARY and PDS3 TABLE PARALLELISMS

TBD

## 2.3      **TABLE_CHARACTER_GROUPED**

This section describes the TABLE_CHARACTER_GROUPED extension of the
PDS4 Table_Base (i.e., Heterogeneous repeating record of Scalars) class where
a contiguous stream of ASCII characters, assembled as sets of repeating fixed-
width fields, maps the "items" contained in a TABLE_CHARACTER_GROUPED
file.

This section identifies a mapping of the PDS3 TABLE object to the PDS4
TABLE_CHARACTER_GROUPED file construct and demonstrates how the byte
stream (e.g., sequence of bits) can be described by both a PDS3 label and a
PDS4 label.

### 2.3.1      TABLE_BASE Class Description and Schema

Figure 2.3-1 depicts a representation of the PDS4 TABLE_BASE class and the
associated parent and child classes.  The figure additionally lists the required or
optional status, and the cardinality of repeating structures.

```
OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET
                                                    Req/Opt    Cardinality

    OBJECT = DESCRIPTION_SECTION                    Optional        1
      DESCRIPTION                                   Required        1
    END_OBJECT = DESCRIPTION_SECTION


    OBJECT = HEADER                                 Optional        1
        DATA_LOCATION                               Required        1

        LOCAL_IDENTIFIER                            Required        1
        COMMENT                                     Optional        1
        BYTES                                       Required        1
        DESCRIPTION                                 Optional        1
        EXTERNAL_STANDARD                           Required        1
        FILE_TYPE                                   Required        1
        NAME                                        Optional        1
    END_OBJECT = HEADER


    OBJECT = TABLE_CHARACTER_GROUPED                Required       1..*
      DATA_LOCATION                                 Required        1
      LOCAL_IDENTIFIER                              Required        1
      COMMENT                                       Optional        1
      FILE_TYPE                                     Required        1
      NUMBER_OF_FIELDS                              Required        1
      NUMBER_OF_ROWS                                Required        1
      ROW_BYTES                                     Required        1

        OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE   Required        1
          REPETITIONS                               Required        1

          OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE   Required       1..*


            OBJECT = TABLE_CHARACTER_GROUPED_FIELD  Required       1..*
                FIELD_NAME                          Required        1
                FIELD_DATA_TYPE                     Required        1
                FIELD_DESCRIPTION                   Optional        1
                FIELD_FORMAT                        Optional        1
                FIELD_LENGTH                        Required        1
                FIELD_LOCATION                      Required        1
                FIELD_MAX_LOGICAL                   Optional        1
                FIELD_MAX_PHYSICAL                  Optional        1
                FIELD_MIN_LOGICAL                   Optional        1
                FIELD_MIN_PHYSICAL                  Optional        1
                FIELD_NUMBER                        Optional        1
                FIELD_SCALING_FACTOR                Optional        1
                FIELD_UNIT                          Optional        1
                FIELD_VALUE_OFFSET                  Optional        1
```

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```
    OBJECT = OBJECT_STATISTICS              Optional   1
        LOCAL_IDENTIFIER                    Required   1
        AVERAGE                             Optional   1
        CHECKSUM                            Optional   1
        MAXIMUM                             Optional   1
        MINIMUM                             Optional   1
        STANDARD_DEVIATION                  Optional   1
    END_OBJECT = OBJECT_STATISTICS


    OBJECT = SPECIAL_CONSTANTS              Optional   1
       ERROR_CONSTANT                       Required   1
       INVALID_CONSTANT                     Required   1
       MISSING_CONSTANT                     Required   1
       NOT_APPLICABLE_CONSTANT              Required   1
       SATURATED_CONSTANT                   Required   1
       UNKNOWN_CONSTANT                     Required   1
    END_OBJECT = SPECIAL_CONSTANTS


   END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD


  END_OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE


 END_OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE


END_OBJECT = TABLE_CHARACTER_GROUPED


  OBJECT = PROPERTY_MAP                         Optional     1..*
     LOCAL_IDENTIFIER                           Required     1
     PROPERTY_MAP_ENTRY                         Required     1..*
  END_OBJECT = PROPERTY_MAP
END_OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET
```

Figure 2.3-1.   Diagram of the TABLE_CHARACTER_GROUPED Schema


From Figure 2.3-1, the overall structure of the TABLE_CHARACTER_GROUPED
data object description can be easily discerned and understood.

1. The parent class, the TAGGED_TABLE_CHARACTER_GROUPED_SET
   class, is comprised of four sub-classes:
   - DESCRIPTION_SECTION class
   - HEADER class
   - TABLE_CHARACTER_GROUPED class
   - PROPERTY_MAP class
2. The DESRIPTION_SECTION class may optionally exist once and only
   once within the context of the the TAGGED_TABLE_CHARACTER_SET
   class.

3.  The DESCRIPTION_SECTION class consists of a single required non-repeating data element.
4.  The HEADER class may optionally exist once and only once within the context of the the TAGGED_TABLE_CHARACTER_SET class.
5.  The HEADER class consists of five required non-repeating data elements, and three optional non-repeating data elements..
6.  The TABLE_CHARACTER class must exist once and only once within the context of the TAGGED_TABLE_CHARACTER_SET class.
7.  The TABLE_CHARACTER class is comprised of six required non-repeating data elements, a single optional non-repeating data element, and a single required repeating sub-class, the TABLE_CHARACTER_FIELD sub-class
8.  The TABLE_CHARACTER_FIELD class must exist once but may exist many times within the context of the TABLE_CHARACTER class.
9.  The TABLE_CHARACTER_FIELD class is comprised of five required non-repeating data elements, ten optional non-repeating data elements, and two  optional non-repeating sub-classes, the OBJECT_STATISTICS sub-class and the SPECIAL_CONSTANTS sub-class.
10. The OBJECT_STATISTICS class may optionally exist once and only once within the context of the the TABLE_CHARACTER_FIELD class.
11. The OBJECT_STATISTICS class is comprised of a single required non-repeating data element, and five optional non-repeating data elements.
12. The SPECIAL_CONSTANTS class may optionally exist once and only once within the context of the the TABLE_CHARACTER_FIELD class.
13. The SPECIAL_CONSTANTS class is comprised of six required non-repeating data elements.
14. The PROPERTY_MAP class may optionally exist once and only once within the context of the the TAGGED_TABLE_CHARACTER_SET class.
15. The PROPERTY_MAP class consists of two required non-repeating data elements and a single optional non-repeating data element.


**2.3.2**          TABLE_CHARACTER_GROUPED Data Product Byte Stream

Figure 2.3-2 depicts a representation a TABLE_CHARACTER_GROUPED byte-stream.  The data object consists of single file containing five character based tables.  Each table has a fixed-length structure where a row consists of 19969 bytes.  The combined number of rows across all five tables is 2052.

| Byte | \<19969 Bytes\> | | | Record |
|---|---|---|---|---|
| 1 | Row 1   AFM_D_HEADER_TABLE | \<CR\> | \<LF\> | 1 |
| 19970 | Row 2 | \<CR\> | \<LF\> | 2 |
| 39939 | Row 3 | \<CR\> | \<LF\> | 3 |
| 59908 | Row 4 | \<CR\> | \<LF\> | 4 |
| 79877 | Row 1   AFM_F_ERROR_TABLE | \<CR\> | \<LF\> | 5 |
| ... | Row 2 | \<CR\> | \<LF\> | 6 |
| ... | Row ... | \<CR\> | \<LF\> | ... |
| ... | Row 512 | \<CR\> | \<LF\> | 516 |
| 1030400 | Row 1   AFM_F_HEIGHT_TABLE | \<CR\> | \<LF\> | 517 |
| ... | Row 2 | \<CR\> | \<LF\> | 518 |
| ... | Row ... | \<CR\> | \<LF\> | ... |
| ... | Row 512 | \<CR\> | \<LF\> | 1028 |
| 20528133 | Row 1   AFM_B_ERROR_TABLE | \<CR\> | \<LF\> | 1029 |
| ... | Row 2 | \<CR\> | \<LF\> | 1030 |
| ... | Row ... | \<CR\> | \<LF\> | ... |
| ... | Row 512 | \<CR\> | \<LF\> | 1540 |
| 30752261 | Row 1   AFM_B_HEIGHT_TABLE | \<CR\> | \<LF\> | 1541 |
| ... | Row 2 | \<CR\> | \<LF\> | 1542 |
| ... | Row ... | \<CR\> | \<LF\> | ... |
| ... | Row 512 | \<CR\> | \<LF\> | 2052 |
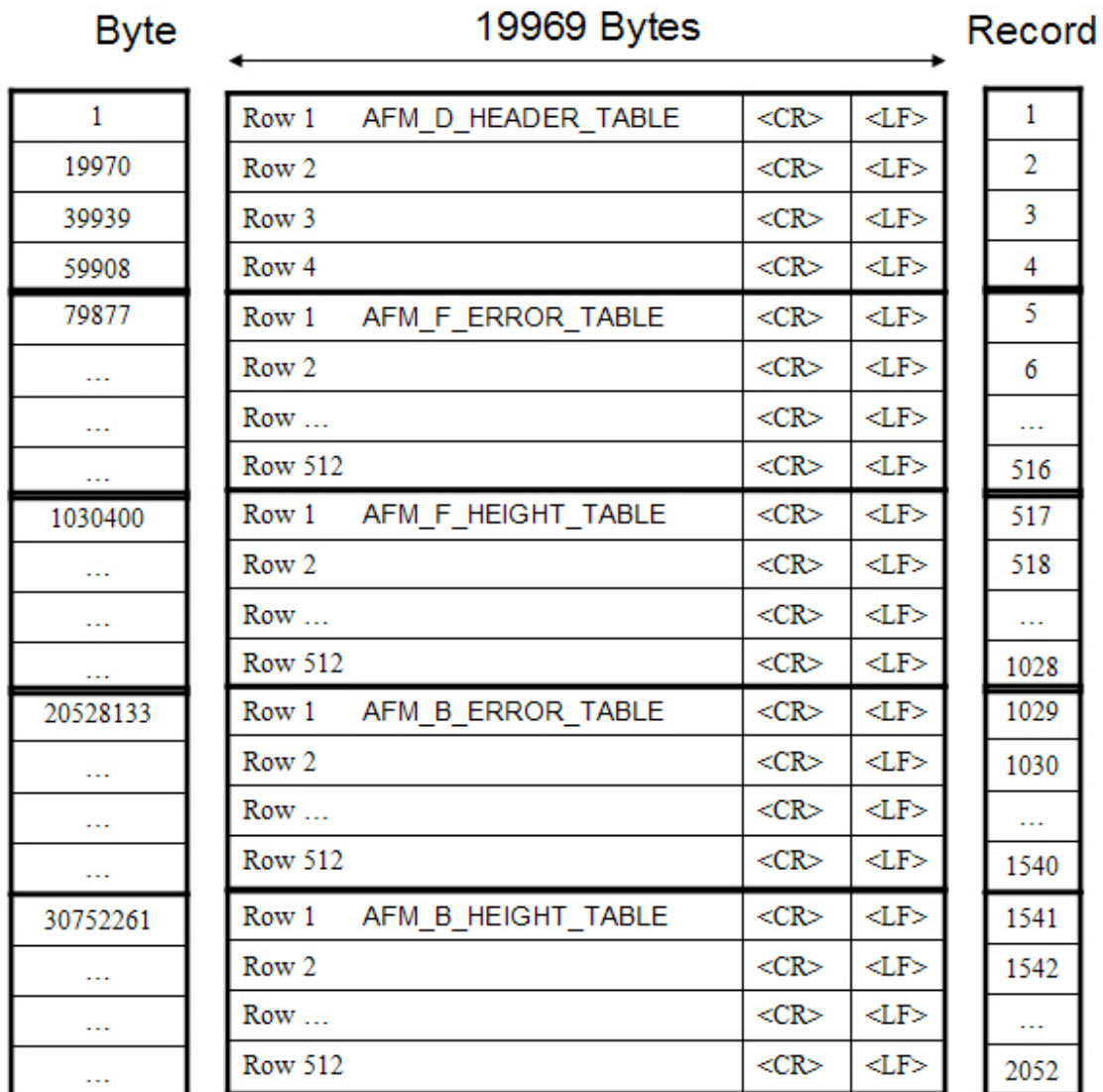
Figure 2.3-2.  Diagram of the TABLE_CHARACTER_GROUPED Byte Stream

With respect to the data product:
1. There are 2052 rows of data (of which 2000+ rows have been omitted from the diagram for ease of reading).
2. The first of five tables, the AFM_D_HEADER_TABLE, contains 4 rows and 22 columns / fields.  Note that under PDS4, the suffix_bytes have been incorporated into an additional column (that occupies 19870 bytes).
3. The second of five tables, the AFM_F_ERROR_TABLE, contains 512 rows and 1536 columns / fields that are a sequence of three columns that are repeated 512 times.
4. The third of five tables, the AFM_F_HEIGHT_TABLE, contains 512 rows and 1536 columns / fields that are a sequence of three columns that are repeated 512 times.

5. The fourth of five tables, the AFM_B_ERROR_TABLE, contains 512 rows and 1536 columns / fields that are a sequence of three columns that are repeated 512 times.
6. The fifth table, the AFM_B_HEIGHT_TABLE, contains 512 rows and 1536 columns / fields that are a sequence of three columns that are repeated 512 times.
7. Each field in each table is fixed-width across all rows in the table.
8. Each field is comprised of ASCII characters.
9. There are 19969 bytes in each row / record in this example file.

**2.3.3**         TABLE_CHARACTER_GROUPED Label Scheme

This section depicts how the TABLE_CHARACTER_GROUPED byte-scheme, as illustrated above, can be described by both a PDS3 label and a PDS4 label.

The PDS4 TABLE_CHARACTER_GROUPED class is the successor to the PDS3 TABLE object.

2.3.3.1   PDS3 TABLE_CHARACTER_GROUPED Label Scheme

The data product depicted in Figure 2.3-2 could be described in PDS3 by use of the TABLE and COLUMN objects.  Note that the PDS label references a label fragment.

