ASCII Data File Format

This section describes the format of a MetroPro ASCII data file. The file is made up of three parts: header, intensity data, and phase data. Each part is followed by a line containing a sharp (#) character. At least one of the data sets must be present. A MetroPro ASCII data file is created by using the dat_to_asc conversion utility.

ASCII Data File Header Information

The header consists of 14 required lines of information. Line 1 is a string constant (not enclosed in quotes). The remaining lines contain named fields.

Line	*Field Name*
1	Zygo ASCII Data File - Format 2
2	SoftwareType MajorVers MinorVers BugVers SoftwareDate
3	IntensOriginX IntensOriginY IntensWidth IntensHeight NBuckets IntensRange
4	PhaseOriginX PhaseOriginY PhaseWidth PhaseHeight
5	Comment
6	PartSerNum
7	PartNum
8	Source IntfScaleFactor WavelengthIn NumericAperture ObliquityFactor Magnification CameraRes TimeStamp
9	CameraWidth CameraHeight SystemType SystemBoard SystemSerial InstrumentId ObjectiveName
10	AcquireMode IntensAvgs PZTCal PZTGain PZTGainTolerance AGC TargetRange LightLevel MinMod MinModPts
11	PhaseRes PhaseAvgs MinimumAreaSize DisconAction DisconFilter ConnectionOrder RemoveTiltBias DataSign CodeVType
12	SubtractSysErr SysErrFile
13	RefractiveIndex PartThickness
14	ZoomDesc

ASCII Data File Header Field Descriptions

Each header field in an ASCII data file is described below. The types of fields are: integer, real, and string. The integer fields are always whole numbers. The real fields may be whole numbers, decimal, or exponential notation. The string fields are fixed-length (blank padded) and enclosed in double-quotes (“ ”).

SoftwareType This integer indicates what program created the data file. The programs are: unknown (0), MetroPro (1), MetroBASIC (2), and d2bug (3).

MajorVers, MinorVers, BugVers These integers contain the version numbers of the program that created the data file.

SoftwareDate This 30-character string contains the time and date that the program was created.

IntensOriginX, IntensOriginY These integers are the coordinates of the origin of the intensity data matrix. They refer to positions in the camera coordinate system. The origin of the camera coordinate system (0,0) is located in the upper left corner of the video monitor.

IntensWidth, IntensHeight These integers are the width (columns) and height (rows) of the intensity data matrix. If no intensity data is present, this value is zero.

NBuckets This integer is the number of buckets of intensity data that are stored. Currently, MetroPro stores one bucket of intensity data. If no intensity data matrix is present, this value is zero.

IntensRange This unsigned integer is the maximum possible value of an intensity data point.

PhaseOriginX, PhaseOriginY These integers are the coordinates of the origin of the connected phase data matrix. They refer to positions in the camera coordinate system. The origin of the camera coordinate system (0,0) is located in the upper left corner of the video monitor.

PhaseWidth, PhaseHeight These integers are the width (columns) and height (rows) of the connected phase data matrix. If no phase data is present, these values are zero.

Comment This 81-character string is a user-entered remark line.

PartSerNum This 39-character string is a user-entered serial number for the part measured.

PartNum This 39-character string is a user-entered identifier of the part measured.

Source This integer indicates the source of the data. A value of 0 indicates the data is from an instrument; 1 indicates that the data was generated.

IntfScaleFactor This real number is the interferometric scale factor. It is the number of waves per fringe as specified by the user.

WavelengthIn This real number is the wavelength, in meters, at which the interferogram was measured.

NumericAperture This real number is 1 / (2 * f-number).

ObliquityFactor This real number is a phase correction factor required when using a Mirau objective on a microscope. A value of 1.0 indicates no correction factor was required.

Magnification This real number is reserved for future use.

CameraRes This real number is the lateral resolving power of a camera pixel in meters/pixel. A value of 0 means that the value is unknown.

TimeStamp This integer is the system representation of the date and time the data was measured or generated. It is the number of seconds since 0:00:00 January 1, 1970.

CameraWidth, CameraHeight These integers are the width (columns) and height (rows) of the usable camera field in pixels.