```
PDS_VERSION_ID                       = "PDS3"
LABEL_REVISION_NOTE                  = "2008-11-14, Initial"

/* File characteristics */
RECORD_TYPE                          = FIXED_LENGTH
RECORD_BYTES                         = 19969
FILE_RECORDS                         = 2052

/* Pointers to object in file */
^AFM_D_HEADER_TABLE          = ("FS004SDD_001_4E0111040000A0.TAB",1)
^AFM_F_ERROR_TABLE           = ("FS004SDD_001_4E0111040000A0.TAB",5)
^AFM_F_HEIGHT_TABLE          = ("FS004SDD_001_4E0111040000A0.TAB",517)
^AFM_B_ERROR_TABLE           = ("FS004SDD_001_4E0111040000A0.TAB",1029)
^AFM_B_HEIGHT_TABLE          = ("FS004SDD_001_4E0111040000A0.TAB",1541)

/* Identification */
DATA_SET_ID                          = "PHX-M-MECA-4-NIRDR-V1.0"
DESCRIPTION                          = "UNK"
PRODUCT_ID                           = "FS004SDD_001_4E0111040000A0"
PRODUCT_VERSION_ID                   = "V1.0"
PRODUCT_TYPE                         = "MECA_AFM_SDD"
RELEASE_ID                           = "0001"
INSTRUMENT_HOST_NAME                 = "PHOENIX"
INSTRUMENT_HOST_ID                   = PHX
INSTRUMENT_NAME                      = "MECA ATOMIC FORCE MICROSCOPE"
```

```
INSTRUMENT_ID                          = "MECA_AFM"
INSTRUMENT_MODE_ID                     = "SCAN"
MISSION_NAME                           = "PHOENIX"

OPS_TOKEN                              = 16#11040000#
OPS_TOKEN_ACTIVITY                     = 16#00001104#
OPS_TOKEN_PAYLOAD                      = 16#00000000#
OPS_TOKEN_COMMAND                      = 16#00000000#
TARGET_NAME                            = MARS


/* Time information */
MISSION_PHASE_NAME                     = "PRIMARY MISSION"
SPACECRAFT_CLOCK_START_COUNT           = "896567771.215"
SPACECRAFT_CLOCK_STOP_COUNT            = "896567771.215"
START_TIME                             = 2008-05-29T22:35:04.536
STOP_TIME                              = 2008-05-29T22:35:04.536
PLANET_DAY_NUMBER                      = 4
EARTH_RECEIVED_START_TIME              = "UNK"
EARTH_RECEIVED_STOP_TIME               = "UNK"
LOCAL_TRUE_SOLAR_TIME                  = "12:58:36"
PRODUCT_CREATION_TIME                  = 2008-11-26T00:32:06.228




/* Data object definition */

OBJECT                                 = AFM_D_HEADER_TABLE
  INTERCHANGE_FORMAT                   = ASCII
  COLUMNS                              = 22
  ROWS                                 = 4
  ROW_BYTES                            = 189
  ROW_SUFFIX_BYTES                     = 19780
  ^STRUCTURE                           = "AFM_D_HEADER.FMT"
  DESCRIPTION                          = "This table contains the AFM scan
                                         parameter information. The table
                                         contains 189 bytes of table data
                                         followed by 19780 bytes of spare
                                         data, of which the last 2 bytes
                                         contain the <CR><LF> pair. "
END_OBJECT                             = AFM_D_HEADER_TABLE

OBJECT                                 = AFM_F_ERROR_TABLE
  INTERCHANGE_FORMAT                   = ASCII
  COLUMNS                              = 1536
  ROWS                                 = 512
  ROW_BYTES                            = 19969
  START_BYTE                           = 79877
  MISSING_CONSTANT                     = 0.00
  DESCRIPTION                          = "This table contains the AFM scan
                                         forward error derivative
                                         information. Each row represents a
                                         scan line along the fast scan
                                         axis"

  OBJECT                               = CONTAINER
    BYTES                              = 39
    DESCRIPTION                        = "The container holds the X-Y-Z
                                         information for each AFM scan
                                         error derivative data point. The
                                         table contains 19969 bytes of
                                         table data of which the last 2
```

```
                                          bytes contain the <CR><LF> pair."
       NAME                            = "FORWARD ERROR DERIVATIVE"
       REPETITIONS                     = 512
       START_BYTE                      = 1

       OBJECT                          = COLUMN
         COLUMN_NUMBER                 = 1
         BYTES                         = 12
         DATA_TYPE                     = ASCII_REAL
         NAME                          = "FORWARD ERROR DERIVATIVE X
                                          COORDINATE"
         START_BYTE                    = 1
       END_OBJECT                      = COLUMN

       OBJECT                          = COLUMN
         COLUMN_NUMBER                 = 2
         BYTES                         = 12
         DATA_TYPE                     = ASCII_REAL
         NAME                          = "FORWARD ERROR DERIVATIVE Y
                                          COORDINATE"
         START_BYTE                    = 14
       END_OBJECT                      = COLUMN

       OBJECT                          = COLUMN
         COLUMN_NUMBER                 = 3
         BYTES                         = 12
         DATA_TYPE                     = ASCII_REAL
         NAME                          = "FORWARD ERROR DERIVATIVE VALUE"
         START_BYTE                    = 27
       END_OBJECT                      = COLUMN
     END_OBJECT                        = CONTAINER
   END_OBJECT                          = AFM_F_ERROR_TABLE

   OBJECT                             = AFM_F_HEIGHT_TABLE
     INTERCHANGE_FORMAT               = ASCII
     COLUMNS                          = 1536
     ROWS                             = 512
     ROW_BYTES                        = 19969
     START_BYTE                       = 10304005
     MISSING_CONSTANT                 = 0.00
     DESCRIPTION                      = "This table contains the AFM scan
                                          forward Z-height derivative.
                                          Each row represents a scan line
                                          along the fast scan axis"

     OBJECT                           = CONTAINER
       BYTES                          = 39
       DESCRIPTION                    = "The container holds the X-Y-Z
                                          information for each AFM forward
                                          derivative scan data point."
       NAME                           = "FORWARD HEIGHT DERIVATIVE"
       REPETITIONS                    = 512
       START_BYTE                     = 1

       OBJECT                         = COLUMN
         COLUMN_NUMBER                = 1
         BYTES                        = 12
         DATA_TYPE                    = ASCII_REAL
         NAME                         = "FORWARD HEIGHT DERIVATIVE X
                                          COORDINATE"
         START_BYTE                   = 1
       END_OBJECT                     = COLUMN
```

```
      OBJECT                           = COLUMN
        COLUMN_NUMBER                  = 2
        BYTES                          = 12
        DATA_TYPE                      = ASCII_REAL
        NAME                           = "FORWARD HEIGHT DERIVATIVE Y
                                           COORDINATE"
        START_BYTE                     = 14
      END_OBJECT                       = COLUMN

      OBJECT                           = COLUMN
        COLUMN_NUMBER                  = 3
        BYTES                          = 12
        DATA_TYPE                      = ASCII_REAL
        NAME                           = "FORWARD HEIGHT DERIVATIVE VALUE"
        START_BYTE                     = 27
      END_OBJECT                       = COLUMN
    END_OBJECT                         = CONTAINER
END_OBJECT                             = AFM_F_HEIGHT_TABLE

OBJECT                                 = AFM_B_ERROR_TABLE
  INTERCHANGE_FORMAT                   = ASCII
  COLUMNS                              = 1536
  ROWS                                 = 512
  ROW_BYTES                            = 19969
  START_BYTE                           = 20528133
  MISSING_CONSTANT                     = 0.00
  DESCRIPTION                          = "This table contains the AFM scan
                                           backward error derivative
                                           information. Each row represents a
                                           scan line along the fast scan
                                           axis."

    OBJECT                             = CONTAINER
      BYTES                            = 39
      DESCRIPTION                      = "The container holds the X-Y-Z
                                           information for each AFM scan error
                                           derivative data point. The table
                                           contains 19969 bytes of table data
                                           of which the last 2 bytes contain
                                           the <CR><LF> pair."
      NAME                             = "BACKWARD ERROR DERIVATIVE"
      REPETITIONS                      = 512
      START_BYTE                       = 1

      OBJECT                           = COLUMN
        COLUMN_NUMBER                  = 1
        BYTES                          = 12
        DATA_TYPE                      = ASCII_REAL
        NAME                           = "BACKWARD ERROR DERIVATIVE X
                                           COORDINATE"
        START_BYTE                     = 1
      END_OBJECT                       = COLUMN

      OBJECT                           = COLUMN
        COLUMN_NUMBER                  = 2
        BYTES                          = 12
        DATA_TYPE                      = ASCII_REAL
        NAME                           = "BACKWARD ERROR DERIVATIVE Y
                                           COORDINATE"
        START_BYTE                     = 14
      END_OBJECT                       = COLUMN

      OBJECT                           = COLUMN
```

```
         COLUMN_NUMBER                = 3
         BYTES                        = 12
         DATA_TYPE                    = ASCII_REAL
         NAME                         = "BACKWARD ERROR DERIVATIVE VALUE"
         START_BYTE                   = 27
       END_OBJECT                     = COLUMN
     END_OBJECT                       = CONTAINER
 END_OBJECT                           = AFM_B_ERROR_TABLE

 OBJECT                               = AFM_B_HEIGHT_TABLE
   INTERCHANGE_FORMAT                 = ASCII
   COLUMNS                            = 1536
   ROWS                               = 512
   ROW_BYTES                          = 19969
   START_BYTE                         = 30752261
   MISSING_CONSTANT                   = 0.00
   DESCRIPTION                        = "This table contains the AFM scan
                                         backward Z-height derivative
                                         information. Each row represents a
                                         scan line along the fast scan axis"

     OBJECT                           = CONTAINER
       BYTES                          = 39
       DESCRIPTION                    = "The container holds the X-Y-Z
                                         information for each AFM backward
                                         scan Z-height derivative
                                         data point."
       NAME                           = "BACKWARD HEIGHT DERIVATIVE"
       REPETITIONS                    = 512
       START_BYTE                     = 1

       OBJECT                         = COLUMN
         COLUMN_NUMBER                = 1
         BYTES                        = 12
         DATA_TYPE                    = ASCII_REAL
         NAME                         = "BACKWARD HEIGHT DERIVATIVE X
                                          COORDINATE"
         START_BYTE                   = 1
       END_OBJECT                     = COLUMN

       OBJECT                         = COLUMN
         COLUMN_NUMBER                = 2
         BYTES                        = 12
         DATA_TYPE                    = ASCII_REAL
         NAME                         = "BACKWARD HEIGHT DERIVATIVE Y
                                          COORDINATE"
         START_BYTE                   = 14
       END_OBJECT                     = COLUMN

       OBJECT                         = COLUMN
         COLUMN_NUMBER                = 3
         BYTES                        = 12
         DATA_TYPE                    = ASCII_REAL
         NAME                         = "BACKWARD HEIGHT DERIVATIVE VALUE"
         START_BYTE                   = 27
       END_OBJECT                     = COLUMN
     END_OBJECT                       = CONTAINER
 END_OBJECT                           = AFM_B_HEIGHT_TABLE
 END
```

The above label references a PDS3 label fragment, AFM_D_HEADER.FMT:

```
OBJECT = COLUMN
   COLUMN_NUMBER = 1
   NAME = cmdTimewhole
   DATA_TYPE = ASCII_INTEGER
   BYTES = 9
   START_BYTE = 1
   UNIT = SECONDS
   DESCRIPTION = "This is the time that the command was issued from
   the spacecraft computer to the MECA subsystem across the serial
   interface. Units are seconds of Spacecraft Clock (SCLK)."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 2
   NAME = cmdTimeremainder
   DATA_TYPE = ASCII_INTEGER
   BYTES = 10
   START_BYTE = 11
   UNIT = "SECONDS/2**32"
   DESCRIPTION = "The remainder, where 2^32 is a full second."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 3
   NAME = readTimewhole
   DATA_TYPE = ASCII_INTEGER
   BYTES = 9
   START_BYTE = 22
   UNIT = SECONDS
   DESCRIPTION = "This is the time that the data was returned to the
   spacecraft computer across the serial interface from the MECA
   subsystem (not used for some telemetry types). Units are seconds
   of Spacecraft Clock (SCLK)."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 4
   NAME = readTimeremainder
   DATA_TYPE = ASCII_INTEGER
   BYTES = 10
   START_BYTE = 32
   UNIT = "SECONDS/2**32"
   DESCRIPTION = "The remainder, where 2^32 is a full second."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 5
   NAME = dataLength
   DATA_TYPE = ASCII_INTEGER
   BYTES = 6
   START_BYTE = 43
   UNIT = BYTES
   DESCRIPTION = "The length of the following record (and all records in
   this product), not including this header."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 6
   NAME = cols
   DATA_TYPE = ASCII_INTEGER
   BYTES = 3
   START_BYTE = 50
   UNIT = POINTS
   DESCRIPTION = "The width (number of points per line) of the AFM
   image."
END_OBJECT = COLUMN
OBJECT = COLUMN
```

```
      COLUMN_NUMBER = 7
      NAME = lines
      DATA_TYPE = ASCII_INTEGER
      BYTES = 3
      START_BYTE = 54
      UNIT = LINES
      DESCRIPTION = "The height (number of lines) of the AFM image."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 8
      NAME = direction
      DATA_TYPE = ASCII_INTEGER
      BYTES = 1
      START_BYTE = 58
      DESCRIPTION = "The scan direction, 1 = forward, 2 = backward."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 9
      NAME = channel
      DATA_TYPE = ASCII_INTEGER
      BYTES = 1
      START_BYTE = 60
      DESCRIPTION = "The RDR data channel, 1= error, 2= z-height."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 10
      NAME = channelGain
      DATA_TYPE = ASCII_INTEGER
      BYTES = 1
      START_BYTE = 62
      DESCRIPTION = "Ranges from 0 to 8, with 0=full (13.8 microns for
      height data and 20 Volts for error data), and reducing by factors
      of 2 each time, e.g. gain of 2 = 3.45 microns (height) or 5 Volts
      (error)."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 11
      NAME = refOMimage
      DATA_TYPE = CHARACTER
      BYTES = 33
      START_BYTE = 64
      DESCRIPTION = "File name of the Optical Microscope image taken
      before the scan for sample context."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 12
      NAME = refOMimage2
      DATA_TYPE = CHARACTER
      BYTES = 33
      START_BYTE = 98
      DESCRIPTION = "Filename of the OM image taken after the scan"
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 13
      NAME = opsToken
      DATA_TYPE = ASCII_INTEGER
      BYTES = 8
      START_BYTE = 132
      DESCRIPTION = "Ops Token for this scan."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 14
      NAME = SwtsTemperature
```

```
      DATA_TYPE = ASCII_INTEGER
      BYTES = 5
      START_BYTE = 141
      UNIT = KELVIN
      DESCRIPTION = "Temperature of the SWTS just prior to the scan."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 15
      NAME = x_scanrange
      DATA_TYPE = ASCII_REAL
      BYTES = 6
      START_BYTE = 147
      DESCRIPTION = "Scan range in the X-direction of the AFM scan plane."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 16
      NAME = y_scanrange
      DATA_TYPE = ASCII_REAL
      BYTES = 6
      START_BYTE = 154
      DESCRIPTION = "Scan range in the Y-direction of the AFM scan plane."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 17
      NAME = smoothing_factor
      DATA_TYPE = ASCII_INTEGER
      BYTES = 2
      START_BYTE = 161
      DESCRIPTION = "The scaling factor used to calibrate the data
      (converts DNs to micrometers for height data and volts for error
      data)"
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 18
      NAME = AFM_OM_ref_X
      DATA_TYPE = ASCII_INTEGER
      BYTES = 3
      START_BYTE = 164
      DESCRIPTION = "The approximate location of the center of the AFM
      scan field relative to the OM image. X-coordinate in pixels."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 19
      NAME = AFM_OM_ref_Y
      DATA_TYPE = ASCII_INTEGER
      BYTES = 3
      START_BYTE = 168
      DESCRIPTION = "The approximate location of the center of the AFM
      scan field relative to the OM image. Y-coordinate in pixels."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 20
      NAME = X_slope
      DATA_TYPE = ASCII_REAL
      BYTES = 6
      START_BYTE = 172
      DESCRIPTION = "Slope correction in the x-direction of the AFM
      scan plane."
   END_OBJECT = COLUMN
   OBJECT = COLUMN
      COLUMN_NUMBER = 21
      NAME = Y_slope
      DATA_TYPE = ASCII_REAL
```

```
   BYTES = 6
   START_BYTE = 179
   DESCRIPTION = "Slope correction in the y-direction of the AFM
   scan plane."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 22
   NAME = ScanSpeed
   DATA_TYPE = ASCII_REAL
   BYTES = 4
   START_BYTE = 186
   DESCRIPTION = "Scan speed of the AFM in micrometers/second"
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 1
   NAME = cmdTimewhole
   DATA_TYPE = ASCII_INTEGER
   BYTES = 9
   START_BYTE = 1
   UNIT = SECONDS
   DESCRIPTION = "This is the time that the command was issued from
   the spacecraft computer to the MECA subsystem across the serial
   interface. Units are seconds of Spacecraft Clock (SCLK)."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 2
   NAME = cmdTimeremainder
   DATA_TYPE = ASCII_INTEGER
   BYTES = 10
   START_BYTE = 11
   UNIT = "SECONDS/2**32"
   DESCRIPTION = "The remainder, where 2^32 is a full second."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 3
   NAME = readTimewhole
   DATA_TYPE = ASCII_INTEGER
   BYTES = 9
   START_BYTE = 22
   UNIT = SECONDS
   DESCRIPTION = "This is the time that the data was returned to the
   spacecraft computer across the serial interface from the MECA
   subsystem (not used for some telemetry types). Units are seconds
   of Spacecraft Clock (SCLK)."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 4
   NAME = readTimeremainder
   DATA_TYPE = ASCII_INTEGER
   BYTES = 10
   START_BYTE = 32
   UNIT = "SECONDS/2**32"
   DESCRIPTION = "The remainder, where 2^32 is a full second."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 5
   NAME = dataLength
   DATA_TYPE = ASCII_INTEGER
   BYTES = 6
   START_BYTE = 43
   UNIT = BYTES
   DESCRIPTION = "The length of the following record (and all records in
   this product), not including this header."
```

```
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 6
   NAME = cols
   DATA_TYPE = ASCII_INTEGER
   BYTES = 3
   START_BYTE = 50
   UNIT = POINTS
   DESCRIPTION = "The width (number of points per line) of the AFM
   image."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 7
   NAME = lines
   DATA_TYPE = ASCII_INTEGER
   BYTES = 3
   START_BYTE = 54
   UNIT = LINES
   DESCRIPTION = "The height (number of lines) of the AFM image."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 8
   NAME = direction
   DATA_TYPE = ASCII_INTEGER
   BYTES = 1
   START_BYTE = 58
   DESCRIPTION = "The scan direction, 1 = forward, 2 = backward."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 9
   NAME = channel
   DATA_TYPE = ASCII_INTEGER
   BYTES = 1
   START_BYTE = 60
   DESCRIPTION = "The RDR data channel, 1= error, 2= z-height."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 10
   NAME = channelGain
   DATA_TYPE = ASCII_INTEGER
   BYTES = 1
   START_BYTE = 62
   DESCRIPTION = "Ranges from 0 to 8, with 0=full (13.8 microns for
   height data and 20 Volts for error data), and reducing by factors
   of 2 each time, e.g. gain of 2 = 3.45 microns (height) or 5 Volts
   (error)."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 11
   NAME = refOMimage
   DATA_TYPE = CHARACTER
   BYTES = 33
   START_BYTE = 64
   DESCRIPTION = "File name of the Optical Microscope image taken
   before the scan for sample context."
END_OBJECT = COLUMN
OBJECT = COLUMN
   COLUMN_NUMBER = 12
   NAME = refOMimage2
   DATA_TYPE = CHARACTER
   BYTES = 33
   START_BYTE = 98
   DESCRIPTION = "Filename of the OM image taken after the scan"
```

```
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 13
               NAME = opsToken
               DATA_TYPE = ASCII_INTEGER
               BYTES = 8
               START_BYTE = 132
               DESCRIPTION = "Ops Token for this scan."
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 14
               NAME = SwtsTemperature
               DATA_TYPE = ASCII_INTEGER
               BYTES = 5
               START_BYTE = 141
               UNIT = KELVIN
               DESCRIPTION = "Temperature of the SWTS just prior to the scan."
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 15
               NAME = x_scanrange
               DATA_TYPE = ASCII_REAL
               BYTES = 6
               START_BYTE = 147
               DESCRIPTION = "Scan range in the X-direction of the AFM scan plane."
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 16
               NAME = y_scanrange
               DATA_TYPE = ASCII_REAL
               BYTES = 6
               START_BYTE = 154
               DESCRIPTION = "Scan range in the Y-direction of the AFM scan plane."
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 17
               NAME = smoothing_factor
               DATA_TYPE = ASCII_INTEGER
               BYTES = 2
               START_BYTE = 161
               DESCRIPTION = "The scaling factor used to calibrate the data
               (converts DNs to micrometers for height data and volts for error
               data)"
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 18
               NAME = AFM_OM_ref_X
               DATA_TYPE = ASCII_INTEGER
               BYTES = 3
               START_BYTE = 164
               DESCRIPTION = "The approximate location of the center of the AFM
               scan field relative to the OM image. X-coordinate in pixels."
            END_OBJECT = COLUMN
            OBJECT = COLUMN
               COLUMN_NUMBER = 19
               NAME = AFM_OM_ref_Y
               DATA_TYPE = ASCII_INTEGER
               BYTES = 3
               START_BYTE = 168
               DESCRIPTION = "The approximate location of the center of the AFM
               scan field relative to the OM image. Y-coordinate in pixels."
            END_OBJECT = COLUMN
            OBJECT = COLUMN
```

```
        COLUMN_NUMBER = 20
        NAME = X_slope
        DATA_TYPE = ASCII_REAL
        BYTES = 6
        START_BYTE = 172
        DESCRIPTION = "Slope correction in the x-direction of the AFM
        scan plane."
     END_OBJECT = COLUMN
     OBJECT = COLUMN
        COLUMN_NUMBER = 21
        NAME = Y_slope
        DATA_TYPE = ASCII_REAL
        BYTES = 6
        START_BYTE = 179
        DESCRIPTION = "Slope correction in the y-direction of the AFM
        scan plane."
     END_OBJECT = COLUMN
     OBJECT = COLUMN
        COLUMN_NUMBER = 22
        NAME = ScanSpeed
        DATA_TYPE = ASCII_REAL
        BYTES = 4
        START_BYTE = 186
        DESCRIPTION = "Scan speed of the AFM in micrometers/second"
     END_OBJECT = COLUMN
```

## 2.3.3.2   PDS4 TABLE_CHARACTER_GROUPED Label Scheme

The same data product can also be described in PDS4 by use of the
TABLE_CHARACTER_GROUPED class, the
TABLE_CHARACTER_GROUPED_SEQUENCE class,  and the
TABLE_CHARACTER_GROUPED_FIELD class:

```
    #PDS4#

    /* ******* LABEL TEMPLATE - PRODUCT_TABLE_CHARACTER_GROUPED ******* */

    OBJECT = PRODUCT_TABLE_CHARACTER_GROUPED;

      OBJECT = IDENTIFICATION_SECTION;
        DD_VERSION_ID        = "DD_VERSION_ID";
        IDENTIFIER           = "PDS4_MECA_PRODUCT_TABLE_CHARACTER_ID:V1.0";
        LABEL_REVISION_NOTE  = "20081223:1.0 - initial version";
        PDS_VERSION_ID       = "PDS4.0";
        PRODUCT_CREATION_TIME = 2008-12-23T00:36:08.000;
        TITLE                = "Phoenix Project MECA ATOMIC FORCE MICROSCOPE
                                Experiment";
        URN                  = "HTTP://PDS-GEOSCIENCES.WUSTL.EDU/GEO/PHX-M-
    MECA-4-NIRDR-V1.0:PHX-M-MECA-4-NIRDR-V1.0:1.0";
        VERSION              = "1.0";
      END_OBJECT = IDENTIFICATION_SECTION;

      OBJECT = DESCRIPTION_SECTION;
        DESCRIPTION          = "Phoenix Project Microscopy, Electrochemistry,
                                and Conductivity Analyzer (MECA) Non-Imaging
                                EDR and RDR (NASA Levels 0 and 1) Archives.";
      END_OBJECT = DESCRIPTION_SECTION;
```

```
OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;
  COMMENT                       = "Observation Intent";
  SPACECRAFT_CLOCK_START_COUNT = "896567771.215";
  SPACECRAFT_CLOCK_STOP_COUNT  = "896567771.215";
  START_TIME                    = 2008-05-29T22:35:04.536;
  STOP_TIME                     = 2008-05-29T22:35:04.536;
END_OBJECT = CIRCUMSTANCES_OF_OBSERVATION_SECTION;

OBJECT = DATASET_SECTION;
  DATA_SET_ID          = "PHX-M-MECA-4-NIRDR-V1.0";
END_OBJECT = DATASET_SECTION;

OBJECT = MISSION_SECTION;
  MISSION_NAME         = "PHOENIX";
END_OBJECT = MISSION_SECTION;

OBJECT = TARGET_SECTION;
  TARGET_NAME          = MARS;
END_OBJECT = TARGET_SECTION;

OBJECT = INSTRUMENT_SECTION;
  INSTRUMENT_ID_NEW    = "MECA_AFM";
END_OBJECT = INSTRUMENT_SECTION;

OBJECT = INSTRUMENT_HOST_SECTION;
  INSTRUMENT_HOST_ID   = PHX;
END_OBJECT = INSTRUMENT_HOST_SECTION;

OBJECT = NODE_SECTION;
  NODE_NAME            = GEOSCIENCES;
END_OBJECT = NODE_SECTION;

OBJECT = OTHER_OBJECTS_SECTION;
  DESCRIPTION          = "N/A";
END_OBJECT = OTHER_OBJECTS_SECTION;