SystemType This integer indicates the type of system used to make the measurement. The system may be: Mark IVxp (1), Maxim•3D (2), Maxim•NT (3), GPI-XP (4), NewView (5), Maxim•GP (6), NewView/GP (7), Mark to GPI conversion (8), or none (0), if the data was software generated.

SystemBoard This integer indicates which system board was in use when the data measurement was taken. Valid values range from 0 to 7.

SystemSerial This integer indicates the serial number of the instrument.

InstrumentId This integer indicates the instrument unit number. Valid values range from 0 to 7.

ObjectiveName This is an 11-character string. For the microscopes, this field indicates the objective in use when the measurement was taken. For the GPI, this field indicates the aperture in use when the measurement was taken. If the data was generated, this field is blank.

AcquireMode This integer indicates the setting of the Acquisition Mode control. The settings are: phase (0), fringe (1), or scan (2).

IntensAvgs This integer is the number of intensity averages performed. Values of 0 or 1 indicate no averaging.

PZTCal This integer indicates whether or not the modulation amplitude was automatically adjusted during acquisition. A value of 1 indicates adjustment; a value of 0 indicates no adjustment.

PZTGain This integer specifies the modulation amplitude value used during data acquisition.

PZTGainTolerance This integer specifies a PZT error range if PZT calibration was adjusted.

AGC This integer indicates whether or not automatic gain control was performed during data acquisition. A value of 1 indicates AGC was used; a value of 0 indicates AGC was not used.

TargetRange This real number is the acceptable tolerance limits of the light intensity used during AGC.

LightLevel This integer is the light level setting used during data acquisition.

MinMod This integer is the minimum value of modulation needed to calculate a phase value. MinMod is equal to 10.23 * MinMod(%). MinMod(%) is a user setting indicating a percentage of full modulation each camera pixel must have in order to be accepted as a valid data point.

MinModPts This integer is the minimum number of data points required to pass MinMod criteria during AGC.

PhaseRes This integer indicates the resolution of the phase data points. A value of 0 indicates normal resolution, with each fringe represented by 4096 counts. A value of 1 indicates high resolution, with each fringe represented by 32768 counts.

PhaseAvgs This integer is the number of phase averages performed.

MinimumAreaSize This integer is the minimum number of contiguous data points required for a valid data region. Any smaller regions are deleted.

DisconAction This integer indicates the action taken when the system encountered discontinuities in phase data. The discontinuity actions are: delete regions (0), filter regions (1), and ignore (2).

DisconFilter This real number specifies the degree to which discontinuities were removed when DisconAction was filter. Valid values range from 0 (none) to 100 (all).

ConnectionOrder This integer specifies the order in which separate regions of phase data were processed. The order may be by location (0) or by size (1).

RemoveTiltBias This integer indicates whether or not the tilt bias was removed from the phase data. A value of 1 indicates it was removed; a value of 0 indicates it was not removed.

DataSign This integer indicates the sign of the data. The data sign may be normal (0) or inverted (1).

CodeVType This integer indicates whether the phase data represents a wavefront (0) or a surface (1). This information is used by the CODE V program.

SubtractSysErr This integer indicates whether or not the system error was subtracted from the phase data. A value of 1 indicates that it was subtracted; a value of 0 indicates it was not subtracted.

SysErrFile This 14-character string is a user-entered name of the file containing the system error data.

RefractiveIndex This real number is the index of refraction as specified by the user. Currently, this value is used only in the calculation of corner cube dihedral angles.

PartThickness This real number is the thickness, in meters, of the part measured. Currently, this value is only relevant to the calculation of homogeneity.

ZoomDescr This 7-character string is the value of the image zoom used during data acquisition.

ASCII Data File Intensity Data

Each data point is an integer. The data is written 10 data points per line in row-major order. Acceptable values are from 0 to the value specified in IntensRange. An invalid point is indicated by a value ≥ 65535. A line containing only a sharp character (#) is output after the data. The number of intensity data points is:

*IntensWidth * IntensHeight * NBuckets*

ASCII Data File Connected Phase Data

Each data point is an integer. The data is written 10 data points per line in row-major order. Acceptable values are in the range from -2097152 to +2097151. An invalid point is indicated by a value ≥ 2147483640. A line containing only a sharp character (#) is output after the data. The number of connected phase data points is:

*PhaseWidth * PhaseHeight*

The phase data points are in internal units representing a scaled number of fringes. To convert a value to waves, multiple by (S * O)/R.