/*** Data Objects in File ***/
/*** (1) AFM_D_HEADER_TABLE  = ("PDS4_MECA_TABLE_CHAR.TAB",1)        ***/
/*** (2) AFM_F_ERROR_TABLE    = ("PDS4_MECA_TABLE_CHAR.TAB",79877)    ***/
/*** (3) AFM_F_HEIGHT_TABLE   = ("PDS4_MECA_TABLE_CHAR.TAB",1030400)  ***/
/*** (4) AFM_B_ERROR_TABLE    = ("PDS4_MECA_TABLE_CHAR.TAB",20528133) ***/
/*** (5) AFM_B_HEIGHT_TABLE   = ("PDS4_MECA_TABLE_CHAR.TAB",30752261) ***/

  OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;

/*** (1) AFM_D_HEADER_TABLE  = ("PDS4_MECA_TABLE_CHAR.TAB",1)    ***/

    OBJECT = TABLE_CHARACTER_GROUPED;
      DATA_LOCATION          = ("PDS4_MECA_TABLE_CHAR_FILE_ID",1);

      COMMENT                = "This table contains the AFM scan
                               parameter information. The table contains
                               189 bytes of table data followed by 19780
                               bytes of spare data, of which the last 2
                               bytes contain the <CR><LF> pair. ";
      LOCAL_IDENTIFIER       = "PDS4_MECA_AFM_D_HEADER_TABLE_ID";
      NUMBER_OF_FIELDS       = 22;
      NUMBER_OF_ROWS         = 4;
      ROW_BYTES              = 19969;

      OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;
        REPETITIONS          = 1;
```

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```
##include "PDS4_AFM_D_HEADER_TABLE.FMT"

          END_OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;

       END_OBJECT = TABLE_CHARACTER_GROUPED;

    END_OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;


   OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;

/*** (2) AFM_F_ERROR_TABLE    = ("PDS4_MECA_TABLE_CHAR.TAB",79877)    ***/

      OBJECT = TABLE_CHARACTER_GROUPED;
         DATA_LOCATION          = ("PDS4_MECA_TABLE_CHAR_FILE_ID",79877);

         COMMENT                = "This table contains the AFM scan forward
                                    Error derivative information. Each row
                                    represents a scan line along the fast scan
                                    axis";
         LOCAL_IDENTIFIER       = "PDS4_MECA_AFM_F_ERROR_TABLE_TABLE_ID";
         NUMBER_OF_FIELDS       = 1536;
         NUMBER_OF_ROWS         = 512;
         ROW_BYTES              = 19969;

         OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;
           REPETITIONS          = 512;
           DESCRIPTION          = "The container holds the X-Y-Z
                                    information for each AFM scan error
                                    derivative data point. The table
                                    contains 19969 bytes of table data of
                                    which the last 2 bytes contain the
                                    <CR><LF> pair. ";

            OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

              OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
                FIELD_NUMBER       = 1;
                FIELD_NAME         = "FORWARD ERROR DERIVATIVE X
                                       COORDINATE";
                FIELD_DATA_TYPE    = ASCII_REAL;
                FIELD_DESCRIPTION  = "N/A";
                FIELD_FORMAT       = "N/A";
                FIELD_LENGTH       = 12;
                FIELD_LOCATION     = 1;

                OBJECT = SPECIAL_CONSTANTS;
                  MISSING_CONSTANT     = 0.00;
                END_OBJECT = SPECIAL_CONSTANTS;

              END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

              OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
                FIELD_NUMBER       = 2;
                FIELD_NAME         = "FORWARD ERROR DERIVATIVE Y
                                       COORDINATE";
                FIELD_DATA_TYPE    = ASCII_REAL;
                FIELD_DESCRIPTION  = "N/A";
                FIELD_FORMAT       = "N/A";
                FIELD_LENGTH       = 12;
                FIELD_LOCATION     = 14;

                OBJECT = SPECIAL_CONSTANTS;
```

```
             MISSING_CONSTANT       = 0.00;
          END_OBJECT = SPECIAL_CONSTANTS;

        END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

        OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
          FIELD_NUMBER          = 3;
          FIELD_NAME            = "FORWARD ERROR DERIVATIVE VALUE";
          FIELD_DATA_TYPE       = ASCII_REAL;
          FIELD_DESCRIPTION     = "N/A";
          FIELD_FORMAT          = "N/A";
          FIELD_LENGTH          = 12;
          FIELD_LOCATION        = 27;

          OBJECT = SPECIAL_CONSTANTS;
            MISSING_CONSTANT     = 0.00;
          END_OBJECT = SPECIAL_CONSTANTS;

        END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

      END_OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

    END_OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;

  END_OBJECT = TABLE_CHARACTER_GROUPED;

 END_OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;


 OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;

/*** (3) AFM_F_HEIGHT_TABLE  = ("PDS4_MECA_TABLE_CHAR.TAB",1030400)  ***/

    OBJECT = TABLE_CHARACTER_GROUPED;
      DATA_LOCATION         = ("PDS4_MECA_TABLE_CHAR_FILE_ID",1030400);

      COMMENT               = "This table contains the AFM scan forward
                               Z-height derivative. Each row represents
                               a scan line along the fast scan axis";
      LOCAL_IDENTIFIER      = "PDS4_MECA_AFM_F_ERROR_TABLE_TABLE_ID";
      NUMBER_OF_FIELDS      = 1536;
      NUMBER_OF_ROWS        = 512;
      ROW_BYTES             = 19969;

      OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;
        REPETITIONS         = 512;
        DESCRIPTION         = "The container holds the X-Y-Z
                               information for each AFM forward
                               derivative scan data point."

        OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

          OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
            FIELD_NUMBER          = 1;
            FIELD_NAME            = "FORWARD HEIGHT DERIVATIVE X
                                      COORDINATE";
            FIELD_DATA_TYPE       = ASCII_REAL;
            FIELD_DESCRIPTION     = "N/A";
            FIELD_FORMAT          = "N/A";
            FIELD_LENGTH          = 12;
            FIELD_LOCATION        = 1;

            OBJECT = SPECIAL_CONSTANTS;
```

```
            MISSING_CONSTANT      = 0.00;
          END_OBJECT = SPECIAL_CONSTANTS;

        END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

        OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
          FIELD_NUMBER          = 2;
          FIELD_NAME            = "FORWARD HEIGHT DERIVATIVE Y
                                    COORDINATE";
          FIELD_DATA_TYPE       = ASCII_REAL;
          FIELD_DESCRIPTION     = "N/A";
          FIELD_FORMAT          = "N/A";
          FIELD_LENGTH          = 12;
          FIELD_LOCATION        = 14;

          OBJECT = SPECIAL_CONSTANTS;
            MISSING_CONSTANT      = 0.00;
          END_OBJECT = SPECIAL_CONSTANTS;

        END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

        OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
          FIELD_NUMBER          = 3;
          FIELD_NAME            = "FORWARD HEIGHT DERIVATIVE VALUE";
          FIELD_DATA_TYPE       = ASCII_REAL;
          FIELD_DESCRIPTION     = "N/A";
          FIELD_FORMAT          = "N/A";
          FIELD_LENGTH          = 12;
          FIELD_LOCATION        = 27;

          OBJECT = SPECIAL_CONSTANTS;
            MISSING_CONSTANT      = 0.00;
          END_OBJECT = SPECIAL_CONSTANTS;

        END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

      END_OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

    END_OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;

  END_OBJECT = TABLE_CHARACTER_GROUPED;

END_OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;


OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;

/*** (4) AFM_B_ERROR_TABLE    = ("PDS4_MECA_TABLE_CHAR.TAB",20528133) ***/

    OBJECT = TABLE_CHARACTER_GROUPED;
      DATA_LOCATION          = ("PDS4_MECA_TABLE_CHAR_FILE_ID",20528133);

      COMMENT                = "This table contains the AFM scan backward
                                error derivative information. Each row
                                represents a scan line along the fast scan
                                axis.";
      LOCAL_IDENTIFIER       = "PDS4_MECA_AFM_F_ERROR_TABLE_TABLE_ID";
      NUMBER_OF_FIELDS       = 1536;
      NUMBER_OF_ROWS         = 512;
      ROW_BYTES              = 19969;

      OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;
        REPETITIONS            = 512;
```

```
            DESCRIPTION             = "The container holds the X-Y-Z information
                                       for each AFM scan error derivative data
                                       point. The table contains 19969 bytes of
                                       table data of which the last 2 bytes
                                       contain the <CR><LF> pair.";

         OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

           OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
             FIELD_NUMBER          = 1;
             FIELD_NAME            = "FORWARD ERROR DERIVATIVE X
                                        COORDINATE";
             FIELD_DATA_TYPE       = ASCII_REAL;
             FIELD_DESCRIPTION     = "N/A";
             FIELD_FORMAT          = "N/A";
             FIELD_LENGTH          = 12;
             FIELD_LOCATION        = 1;

             OBJECT = SPECIAL_CONSTANTS;
               MISSING_CONSTANT      = 0.00;
             END_OBJECT = SPECIAL_CONSTANTS;

           END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

           OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
             FIELD_NUMBER          = 2;
             FIELD_NAME            = "FORWARD ERROR DERIVATIVE Y
                                        COORDINATE";
             FIELD_DATA_TYPE       = ASCII_REAL;
             FIELD_DESCRIPTION     = "N/A";
             FIELD_FORMAT          = "N/A";
             FIELD_LENGTH          = 12;
             FIELD_LOCATION        = 14;

             OBJECT = SPECIAL_CONSTANTS;
               MISSING_CONSTANT      = 0.00;
             END_OBJECT = SPECIAL_CONSTANTS;

           END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

           OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
             FIELD_NUMBER          = 3;
             FIELD_NAME            = "BACKWARD ERROR DERIVATIVE VALUE";
             FIELD_DATA_TYPE       = ASCII_REAL;
             FIELD_DESCRIPTION     = "N/A";
             FIELD_FORMAT          = "N/A";
             FIELD_LENGTH          = 12;
             FIELD_LOCATION        = 27;

             OBJECT = SPECIAL_CONSTANTS;
               MISSING_CONSTANT      = 0.00;
             END_OBJECT = SPECIAL_CONSTANTS;

           END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

         END_OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

       END_OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;

    END_OBJECT = TABLE_CHARACTER_GROUPED;

 END_OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;
```

```
      OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;

/*** (5) AFM_B_HEIGHT_TABLE   = ("PDS4_MECA_TABLE_CHAR.TAB",30752261) ***/

    OBJECT = TABLE_CHARACTER_GROUPED;
      DATA_LOCATION          = ("PDS4_MECA_TABLE_CHAR_FILE_ID",30752261);

      COMMENT                = "This table contains the AFM scan backward
                                Z-height derivative information. Each row
                                represents a scan line along the fast scan
                                axis";
      LOCAL_IDENTIFIER       = "PDS4_MECA_AFM_F_ERROR_TABLE_TABLE_ID";
      NUMBER_OF_FIELDS       = 1536;
      NUMBER_OF_ROWS         = 512;
      ROW_BYTES              = 19969;

      OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;
        REPETITIONS          = 512;
        DESCRIPTION          = "The container holds the X-Y-Z
                                information for each AFM backward
                                scan Z-height derivative data point.";

          OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

            OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
              FIELD_NUMBER       = 1;
              FIELD_NAME         = "BACKWARD HEIGHT DERIVATIVE X
                                    COORDINATE";
              FIELD_DATA_TYPE    = ASCII_REAL;
              FIELD_DESCRIPTION  = "N/A";
              FIELD_FORMAT       = "N/A";
              FIELD_LENGTH       = 12;
              FIELD_LOCATION     = 1;

              OBJECT = SPECIAL_CONSTANTS;
                MISSING_CONSTANT   = 0.00;
              END_OBJECT = SPECIAL_CONSTANTS;

            END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

            OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
              FIELD_NUMBER       = 2;
              FIELD_NAME         = "BACKWARD HEIGHT DERIVATIVE Y
                                    COORDINATE";
              FIELD_DATA_TYPE    = ASCII_REAL;
              FIELD_DESCRIPTION  = "N/A";
              FIELD_FORMAT       = "N/A";
              FIELD_LENGTH       = 12;
              FIELD_LOCATION     = 14;

              OBJECT = SPECIAL_CONSTANTS;
                MISSING_CONSTANT   = 0.00;
              END_OBJECT = SPECIAL_CONSTANTS;

            END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

            OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
              FIELD_NUMBER       = 3;
              FIELD_NAME         = "BACKWARD HEIGHT DERIVATIVE VALUE";
              FIELD_DATA_TYPE    = ASCII_REAL;
              FIELD_DESCRIPTION  = "N/A";
              FIELD_FORMAT       = "N/A";
```

```
                FIELD_LENGTH           = 12;
                FIELD_LOCATION         = 27;

                OBJECT = SPECIAL_CONSTANTS;
                  MISSING_CONSTANT      = 0.00;
                END_OBJECT = SPECIAL_CONSTANTS;

              END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

            END_OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

          END_OBJECT = TABLE_CHARACTER_GROUPED_SEQUENCE;

        END_OBJECT = TABLE_CHARACTER_GROUPED;

      END_OBJECT = TAGGED_TABLE_CHARACTER_GROUPED_SET;


      OBJECT = PROPERTY_MAP;                              /* OPTIONAL */
        LOCAL_IDENTIFIER    = "N/A";                      /* OPTIONAL */
        PROPERTY_MAP_ENTRY  = (
          ("MECA_AFM_SDD", PRODUCT_ID,
"FS004SDD_001_4E0111040000A0"),
          ("MECA_AFM_SDD", PRODUCT_VERSION_ID,        "V1.0"),
          ("MECA_AFM_SDD", PRODUCT_TYPE,              "MECA_AFM_SDD"),
          ("MECA_AFM_SDD", RELEASE_ID,                "0001"),
          ("MECA_AFM_SDD", INSTRUMENT_HOST_NAME,      "PHOENIX"),
          ("MECA_AFM_SDD", INSTRUMENT_HOST_ID,        "PHX"),
          ("MECA_AFM_SDD", INSTRUMENT_NAME,           "MECA ATOMIC FORCE
MICROSCOPE"),
          ("MECA_AFM_SDD", INSTRUMENT_ID,             "MECA_AFM"),
          ("MECA_AFM_SDD", INSTRUMENT_MODE_ID,        "SCAN"),
          ("MECA_AFM_SDD", MISSION_NAME,              "PHOENIX"),
          ("MECA_AFM_SDD", OPS_TOKEN,                 16#11040000#),
          ("MECA_AFM_SDD", OPS_TOKEN_ACTIVITY,        16#00001104#),
          ("MECA_AFM_SDD", OPS_TOKEN_PAYLOAD,         16#00000000#),
          ("MECA_AFM_SDD", OPS_TOKEN_COMMAND,         16#00000000#),
          ("MECA_AFM_SDD", MISSION_PHASE_NAME,        "PRIMARY MISSION"),
          ("MECA_AFM_SDD", PLANET_DAY_NUMBER,         4),
          ("MECA_AFM_SDD", EARTH_RECEIVED_START_TIME, "UNK"),
          ("MECA_AFM_SDD", EARTH_RECEIVED_STOP_TIME,  "UNK"),
          ("MECA_AFM_SDD", LOCAL_TRUE_SOLAR_TIME,     "12:58:36"),
          ("MECA_AFM_SDD", PRODUCT_CREATION_TIME,     2008-11-26T00:32:06.228)
                        );
      END_OBJECT = PROPERTY_MAP;


      OBJECT = FILE_SECTION;

        OBJECT = FILE_CHARACTER_FIXED;
          LOCAL_IDENTIFIER     = "PDS4_MECA_TABLE_CHAR_FILE_ID";
          CHECKSUM             = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
          FILE_SIZE            = 111;
          FILE_NAME            = "PDS4_MECA_TABLE_CHAR.TAB";
          FILE_TYPE            = CHARACTER;
          MAX_RECORD_BYTES     = 19969;
          RECORD_TYPE          = FIXED;
        END_OBJECT = FILE_CHARACTER_FIXED;

      END_OBJECT = FILE_SECTION;

    END_OBJECT = PRODUCT_TABLE_CHARACTER_GROUPED;
```

The above label references a PDS4 label fragment,
PDS4_AFM_D_HEADER.FMT:

```
    OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;

      OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER        = 1;
        FIELD_NAME          = cmdTimewhole;
        FIELD_DATA_TYPE     = ASCII_INTEGER;
        FIELD_DESCRIPTION   = "This is the time that the command was issued
                                   from the spacecraft computer to the MECA
                                   subsystem across the serial interface.
                                   Units are seconds of Spacecraft Clock
                                   (SCLK).";
        FIELD_FORMAT        = "N/A";
        FIELD_LENGTH        = 9;
        FIELD_LOCATION      = 1;
        FIELD_UNIT          = SECONDS;
      END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

      OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER        = 2;
        FIELD_NAME          = cmdTimeremainder;
        FIELD_DATA_TYPE     = ASCII_INTEGER;
        FIELD_DESCRIPTION   = "The remainder, where 2^32 is a full
                                   second.";
        FIELD_FORMAT        = "N/A";
        FIELD_LENGTH        = 10;
        FIELD_LOCATION      = 11;
        FIELD_UNIT          = "SECONDS/2**32";
      END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

      OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER        = 3;
        FIELD_NAME          = readTimewhole;
        FIELD_DATA_TYPE     = ASCII_INTEGER;
        FIELD_DESCRIPTION   = "This is the time that the data was returned
                                   to the spacecraft computer across the
                                   serial interface from the MECA subsystem
                                   (not used for some telemetry types). Units
                                   are seconds of Spacecraft Clock (SCLK).";
        FIELD_FORMAT        = "N/A";
        FIELD_LENGTH        = 9;
        FIELD_LOCATION      = 22;
        FIELD_UNIT          = SECONDS;
      END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

      OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER        = 4;
        FIELD_NAME          = readTimeremainder;
        FIELD_DATA_TYPE     = ASCII_INTEGER;
        FIELD_DESCRIPTION   = "The remainder, where 2^32 is a full second.";
        FIELD_FORMAT        = "N/A";
        FIELD_LENGTH        = 10;
        FIELD_LOCATION      = 32;
        FIELD_UNIT          = "SECONDS/2**32";
      END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

      OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER        = 5;
```

```
  FIELD_NAME          = dataLength;
  FIELD_DATA_TYPE     = ASCII_INTEGER;
  FIELD_DESCRIPTION   = "The length of the following record
                         (and all records in this product),
                         not including this header.";
  FIELD_FORMAT        = "N/A";
  FIELD_LENGTH        = 6;
  FIELD_LOCATION      = 43;
  FIELD_UNIT          = BYTES;
END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
  FIELD_NUMBER        = 6;
  FIELD_NAME          = cols;
  FIELD_DATA_TYPE     = ASCII_INTEGER;
  FIELD_DESCRIPTION   = "The width (number of points per line)
                         of the AFM image.";
  FIELD_FORMAT        = "N/A";
  FIELD_LENGTH        = 3;
  FIELD_LOCATION      = 50;
  FIELD_UNIT          = POINTS;
END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
  FIELD_NUMBER        = 7;
  FIELD_NAME          = lines;
  FIELD_DATA_TYPE     = ASCII_INTEGER;
  FIELD_DESCRIPTION   = "The height (number of lines) of the
                         AFM image.";
  FIELD_FORMAT        = "N/A";
  FIELD_LENGTH        = 3;
  FIELD_LOCATION      = 54;
  FIELD_UNIT          = LINES;
END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
  FIELD_NUMBER        = 8;
  FIELD_NAME          = direction;
  FIELD_DATA_TYPE     = ASCII_INTEGER;
  FIELD_DESCRIPTION   = "The scan direction, 1 = forward,
                         2 = backward.";
  FIELD_FORMAT        = "N/A";
  FIELD_LENGTH        = 1;
  FIELD_LOCATION      = 58;
  FIELD_UNIT          = "N/A";
END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
  FIELD_NUMBER        = 9;
  FIELD_NAME          = channel;
  FIELD_DATA_TYPE     = ASCII_INTEGER;
  FIELD_DESCRIPTION   = "The RDR data channel, 1= error,
                         2= z-height.";
  FIELD_FORMAT        = "N/A";
  FIELD_LENGTH        = 1;
  FIELD_LOCATION      = 60;
  FIELD_UNIT          = "N/A";
END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
  FIELD_NUMBER        = 10;
  FIELD_NAME          = channelGain;
  FIELD_DATA_TYPE     = ASCII_INTEGER;
```

```
      FIELD_DESCRIPTION      = "Ranges from 0 to 8, with 0=full
                                (13.8 microns for height data and
                                20 Volts for error data), and reducing
                                by factors of 2 each time, e.g. gain
                                of 2 = 3.45 microns (height) or 5 Volts
                                (error).";
      FIELD_FORMAT           = "N/A";
      FIELD_LENGTH           = 1;
      FIELD_LOCATION         = 62;
      FIELD_UNIT             = "N/A";
   END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

   OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
      FIELD_NUMBER           = 11;
      FIELD_NAME             = refOMimage;
      FIELD_DATA_TYPE        = CHARACTER;
      FIELD_DESCRIPTION      = "File name of the Optical Microscope image
                                taken before the scan for sample context.";
      FIELD_FORMAT           = "N/A";
      FIELD_LENGTH           = 33;
      FIELD_LOCATION         = 64;
      FIELD_UNIT             = "N/A";
   END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

   OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
      FIELD_NUMBER           = 12;
      FIELD_NAME             = refOMimage2;
      FIELD_DATA_TYPE        = CHARACTER;
      FIELD_DESCRIPTION      = "Filename of the OM image taken after the
                                scan";
      FIELD_FORMAT           = "N/A";
      FIELD_LENGTH           = 33;
      FIELD_LOCATION         = 98;
      FIELD_UNIT             = "N/A";
   END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

   OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
      FIELD_NUMBER           = 13;
      FIELD_NAME             = opsToken;
      FIELD_DATA_TYPE        = ASCII_INTEGER;
      FIELD_DESCRIPTION      = "Ops Token for this scan.";
      FIELD_FORMAT           = "N/A";
      FIELD_LENGTH           = 8;
      FIELD_LOCATION         = 132;
      FIELD_UNIT             = "N/A";
   END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

   OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
      FIELD_NUMBER           = 14;
      FIELD_NAME             = SwtsTemperature;
      FIELD_DATA_TYPE        = ASCII_INTEGER;
      FIELD_DESCRIPTION      = "Temperature of the SWTS just prior to
                                the scan.";
      FIELD_FORMAT           = "N/A";
      FIELD_LENGTH           = 5;
      FIELD_LOCATION         = 141;
      FIELD_UNIT             = KELVIN;
   END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

   OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
      FIELD_NUMBER           = 15;
      FIELD_NAME             = x_scanrange;
      FIELD_DATA_TYPE        = ASCII_REAL;
```

```
     FIELD_DESCRIPTION     = "Scan range in the X-direction of the AFM
                               scan plane.";
   FIELD_FORMAT          = "N/A";
   FIELD_LENGTH          = 6;
   FIELD_LOCATION        = 147;
   FIELD_UNIT            = "N/A";
 END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

 OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
   FIELD_NUMBER          = 16;
   FIELD_NAME            = y_scanrange;
   FIELD_DATA_TYPE       = ASCII_REAL;
   FIELD_DESCRIPTION     = "Scan range in the Y-direction of the AFM
                               scan plane.";
   FIELD_FORMAT          = "N/A";
   FIELD_LENGTH          = 6;
   FIELD_LOCATION        = 154;
   FIELD_UNIT            = "N/A";
 END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

 OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
   FIELD_NUMBER          = 17;
   FIELD_NAME            = smoothing_factor;
   FIELD_DATA_TYPE       = ASCII_INTEGER;
   FIELD_DESCRIPTION     = "The scaling factor used to calibrate the
                               data (converts DNs to micrometers for height
                               data and volts for error data)";
   FIELD_FORMAT          = "N/A";
   FIELD_LENGTH          = 2;
   FIELD_LOCATION        = 161;
   FIELD_UNIT            = "N/A";
 END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

 OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
   FIELD_NUMBER          = 18;
   FIELD_NAME            = AFM_OM_ref_X;
   FIELD_DATA_TYPE       = ASCII_INTEGER;
   FIELD_DESCRIPTION     = "The approximate location of the center of
                               the AFM scan field relative to the OM image.
                               X-coordinate in pixels.";
   FIELD_FORMAT          = "N/A";
   FIELD_LENGTH          = 3;
   FIELD_LOCATION        = 164;
   FIELD_UNIT            = "N/A";
 END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

 OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
   FIELD_NUMBER          = 19;
   FIELD_NAME            = AFM_OM_ref_Y;
   FIELD_DATA_TYPE       = ASCII_INTEGER;
   FIELD_DESCRIPTION     = "The approximate location of the center of
                               the AFM scan field relative to the OM image.
                               Y-coordinate in pixels.";
   FIELD_FORMAT          = "N/A";
   FIELD_LENGTH          = 3;
   FIELD_LOCATION        = 168;
   FIELD_UNIT            = "N/A";
 END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

 OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
   FIELD_NUMBER          = 20;
   FIELD_NAME            = X_slope;
   FIELD_DATA_TYPE       = ASCII_REAL;
```

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```
        FIELD_DESCRIPTION      = "Slope correction in the x-direction of the
                                  AFM scan plane.";
        FIELD_FORMAT           = "N/A";
        FIELD_LENGTH           = 6;
        FIELD_LOCATION         = 172;
        FIELD_UNIT             = "N/A";
     END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

     OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER           = 21;
        FIELD_NAME             = Y_slope;
        FIELD_DATA_TYPE        = ASCII_REAL;
        FIELD_DESCRIPTION      = "Slope correction in the y-direction of the
                                  AFM scan plane.";
        FIELD_FORMAT           = "N/A";
        FIELD_LENGTH           = 6;
        FIELD_LOCATION         = 179;
        FIELD_UNIT             = "N/A";
     END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

     OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER           = 22;
        FIELD_NAME             = ScanSpeed;
        FIELD_DATA_TYPE        = ASCII_REAL;
        FIELD_DESCRIPTION      = "Scan speed of the AFM in micrometers/second";
        FIELD_FORMAT           = "N/A";
        FIELD_LENGTH           = 4;
        FIELD_LOCATION         = 186;
        FIELD_UNIT             = "N/A";
     END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

/** Add Field to equivalence ROW_SUFFIX_BYTES    = 19780 */

     OBJECT = TABLE_CHARACTER_GROUPED_FIELD;
        FIELD_NUMBER           = 23;
        FIELD_NAME             = RowSuffixBytes;
        FIELD_DATA_TYPE        = CHARACTER;
        FIELD_DESCRIPTION      = "Padding out to row_bytes -
                                  no data can be found here";
        FIELD_FORMAT           = "N/A";
        FIELD_LENGTH           = 19780;
        FIELD_LOCATION         = 191;
        FIELD_UNIT             = "N/A";
     END_OBJECT = TABLE_CHARACTER_GROUPED_FIELD;

   END_OBJECT = TABLE_CHARACTER_FIELD_SEQUENCE;
```

### 2.3.4 PDS4 TABLE_CHARACTER_GROUPED and PDS3 TABLE PARALLELISMS

TBD

# 3.0      UNENCODED STREAM BASE

## 3.1      SOFTWARE_SET

This section describes the SOFTWARE_SET class where one or more files, as identified as a set, comprise a logically complete "copy" of the referenced Software.

This section identifies a mapping of the PDS3 SOFTWARE object to the PDS4 SOFTWARE_SET class and demonstrates how the software "pieces / fragments" can be described by both a PDS3 label and a PDS4 label.

### 3.1.1      SOFTWARE_SET Class Description and Schema

Figure 3.1-1 depicts a representation of the PDS4 SOFTWARE_SET class and the associated parent and child classes.  The figure additionally lists the required or optional status, and the cardinality of repeating structures.