Where: S = IntfScaleFactor, O = ObliquityFactor, and R = 4096 for normal PhaseRes or 32768 for high PhaseRes.

ASCII Data File Programming Notes

This section provides notes for persons writing programs to create MetroPro compatible ASCII data files.

- The string fields must be blank-padded to the indicated fixed length.
- If a data set is not present, its concluding line containing a sharp character must still be present.
- Many of the fields in the header can be assigned null values since they are not used in calculations. Null values are zero for numeric fields or blanks for string fields. The following paragraphs indicate which fields must have true values.
- The IntensOriginX, IntensOriginY and PhaseOriginX, PhaseOriginY coordinates must be non-negative.
- The IntensWidth, Height and NBuckets values must correctly indicate the number of points in the intensity data matrix.
- The PhaseWidth, PhaseHeight values must correctly indicate the number of points in the phase data matrix.
- The CameraWidth, CameraHeight fields must describe a camera coordinate system that encloses the intensity and phase data matrices. The maximum values are (512,512).
- In order that phase values be correctly analyzed, the IntfScaleFactor, ObliquityFactor, WavelengthIn, and PhaseRes fields must have true values.

- In order that intensity values be correctly analyzed, the IntensRange field must have a true value.
- If lateral dimensions are to be reported in units other than pixels, the CameraRes field must have a true value.
- In order to obtain correct encircled energy and MTF cutoff frequency results, the NumericAperture field must have a true value.

ASCII Data File Example

Following is an example data file containing tiny 6x6 intensity and phase data matrices. Note that line 5 containing the Comment field is truncated.

```
Zygo ASCII Data File - Format 1                          Header
1 1 6 6 "Thu May 23 15:36:21 EDT 1991 "                  Fields
122 118 6 6 1 1023
122 118 6 6
"
"      "
"      "
0 0.5 6.328e-07 0 1 0 0 671819076
262 235 1 0 5555 0 "Sm Aperture"
0 0 1 1686 3 1 0.1 40 71 50
0 0 20 1 0 0 0 0 0
0 "    "
0 0
0
#                                                        Intensity
404 414 414 423 434 448 422 431 435 442                  Data Matrix
452 459 459 460 456 458 465 470 464 453
449 445 456 474 459 462 457 450 444 457
453 444 440 425 421 430
#                                                        Phase
2530 2566 2606 2649 2698 2751 2693 2731 2773 2812        Data Matrix
2868 2913 2860 2905 2944 2990 3036 3094 3030 3072
3121 3161 3207 3261 3206 3255 3298 3337 3381 3423
3356 3410 3452 3503 3548 3592
#
```

Raw ASCII Data File Format

This section describes the format of a MetroPro Raw ASCII data file. This format contains no header information and bare measurement data in row order of the data matrix. A raw ASCII data file is created by using the dat_to_raw_asc conversion utility.

Composition of a Raw ASCII File

First Line	The total number of data points.
Subsequent Lines	The matrix data is listed as: column number (x), row number (y), and data value (z). These numbers are separated by a space. The number of lines is equal to the number of data points. The data is presented in row-major order. The data value (z) is the connected phase data value from the binary file.
Second Last Line	Minimum value of all data points.
Last Line	Range of the data; the maximum data value minus the minimum data value.

Raw ASCII Data File Example

Following is an example raw ASCII data file. Note that the data entry is truncated.

```
60268                    First line is the number of data points followed by data.
0 0 0.732558             Data: column number, row number, data value.
1 0 0.728682             The number of data lines is equal to number of data
2 0 0.722868             points.
3 0 0.722868
4 0 0.717054
5 0 0.717054
6 0 0.718992
7 0 0.717054
8 0 0.715116
9 0 0.717054
10 0 0.715116
...
...
283 209 0.697674
284 209 0.695736
285 209 0.697674
286 209 0.697674
-4360                    2nd to last line is the minimum data value.
4128                     Last line is the data range.
```