```
OBJECT = SOFTWARE_SET
                                              Req/Opt    Cardinality

   OBJECT = TAGGED_SOFTWARE_FORMAT            Required      1..*
      DESCRIPTION                             Optional      1

      OBJECT = TAGGED_FILE                    Required      1..*
        LOCAL_IDENTIFIER                      Required      1
        CHECKSUM                              Required      1
        FILE_SIZE                             Required      1
        FILE_SPECIFICATION_NAME               Required      1
        FILE_TYPE                             Required      1
      END_OBJECT = TAGGED_FILE


      OBJECT = SOFTWARE_BINARY                Optional      1..*
        OS_VERSION                            Required      1
        FILES                                 Required      1
        SUPPORTED_OS                          Required      1
        SUPPORTED_ARCHITECTURE                Required      1
        SW_FORMAT_TYPE                        Required      1
        SYSTEM_REQUIREMENTS                   Required      1

        PROGRAM_NOTES_IDENTIFIER              Required      1
      END_OBJECT = SOFTWARE_BINARY


      OBJECT = SOFTWARE_SCRIPT                Optional      1..*
        FILES                                 Required      1
        INSTALL_NOTES                         Required      1
        SUPPORTED_ARCHITECTURE                Required      1
        SYSTEM_REQUIREMENTS                   Required      1
      END_OBJECT = SOFTWARE_SCRIPT


      OBJECT = SOFTWARE_SOURCE                Optional      1..*
        OS_VERSION                            Required      1
        COMPILE_NOTES                         Required      1
        FILES                                 Required      1
        SOFTWARE_DIALECT                      Required      1
        SOFTWARE_LANGUAGE                     Required      1
        SUPPORTED_OS                          Required      1
        SUPPORTED_ARCHITECTURE                Required      1
        SW_FORMAT_TYPE                        Required      1
        SYSTEM_REQUIREMENTS                   Required      1

        PROGRAM_NOTES_IDENTIFIER              Required      1
      END_OBJECT = SOFTWARE_SOURCE


   END_OBJECT = TAGGED_SOFTWARE_FORMAT
```

```
OBJECT = SOFTWARE_SET_DESC                        Required        1
   VERSION                                        Required        1
   AUTHOR_LIST                                    Required        1
   DESCRIPTION                                    Required        1
   NAME                                           Required        1
   SOFTWARE_ID                                    Required        1
   SOFTWARE_TYPE                                  Required        1

   PROGRAMMERS_MANUAL_IDENTIFIER                  Required        1
   USERS_MANUAL_IDENTIFIER                        Required        1
END_OBJECT = SOFTWARE_SET_DESC


OBJECT = IDENTIFICATION_SECTION                   Required        1
   URN                                            Required        1
   IDENTIFIER                                     Required        1
   TITLE                                          Required        1
   VERSION                                        Required        1
   DD_VERSION_ID                                  Required        1
   PDS_VERSION_ID                                 Required        1
   LABEL_REVISION_NOTE                            Required        1
   PRODUCT_CREATION_TIME                          Required        1
END_OBJECT = IDENTIFICATION_SECTION

END_OBJECT = SOFTWARE_SET
```

Figure 3.1-1.   Diagram of the SOFTWARE_SET Schema

From Figure 3.1-1, the overall structure of the SOFTWARE_SET data object description can be easily discerned and understood.

1. The parent class, the SOFTWARE_SET class, is comprised of three sub-classes:
   - TAGGED_SOFTWARE_FORMAT class
   - SOFTWARE_SET_DESC class
   - IDENTIFICATION_SECTION class
2. The TAGGED_SOFTWARE_FORMAT class must exist once but may exist many times within the context of the SOFTWARE_SET class.
3. The TAGGED_ SOFTWARE _FORMAT class is comprised of four sub-classes, the TAGGED_FILE class, the SOFTWARE_BINARY class, the SOFTWARE_SCRIPT class, and the SOFTWARE_SOURCE class.
4. The TAGGED_ FILE class must exist once but may exist many times within the context of the TAGGED_SOFTWARE_FORMAT class.
5. The TAGGED_FILE class is comprised of five required non-repeating data elements.
6. The SOFTWARE_BINARY class may optionally once but may exist many times within the context of the TAGGED_SOFTWARE_FORMAT class.
7. The SOFTWARE_BINARY class is comprised of seven required non-repeating data elements.  These data elements must exist once and only once within the context of the SOFTWARE_BINARY class.

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8. The SOFTWARE_SCRIPT class may optionally once but may exist many times within the context of the TAGGED_SOFTWARE_FORMAT class.
9. The SOFTWARE_SCRIPT class is comprised of four required non-repeating data elements. These data elements must exist once and only once within the context of the SOFTWARE_BINARY class.
10. The SOFTWARE_SOURCE class may optionally once but may exist many times within the context of the TAGGED_SOFTWARE_FORMAT class.
11. The SOFTWARE_SOURCE class is comprised of nine required non-repeating data elements. These data elements must exist once and only once within the context of the SOFTWARE_BINARY class.
12. Within the context of the TAGGED_SOFTWARE_FORMAT class, the SOFTWARE_BINARY, the SOFTWARE_SCRIPT, or the SOFTWARE_SOURCE class must exist at least once.
13. The SOFTWARE_SET_DESC class must exist once and only once within the context of the SOFTWARE_SET class.
14. The SOFTWARE _SET_DESC class is comprised of eight required non-repeating data elements.
15. The IDENTIFICATION_SECTION class must exist once and only once within the context of the SOFTWARE_SET class.
16. The IDENTIFICATION_SECTION class is comprised of eight required non-repeating data elements.
17. Within the context of the SOFTWARE_BINARY and the SOFTWARE_SOURCE classes, there exists an IDENTIFIER data element that references a DOCUMENT_SET class. The identifier references the Programmers Notes document. This document exist somewhere within the context of PDS.
18. Within the context of the SOFTWARE_SET_DESC class, there exists two IDENTIFIER data elements that each reference a DOCUMENT_SET class. One identifier references the Programmers Manual while the other class references the Users Guide. Both documents exist somewhere within the context of PDS.

### 3.1.2 SOFTWARE_SET Structure and Constituent Parts

Figure 3.1-2 depicts a representation of the overall structure and the individual constituent parts of a PDS4 SOFTWARE_SET.

```
SOFTWARE/SORTREF.LBL
SOFTWARE/SORTREF.PL
SOFTWARE/SORTREF.L
```
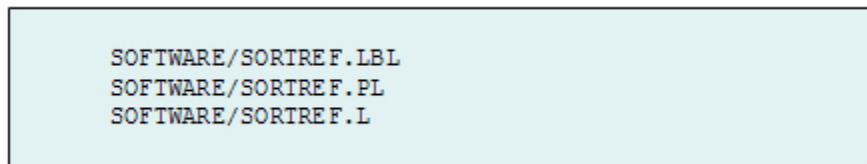
Figure 3.1-2.   Diagram of the SOFTWARE_SET Structure

With respect to the above structure:
1. The set of software files is described by the LBL file which is resident in the SOFTWARE directory.
2. The software is comprised of a single Perl script.
3. The UNIX-man file is considered a document and is described using the DOCUMENT_SET class.

### 3.1.3       SOFTWARE_SET Label Scheme

This section depicts how the structure and constituent parts of a SOFTWARE_SET, as illustrated above, can be described by both a PDS3 label and a PDS4 label.

The PDS4 SOFTWARE_SET class is the successor to the PDS3 SOFTWARE object.

### 3.1.3.1    PDS3 SOFTWARE_SET Structure and Constituent Parts

Under PDS3, the data product depicted in Figure 3.1-2 is described by a very terse set of information which principally focused on a high level description of the software function.

```
PDS_VERSION_ID          = PDS3
RECORD_TYPE             = STREAM

OBJECT      = SOFTWARE
  SOFTWARE_ID           = SBN_REFSORT
  SOFTWARE_VERSION_ID = "V1.0"
  SOFTWARE_PURPOSE    = VERIFICATION

  OBJECT      = SOFTWARE_INFORMATION
    SOFTWARE_NAME   = REFSORT
    DATA_FORMAT     = PDS
    SOFTWARE_LICENSE_TYPE  = "PUBLIC DOMAIN"
    TECHNICAL_SUPPORT_TYPE = FULL
    REQUIRED_STORAGE_BYTES = 5000
    PDS_USER_ID           = "N/A"
    NODE_ID               = SBN
    SOFTWARE_DESC         = "This Perl utility sorts a file containing
                            a series of (properly-formatted) REFERENCE
                            objects according to the value of the
                            REFERENCE_KEY_ID elements. Formatting is
                            not otherwise changed. A text version
                            of a Unix 'man' page is included in the
                            distribution, in addition to the man page
                            source file."
    END_OBJECT = SOFTWARE_INFORMATION
```

```
          OBJECT      = SOFTWARE_ONLINE
             ON_LINE_IDENTIFICATION =
"http://pdssbn.astro.umd.edu/software/refsort.tar"
             ON_LINE_NAME            = "SBN REFERENCE Object Source Routine"
             NODE_ID                 = SBN
             PROTOCOL_TYPE           = URL
             PLATFORM                = MULTIPLE
          END_OBJECT = SOFTWARE_ONLINE

        END_OBJECT = SOFTWARE
        END
```

## 3.1.3.2   PDS4 SOFTWARE_SET Structure and Constituent Parts

The same data product can also be described in PDS4 in a single label by use of the SOFTWARE_SET class.  Under PDS4, the SOFTWARE_SET data product depicted in Figure 3.1-2 is described by a more descriptive set of metadata that is descriptive of the function of the software; as well as, the document that accompany the software.

```
        #PDS4#

        /* ******* Label Template - Software_Set ******* */

        OBJECT = SOFTWARE_SET;

          OBJECT = IDENTIFICATION_SECTION;
            URN                   = "N/A";
            IDENTIFIER            = "PDS4_SBN_REFSOFT_ODL:v1.0";
            TITLE                 = "SBN REFSOFT V1.0 Perl Source Routine";
            VERSION               = "1.0";
            DD_VERSION_ID         = "DD_VERSION_ID";
            PDS_VERSION_ID        = "PDS4.0";
            LABEL_REVISION_NOTE   = "20081223:1.0 - initial version";
            PRODUCT_CREATION_TIME = 2008-12-23T00:36:08.000;
          END_OBJECT = IDENTIFICATION_SECTION;

          OBJECT = TAGGED_SOFTWARE_FORMAT;

            OBJECT = TAGGED_FILE;
              LOCAL_IDENTIFIER        = "SORTREF.PL";
              CHECKSUM                = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
              FILE_SIZE               = 111;
              FILE_SPECIFICATION_NAME = "SOFTWARE/SORTREF.PL";
              FILE_TYPE               = CHARACTER;
            END_OBJECT = TAGGED_FILE;

            OBJECT = SOFTWARE_SCRIPT;
              FILES                 = 1;
              INSTALL_NOTES         = "Installation requires no level of
                                      expertise whatsoever.";
              SUPPORTED_ARCHITECTURE = MOST;
              SYSTEM_REQUIREMENTS    = PERL;
            END_OBJECT = SOFTWARE_SCRIPT;

          END_OBJECT = TAGGED_SOFTWARE_FORMAT;
```

```
OBJECT = SOFTWARE_SET_DESC;
  VERSION                = "V1.0";
  AUTHOR_LIST            = "A.RAUGH";
  DESCRIPTION            = "Reads a file containing a simple list
                           of PDS REFERENCE object definitions,
                           sorts the definitions based on the
                           REFERENCE_KEY_ID values, and output the
                           result.

                           Any lines in the file preceding the first
                           REFERENCE object are preserved; comments
                           between references and any lines following
                           the END statement are deleted.

                           A single blank line will be inserted between
                           REFERENCE objects. If the input lines are
                           padded to 80 bytes and have CR/LF carriage-
                           control, so will the inserted blank lines;
                           otherwise these will just consist of a
                           linefeed. The output file will only contain
                           an END statement if one was found in the
                           original file.
                           ";
  NAME                   = "SBN -- SORT References based on REF_KEY_ID";
  SOFTWARE_ID            = "REFSOFT V1.0;
  SOFTWARE_TYPE          = "UTILITY / REFERENCES";

  /* Include reference to the Unix Manual for both Docs */
  PROGRAMMERS_MANUAL_IDENTIFIER = "PDS4_SBN_SORTREF_MANUAL";
  USERS_MANUAL_IDENTIFIER       = "PDS4_SBN_SORTREF_MANUAL";
END_OBJECT = SOFTWARE_SET_DESC;

END_OBJECT = SOFTWARE_SET;
```

**3.1.4**        PDS4 SOFTWARE_SET and PDS3 SOFTWARE PARALLELISMS

TBD

# 4.0 ENCODED STREAM BASE

## 4.1 DOCUMENT_SET

This section describes the DOCUMENT_SET class where one or more files, as identified as a set, comprise a logically complete "copy" of the referenced document file(s).

This section identifies a mapping of the PDS3 DOCUMENT object to the PDS4 DOCUMENT_SET class and demonstrates how the document "pieces / fragments" can be described by both a PDS3 label and a PDS4 label.

### 4.1.1 DOCUMENT_SET Class Description and Schema

Figure 4.1-1 depicts a representation of the PDS4 DOCUMENT_SET class and the associated parent and child classes.  The figure additionally lists the required or optional status, and the cardinality of repeating structures.

```
OBJECT = DOCUMENT_SET
                                                      Req/Opt    Cardinality

      OBJECT = TAGGED_DOCUMENT_FORMAT                 Required      1..*
        DESCRIPTION                                   Optional      1


          OBJECT = TAGGED_FILE                        Required      1..*
            LOCAL_IDENTIFIER                          Required      1
            CHECKSUM                                  Required      1
            FILE_SIZE                                 Required      1
            FILE_NAME                                 Required      1
            FILE_TYPE                                 Required      1
          END_OBJECT = TAGGED_DOCUMENT_PART


          OBJECT = DOCUMENT_FORMAT                    Required      1
            DESCRIPTION                               Optional      1
            FORMAT_TYPE                               Required      1
          END_OBJECT = DOCUMENT_FORMAT


        END_OBJECT = TAGGED_DOCUMENT_FORMAT


    OBJECT = DOCUMENT_SET_DESC                        Required      1
        TITLE                                         Required      1
        ACKOWLEDGEMENT                                Optional      1
        AUTHOR_LIST                                   Required      1
        DESCRIPTION                                   Optional      1
        DOI                                           Optional      1
        PUBLICATION_DATE                              Required      1
        RIGHTS                                        Required      1
    END_OBJECT = DOCUMENT_SET_DESC

    OBJECT = IDENTIFICATION_SECTION                   Required      1
        URN                                           Required      1
        IDENTIFIER                                    Required      1
        TITLE                                         Required      1
        VERSION                                       Required      1
        DD_VERSION_ID                                 Required      1
        PDS_VERSION_ID                                Required      1
        LABEL_REVISION_NOTE                           Required      1
        PRODUCT_CREATION_TIME                         Required      1
    END_OBJECT = IDENTIFICATION_SECTION

END_OBJECT = DOCUMENT_SET
```

Figure 4.1-1.   Diagram of the DOCUMENT_SET Schema

From Figure 4.1-1, the overall structure of the DOCUMENT_SET data object
description can be easily discerned and understood.

1.  The parent class, the DOCUMENT_SET class, is comprised of three sub-
    classes:
    - TAGGED_DOCUMENT_FORMAT class
    - DOCUMENT_SET_DESC class

- IDENTIFICATION_SECTION class.
2. The TAGGED_DOCUMENT_FORMAT class must exist once but may exist many times within the context of the DOCUMENT_SET class.
3. The TAGGED_DOCUMENT_FORMAT class is comprised of a single optional non-repeating data element and two sub-classes, the TAGGED_FILE class and the DOCUMENT_FORMAT class.
4. The TAGGED_FILE class must exist once but may exist many times within the context of the TAGGED_DOCUMENT_FORMAT class.
5. The TAGGED_FILE class is comprised of five required non-repeating data elements.
6. The DOCUMENT_FORMAT class must exist once and only once within the context of the TAGGED_DOCUMENT_FORMAT class.
7. The DOCUMENT_FORMAT class is comprised of a single optional non-repeating data element and a single required non-repeating data element.
8. The DOCUMENT_SET_DESC class must exist once and only once within the context of the DOCUMENT_SET class.
9. The DOCUMENT_SET_DESC class is comprised of four required non-repeating data elements and three optional non-repeating data elements.
10. The IDENTIFICATION_SECTION class must exist once and only once within the context of the DOCUMENT_SET class.
11. The IDENTIFICATION_SECTION class is comprised of eight required non-repeating data elements.

### 4.1.2      DOCUMENT_SET Structure and Constituent Parts

Figure 4.1-2 depicts a representation of the overall structure and the individual constituent parts of a PDS4 DOCUMENT_SET.

```
DOCUMENT/MECA_RDR_SIS.LBL
DOCUMENT/MECA_RDR_SIS.PDF
DOCUMENT/MECA_RDR_SIS.HTM
DOCUMENT/IMAGE_FILES/IMAGE001.GIF
DOCUMENT/IMAGE_FILES/IMAGE002.GIF
DOCUMENT/IMAGE_FILES/IMAGE003.JPG
DOCUMENT/IMAGE_FILES/IMAGE004.GIF
DOCUMENT/IMAGE_FILES/IMAGE005.GIF
DOCUMENT/IMAGE_FILES/IMAGE006.GIF
DOCUMENT/IMAGE_FILES/IMAGE007.GIF
DOCUMENT/IMAGE_FILES/IMAGE008.GIF
DOCUMENT/IMAGE_FILES/IMAGE009.GIF
DOCUMENT/IMAGE_FILES/IMAGE010.GIF
DOCUMENT/IMAGE_FILES/IMAGE011.GIF
DOCUMENT/IMAGE_FILES/IMAGE012.GIF
DOCUMENT/IMAGE_FILES/IMAGE013.GIF
DOCUMENT/IMAGE_FILES/IMAGE014.GIF
DOCUMENT/IMAGE_FILES/IMAGE015.GIF
DOCUMENT/IMAGE_FILES/IMAGE016.JPG
DOCUMENT/IMAGE_FILES/IMAGE017.GIF
DOCUMENT/IMAGE_FILES/IMAGE018.GIF
DOCUMENT/IMAGE_FILES/IMAGE019.GIF
DOCUMENT/IMAGE_FILES/IMAGE020.GIF
DOCUMENT/IMAGE_FILES/IMAGE021.GIF
DOCUMENT/IMAGE_FILES/IMAGE022.GIF
```

Figure 4.1-2.   Diagram of the DOCUMENT_SET Structure


With respect to the above structure:
4.  The set of documents is described by the LBL file which is resident in the DOCUMENT directory.
5.  The document is represented as both a PDF version and an HTML version.
6.  The PDF version is comprised of a single file which is resident in the DOCUMENT directory.
7.  The HTML version is a multi-part document which is comprised of some 20+ files where the parent HTM file, resident in the DOCUMENT directory, references the 20+ associated images which are resident in the DOCUMENT/IMAGE_FILES directory.


**4.1.3**        DOCUMENT_SET Label Scheme

This section depicts how the structure and constituent parts of a DOCUMENT_SET, as illustrated above, can be described by both a PDS3 label and a PDS4 label.

The PDS4 DOCUMENT_SET class is the successor to the PDS3 DOCUMENT
object.


## 4.1.3.1    PDS3 DOCUMENT_SET Label Scheme

Under PDS3, the data product depicted in Figure 4.1-2 must be described by two
separate label files, as the files that comprise the document reside in separate
directories.

The primary label describes the files that reside in the DOCUMENT directory.
These files describe both the PDF version and the HTML version of the
document:

```
PDS_VERSION_ID          = PDS3
RECORD_TYPE             = UNDEFINED
^PDF_DOCUMENT           = "MECA_RDR_SIS.PDF"
^HTML_DOCUMENT          = "MECA_RDR_SIS.HTM"

OBJECT                  = PDF_DOCUMENT
DOCUMENT_NAME           = "Phoenix Project Software Interface
                           Specification(SIS) MECA Non-Imaging Reduced
                           Data Record (RDR)"
DOCUMENT_TOPIC_TYPE     = "DATA PRODUCT SIS"
INTERCHANGE_FORMAT      = BINARY
DOCUMENT_FORMAT         = "ADOBE PDF"
DESCRIPTION             = "The MECA Non-Imaging RDR SIS
                           describes the format and content of MECA
                           Non-Imaging RDR data products. This file
                           is intended to be viewed using a PDF reader
                           such as Adobe Acrobat."
PUBLICATION_DATE        = 2008-12-23
END_OBJECT              = PDF_DOCUMENT

OBJECT                  = HTML_DOCUMENT
DOCUMENT_NAME           = "Phoenix Project Software Interface
                           Specification(SIS) MECA Non-Imaging
                           Reduced Data Record (RDR)"
DOCUMENT_TOPIC_TYPE     = "DATA PRODUCT SIS"
INTERCHANGE_FORMAT      = ASCII
DOCUMENT_FORMAT         = "HTML"
DESCRIPTION             = "The MECA Non-Imaging RDR SIS
                           describes the format and content of MECA
                           Non-Imaging RDR data products. This file
                           is intended to be viewed using a web
                           browser."
PUBLICATION_DATE        = 2008-12-23
END_OBJECT              = HTML_DOCUMENT
END
```

The secondary label describes the files that reside in the
DOCUMENT/IMAGE_FILES directory.  These files describe the GIF and JPG
images that are referenced by the HTML version of the document:

```
PDS_VERSION_ID          = PDS3
RECORD_TYPE             = UNDEFINED

^GIF1_DOCUMENT          = "IMAGE001.GIF"
^GIF2_DOCUMENT          = "IMAGE002.GIF"
^JPG3_DOCUMENT          = "IMAGE003.JPG"
^GIF4_DOCUMENT          = "IMAGE004.GIF"
^GIF5_DOCUMENT          = "IMAGE005.GIF"
^GIF6_DOCUMENT          = "IMAGE006.GIF"
^GIF7_DOCUMENT          = "IMAGE007.GIF"
^GIF8_DOCUMENT          = "IMAGE008.GIF"
^GIF9_DOCUMENT          = "IMAGE009.GIF"
^GIF10_DOCUMENT         = "IMAGE010.GIF"
^GIF11_DOCUMENT         = "IMAGE011.GIF"
^GIF12_DOCUMENT         = "IMAGE012.GIF"
^GIF13_DOCUMENT         = "IMAGE013.GIF"
^GIF14_DOCUMENT         = "IMAGE014.GIF"
^GIF15_DOCUMENT         = "IMAGE015.GIF"
^JPG16_DOCUMENT         = "IMAGE016.JPG"
^GIF17_DOCUMENT         = "IMAGE017.GIF"
^GIF18_DOCUMENT         = "IMAGE018.GIF"
^GIF19_DOCUMENT         = "IMAGE019.GIF"
^GIF20_DOCUMENT         = "IMAGE020.GIF"
^GIF21_DOCUMENT         = "IMAGE021.GIF"
^GIF22_DOCUMENT         = "IMAGE022.GIF"

OBJECT                  = GIF1_DOCUMENT
  DOCUMENT_NAME         = "IMAGE001.GIF"
  DOCUMENT_TOPIC_TYPE   = "N/A"
  INTERCHANGE_FORMAT    = BINARY
  DOCUMENT_FORMAT       = GIF
  DESCRIPTION           = "Image 1 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE      = 2008-12-23
END_OBJECT              = GIF1_DOCUMENT

OBJECT                  = GIF2_DOCUMENT
  DOCUMENT_NAME         = "IMAGE002.GIF"
  DOCUMENT_TOPIC_TYPE   = "N/A"
  INTERCHANGE_FORMAT    = BINARY
  DOCUMENT_FORMAT       = GIF
  DESCRIPTION           = "Image 2 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE      = 2008-12-23
END_OBJECT              = GIF2_DOCUMENT

OBJECT                  = JPG3_DOCUMENT
  DOCUMENT_NAME         = "IMAGE003.JPG"
  DOCUMENT_TOPIC_TYPE   = "N/A"
  INTERCHANGE_FORMAT    = BINARY
  DOCUMENT_FORMAT       = JPG
  DESCRIPTION           = "Image 3 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE      = 2008-12-23
END_OBJECT              = JPG3_DOCUMENT

OBJECT                  = GIF4_DOCUMENT
  DOCUMENT_NAME         = "IMAGE004.GIF"
  DOCUMENT_TOPIC_TYPE   = "N/A"
  INTERCHANGE_FORMAT    = BINARY
  DOCUMENT_FORMAT       = GIF
  DESCRIPTION           = "Image 4 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE      = 2008-12-23
END_OBJECT              = GIF4_DOCUMENT

OBJECT                  = GIF5_DOCUMENT
```

```
  DOCUMENT_NAME       = "IMAGE005.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 5 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF5_DOCUMENT

OBJECT                = GIF6_DOCUMENT
  DOCUMENT_NAME       = "IMAGE006.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 6 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF6_DOCUMENT

OBJECT                = GIF7_DOCUMENT
  DOCUMENT_NAME       = "IMAGE007.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 7 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF7_DOCUMENT

OBJECT                = GIF8_DOCUMENT
  DOCUMENT_NAME       = "IMAGE008.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 8 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF8_DOCUMENT

OBJECT                = GIF9_DOCUMENT
  DOCUMENT_NAME       = "IMAGE009.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 9 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF9_DOCUMENT

OBJECT                = GIF10_DOCUMENT
  DOCUMENT_NAME       = "IMAGE010.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 10 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF10_DOCUMENT

OBJECT                = GIF11_DOCUMENT
  DOCUMENT_NAME       = "IMAGE011.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT  = BINARY
  DOCUMENT_FORMAT     = GIF
  DESCRIPTION         = "Image 11 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE    = 2008-12-23
END_OBJECT            = GIF11_DOCUMENT

OBJECT                = GIF12_DOCUMENT
```

```
  DOCUMENT_NAME        = "IMAGE012.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = GIF
  DESCRIPTION          = "Image 12 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = GIF12_DOCUMENT

OBJECT                 = GIF13_DOCUMENT
  DOCUMENT_NAME        = "IMAGE013.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = GIF
  DESCRIPTION          = "Image 13 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = GIF13_DOCUMENT

OBJECT                 = GIF14_DOCUMENT
  DOCUMENT_NAME        = "IMAGE014.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = GIF
  DESCRIPTION          = "Image 14 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = GIF14_DOCUMENT

OBJECT                 = GIF15_DOCUMENT
  DOCUMENT_NAME        = "IMAGE015.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = GIF
  DESCRIPTION          = "Image 15 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = GIF15_DOCUMENT

OBJECT                 = JPG16_DOCUMENT
  DOCUMENT_NAME        = "IMAGE016.JPG"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = JPG
  DESCRIPTION          = "Image 16 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = JPG16_DOCUMENT

OBJECT                 = GIF17_DOCUMENT
  DOCUMENT_NAME        = "IMAGE017.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = GIF
  DESCRIPTION          = "Image 17 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = GIF17_DOCUMENT

OBJECT                 = GIF18_DOCUMENT
  DOCUMENT_NAME        = "IMAGE018.GIF"
  DOCUMENT_TOPIC_TYPE = "N/A"
  INTERCHANGE_FORMAT   = BINARY
  DOCUMENT_FORMAT      = GIF
  DESCRIPTION          = "Image 18 in MECA_RDR_SIS.HTM"
  PUBLICATION_DATE     = 2008-12-23
END_OBJECT             = GIF18_DOCUMENT

OBJECT                 = GIF19_DOCUMENT
```

```
            DOCUMENT_NAME        = "IMAGE019.GIF"
            DOCUMENT_TOPIC_TYPE = "N/A"
            INTERCHANGE_FORMAT  = BINARY
            DOCUMENT_FORMAT      = GIF
            DESCRIPTION          = "Image 19 in MECA_RDR_SIS.HTM"
            PUBLICATION_DATE     = 2008-12-23
          END_OBJECT             = GIF19_DOCUMENT

          OBJECT                 = GIF20_DOCUMENT
            DOCUMENT_NAME        = "IMAGE020.GIF"
            DOCUMENT_TOPIC_TYPE = "N/A"
            INTERCHANGE_FORMAT  = BINARY
            DOCUMENT_FORMAT      = GIF
            DESCRIPTION          = "Image 20 in MECA_RDR_SIS.HTM"
            PUBLICATION_DATE     = 2008-12-23
          END_OBJECT             = GIF20_DOCUMENT

          OBJECT                 = GIF21_DOCUMENT
            DOCUMENT_NAME        = "IMAGE021.GIF"
            DOCUMENT_TOPIC_TYPE = "N/A"
            INTERCHANGE_FORMAT  = BINARY
            DOCUMENT_FORMAT      = GIF
            DESCRIPTION          = "Image 21 in MECA_RDR_SIS.HTM"
            PUBLICATION_DATE     = 2008-12-23
          END_OBJECT             = GIF21_DOCUMENT

          OBJECT                 = GIF22_DOCUMENT
            DOCUMENT_NAME        = "IMAGE022.GIF"
            DOCUMENT_TOPIC_TYPE = "N/A"
            INTERCHANGE_FORMAT  = BINARY
            DOCUMENT_FORMAT      = GIF
            DESCRIPTION          = "Image 22 in MECA_RDR_SIS.HTM"
            PUBLICATION_DATE     = 2008-12-23
          END_OBJECT             = GIF22_DOCUMENT

          END
```

## 4.1.3.2    PDS4 DOCUMENT_SET Label Scheme

The same data product can also be described in PDS4 in a single label by use of
the DOCUMENT_SET class:

```
    #PDS4#

    /* ******* Label Template : Document_Set ******* */

    OBJECT = DOCUMENT_SET;

      OBJECT = IDENTIFICATION_SECTION;
        URN                    = "HTTP://PDS-GEOSCIENCES.WUSTL.EDU/GEO/PHX-M-
MECA-4-NIRDR-V1/PHXMEC_1XXX/DOCUMENT/:1.0";
        IDENTIFIER             = "PDS4_MECA_DOCUMENT_SET_ODL.LBL";
        TITLE                  = "Phoenix Project Software Interface
                                  Specification (SIS) MECA Non-Imaging Reduced
                                  Data Record (RDR)";
        VERSION                = "1.0";
        DD_VERSION_ID          = "DD_VERSION_ID";
        PDS_VERSION_ID         = "PDS4.0";
```

```
    LABEL_REVISION_NOTE     = "20081223:1.0 - initial version";
    PRODUCT_CREATION_TIME   = 2008-12-23T00:36:08.000;
END_OBJECT = IDENTIFICATION_SECTION;

OBJECT = TAGGED_DOCUMENT_FORMAT;
  DESCRIPTION                   = "The PDF version of the MECA Non-Imaging RDR
                                   SIS";

  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER            = "MECA_RDR_SIS-PDF_FILE";
    CHECKSUM                    = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                   = 111;
    FILE_NAME                   = "MECA_RDR_SIS.PDF";
    FILE_TYPE                   = BINARY;
  END_OBJECT = TAGGED_FILE;

  OBJECT = DOCUMENT_FORMAT;
    DESCRIPTION                 = "N/A";
    FORMAT_TYPE                 = "PS-ADOBE-2.0";
  END_OBJECT = DOCUMENT_FORMAT;

END_OBJECT = TAGGED_DOCUMENT_FORMAT;

OBJECT = TAGGED_DOCUMENT_FORMAT;
  DESCRIPTION                   = "The HTML version of the MECA Non-Imaging RDR
                                   SIS";

  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER            = "MECA_RDR_SIS-HTML_FILE";
    CHECKSUM                    = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                   = 111;
    FILE_NAME                   = "MECA_RDR_SIS.HTM";
    FILE_TYPE                   = CHARACTER;
  END_OBJECT = TAGGED_FILE;

  OBJECT = DOCUMENT_FORMAT;
    DESCRIPTION                 = "N/A";
    FORMAT_TYPE                 = "HTML Version 3.2";
  END_OBJECT = DOCUMENT_FORMAT;

END_OBJECT = TAGGED_DOCUMENT_FORMAT;

OBJECT = TAGGED_DOCUMENT_FORMAT;
  DESCRIPTION                   = "The HTML version of the MECA Non-Imaging RDR
                                   SIS describes the format and content of MECA
                                   Non-Imaging RDR data products. This file is
                                   intended to be viewed using a web browser.";

  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER            = "MECA_RDR_SIS-HTML_FILE";
    CHECKSUM                    = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                   = 111;
    FILE_NAME                   = "MECA_RDR_SIS.HTM";
    FILE_TYPE                   = CHARACTER;
  END_OBJECT = TAGGED_FILE;

  OBJECT = DOCUMENT_FORMAT;
    DESCRIPTION                 = "N/A";
    FORMAT_TYPE                 = "HTML Version 3.2";
  END_OBJECT = DOCUMENT_FORMAT;

END_OBJECT = TAGGED_DOCUMENT_FORMAT;
```

```
OBJECT = TAGGED_DOCUMENT_FORMAT;
  DESCRIPTION            = "The underlying GIF images associated with the
                           HTML version of the MECA Non-Imaging RDR SIS";

  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE001-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE001.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE002-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE002.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE004-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE004.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE005-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE005.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE006-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE006.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE007-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE007.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE008-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE008.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE009-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE            = 111;
    FILE_NAME            = "IMAGE009.GIF";
    FILE_TYPE            = BINARY;
  END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER      = "MECA_RDR_SIS-IMAGE010-FILE";
    CHECKSUM              = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
```

```
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE010.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE011-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE011.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE012-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE012.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE013-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE013.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
 OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE014-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE014.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE015-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE015.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE017-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE017.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE018-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE018.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE019-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
    FILE_SIZE                = 111;
    FILE_NAME                = "IMAGE019.GIF";
    FILE_TYPE                = BINARY;
 END_OBJECT = TAGGED_FILE;
OBJECT = TAGGED_FILE;
    LOCAL_IDENTIFIER         = "MECA_RDR_SIS-IMAGE020-FILE";
    CHECKSUM                 = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
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        FILE_SIZE               = 111;
        FILE_NAME               = "IMAGE020.GIF";
        FILE_TYPE               = BINARY;
    END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
        LOCAL_IDENTIFIER        = "MECA_RDR_SIS-IMAGE021-FILE";
        CHECKSUM                = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
        FILE_SIZE               = 111;
        FILE_NAME               = "IMAGE021.GIF";
        FILE_TYPE               = BINARY;
    END_OBJECT = TAGGED_FILE;
  OBJECT = TAGGED_FILE;
        LOCAL_IDENTIFIER        = "MECA_RDR_SIS-IMAGE022-FILE";
        CHECKSUM                = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
        FILE_SIZE               = 111;
        FILE_NAME               = "IMAGE022.GIF";
        FILE_TYPE               = BINARY;
    END_OBJECT = TAGGED_FILE;

    OBJECT = DOCUMENT_FORMAT;
        DESCRIPTION             = "ENCODING_TYPE = GIF89A";
        FORMAT_TYPE             = "International Standard GIF89a";
    END_OBJECT = DOCUMENT_FORMAT;

END_OBJECT = TAGGED_DOCUMENT_FORMAT;


OBJECT = TAGGED_DOCUMENT_FORMAT;
    DESCRIPTION          = "The underlying JPG images associated with the
                            HTML version of the MECA Non-Imaging RDR SIS";

    OBJECT = TAGGED_FILE;
        LOCAL_IDENTIFIER        = "MECA_RDR_SIS-IMAGE003-FILE";
        CHECKSUM                = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
        FILE_SIZE               = 111;
        FILE_NAME               = "IMAGE003.JPG";
        FILE_TYPE               = BINARY;
    END_OBJECT = TAGGED_FILE;
    OBJECT = TAGGED_FILE;
        LOCAL_IDENTIFIER        = "MECA_RDR_SIS-IMAGE016-FILE";
        CHECKSUM                = "0ff0a5dd0f3ea4e104b0eae98c87f36c";
        FILE_SIZE               = 111;
        FILE_NAME               = "IMAGE016.JPG";
        FILE_TYPE               = BINARY;
    END_OBJECT = TAGGED_FILE;

    OBJECT = DOCUMENT_FORMAT;
        DESCRIPTION             = "ENCODING_TYPE = JPEG";
        FORMAT_TYPE             = "International Standard ISO 10918-1"
    END_OBJECT = DOCUMENT_FORMAT;

END_OBJECT = TAGGED_DOCUMENT_FORMAT;


OBJECT = DOCUMENT_SET_DESC;
    ACKNOWLEDGEMENT     = "N/A";
    AUTHOR_LIST         = "S.SLAVNEY";
    DESCRIPTION         = "Phoenix Project Software Interface
                           Specification (SIS) MECA Non-Imaging Reduced
                           Data Record (RDR)";
    DOI                 = "TBD";
    PUBLICATION_DATE    = 2008-12-23;
    RIGHTS              = PUBLIC_DOMAIN;
    TITLE               = "Phoenix Project Software Interface
```

```
                           Specification (SIS) MECA Non-Imaging Reduced
                           Data Record (RDR)";
      END_OBJECT = DOCUMENT_SET_DESC;

   END_OBJECT = DOCUMENT_SET;
```

## 4.1.4 PDS4 DOCUMENT_SET and PDS3 DOCUMENT PARALLELISMS

TBD

# APPENDIX A    ACRONYMS

The following acronyms are pertain to this document:

| | |
|---|---|
| ADM | Architecture Development Method |
| API | Application Programming Interface |
| COTS | Commercial Off-The-Shelf |
| EN | Engineering Node (PDS) |
| ESDIS | Earth Science Data and Information System |
| FTP | File Transfer Protocol |
| IEEE | Institute of Electrical and Electronics Engineers |
| IPDA | International Planetary Data Alliance |
| IT | Information Technology |
| JPL | Jet Propulsion Laboratory |
| NASA | National Aeronautics and Space Administration |
| NSSDC | National Space Science Data Center |
| PDS | Planetary Data System |
| RM-ODP | Reference Model of Open Distributed Processing |
| RSS | Really Simple Syndication |
| SDSC | San Diego Supercomputing Center |
| SOA | Service-Oriented Architecture |
| TB | Terabyte |
| TOGAF | The Open Group Architecture Framework |
| XML | eXtensible Markup Language |

# APPENDIX B    DEFINITION OF TERMS

The following are definitions of essential terms used throughout this document:

An "attribute" is a property or characteristic that allows both identification and distinction.

A "class" is the set of attributes which identifies a family. A class is generic -- a template from which individual members of each family may be constructed.

An "object" is a specific instance of a class.

"Cardinality" is the number of values allowed to an attribute or association in a single class. Cardinality in general is stated as a range with a minimum and maximum. For example, an attribute that may be multi-valued will have a cardinality of "1..*". A cardinality where the minimum and maximum are the same is often shown as the single value. For example, an attribute required to have exactly one value will have a cardinality of "1". When a value is required the minimum cardinality is at least 1. At least one value is always required in PDS4.

"Entity" is a generic term used to refer to specific attributes or associations listed in a class definition.