

System/Prescription Data

File : C:\Users\Kops Laptop\Dropbox_KOPS & Prof\Customers_Apple\zemax\HYUN
lens\1_12_2023 Hyun lens model example 1 latest.ZOS
Title:
Date : 1/17/2023

GENERAL LENS DATA:

Surfaces : 15
Stop : 5
System Aperture : Image Space F/# = 1.7916
Fast Semi-Diameters : On
Field Unpolarized : On
Convert thin film phase to ray equivalent : On
J/E Conversion Method : X Axis Reference
Glass Catalogs : SCHOTT
Ray Aiming : Real Reference, Cache On
Automatically Calculate Pupil Shifts : On
X Pupil Shift : 0
Y Pupil Shift : 0
Z Pupil Shift : -0.1715265
X Pupil Compress : 0
Y Pupil Compress : 0
Apodization : Uniform, factor = 0.00000E+00
Reference OPD : Exit Pupil
Paraxial Rays Setting : Ignore Coordinate Breaks
Method to Compute F/# : Tracing Rays
Method to Compute Huygens Integral : Auto
Print Coordinate Breaks : On
Multi-Threading : On
OPD Modulo 2 Pi : Off
Temperature (C) : 2.00000E+01
Pressure (ATM) : 1.00000E+00
Adjust Index Data To Environment : Off
Effective Focal Length : 0.9775276 (in air at system temperature and pressure)
Effective Focal Length : 0.9775276 (in image space)
Back Focal Length : 0.8578879
Total Track : 4.83763
Image Space F/# : 1.7916
Paraxial Working F/# : 1.7916
Working F/# : 1.783306
Image Space NA : 0.2688082
Object Space NA : 2.728086e-11
Stop Radius : 0.3340801
Paraxial Image Height : 3.008521
Paraxial Magnification : 0
Entrance Pupil Diameter : 0.5456171
Entrance Pupil Position : 1.603795
Exit Pupil Diameter : 1.886504
Exit Pupil Position : -3.092358
Field Type : Angle in degrees
Maximum Radial Field : 72
Primary Wavelength [μm] : 0.5875618
Angular Magnification : 0.316116
Lens Units : Millimeters
Source Units : Watts
Analysis Units : Watts/cm^2
Afocal Mode Units : milliradians
MTF Units : cycles/millimeter
Include Calculated Data in Session File : On

Include Calculated Data in Session File : On

Fields : 3

Field Type : Angle in degrees

#	X-Value	Y-Value	Weight
1	0.000000	0.000000	1.000000
2	0.000000	30.000000	1.000000
3	0.000000	72.000000	1.000000

Vignetting Factors

#	VDX	VDY	VCX	VCY	VAN
1	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.000000	0.000000	0.000000	0.000000	0.000000
3	0.000000	0.000000	0.000000	0.000000	0.000000

Wavelengths : 3

Units: μm

#	Value	Weight
1	0.486133	0.500000
2	0.587562	1.000000
3	0.656273	0.500000

Predicted coordinate ABCD matrix:

A = 0.9775
 B = 0
 C = 0
 D = 0.9775

SURFACE DATA SUMMARY:

Surf	Type	Radius	Thickness	Glass
	Clear Diam	Chip Zone	Mech Diam	Conic
OBJ	STANDARD	Infinity	Infinity	
	0		0	0
1	STANDARD	2	1	
	3.385711	0	3.385711	0
2	EVENASPH	6.94734	0.22838	1.487490, 70.410000
	2.28543	0	2.28543	-1200.263
3	EVENASPH	0.6574	0.42632	
	1.2	0	1.2	-0.3598882
4	EVENASPH	1.0211	0.30019	1.755200, 27.580000
	0.9791447	0	0.9791447	1.493089
STO	EVENASPH	0.75068	0.1804	
	0.8	0	0.9791447	1.481931
6	STANDARD	3.04316	0.68443	1.665450, 52.890000
	1.6	0	1.6	0
7	STANDARD	-0.85763	0.001	
	1.6	0	1.6	0
8	STANDARD	-0.858	0.021	
	1.2	0	1.2	0
9	STANDARD	2.18749	0.69376	1.620410, 44.460000
	1.46	0	1.46	0

10	STANDARD	1.44	-0.76481	0	0.22217	1.755200, 27.580000	1.46	0
11	STANDARD	1.8	-6.64485	0	0.08887		1.8	0
12	STANDARD	2	Infinity	0	0.1333	1.487490, 70.410000	2	0
13	STANDARD	2	Infinity	0	0		2	0
14	STANDARD	2	Infinity	0	0.85781		2	0
IMA	STANDARD	2.1	Infinity	0			2.1	0

SURFACE DATA DETAIL:

Surface OBJ STANDARD

Surface 1 STANDARD

Surface 2 EVENASPH

Coefficient on r^ 2	:	0
Coefficient on r^ 4	:	0.075979305
Coefficient on r^ 6	:	0.012516287
Coefficient on r^ 8	:	-0.045842287
Coefficient on r^10	:	0.016303652
Coefficient on r^12	:	0
Coefficient on r^14	:	0
Coefficient on r^16	:	0

Surface 3 EVENASPH

Coefficient on r^ 2	:	0
Coefficient on r^ 4	:	-0.25331387
Coefficient on r^ 6	:	1.6487496
Coefficient on r^ 8	:	-1.9974263
Coefficient on r^10	:	6.0970908
Coefficient on r^12	:	0
Coefficient on r^14	:	0
Coefficient on r^16	:	0
Aperture	:	Floating Aperture
Maximum Radius	:	0.6

Surface 4 EVENASPH

Coefficient on r^ 2	:	0
Coefficient on r^ 4	:	-0.95494178
Coefficient on r^ 6	:	-0.10616202
Coefficient on r^ 8	:	-5.6434513
Coefficient on r^10	:	1.6293293
Coefficient on r^12	:	0
Coefficient on r^14	:	0
Coefficient on r^16	:	0
Aperture	:	Floating Aperture
Maximum Radius	:	0.48957236

Surface STO EVENASPH

Coefficient on r^ 2	:	0
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Coefficient on r^4 : -1.016
 Coefficient on r^6 : -2.9743694
 Coefficient on r^8 : 9.1889459
 Coefficient on r^{10} : -76.233573
 Coefficient on r^{12} : 0
 Coefficient on r^{14} : 0
 Coefficient on r^{16} : 0
 Aperture : Floating Aperture
 Maximum Radius : 0.4

Surface 6 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 0.8

Surface 7 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 0.8

Surface 8 STANDARD
 Aperture : Circular Aperture
 Minimum Radius : 0
 Maximum Radius : 0.6

Surface 9 STANDARD
 Aperture : Circular Aperture
 Minimum Radius : 0
 Maximum Radius : 0.73

Surface 10 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 0.72

Surface 11 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 0.9

Surface 12 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 1

Surface 13 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 1

Surface 14 STANDARD
 Aperture : Floating Aperture
 Maximum Radius : 1

Surface IMA STANDARD

EDGE THICKNESS DATA:

Surf	Edge
1	0.178752
2	0.487384
3	0.121886
4	0.329808
STO	0.189505
6	0.028842
7	0.304874
8	0.391079
9	0.061492
10	0.667806

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11      0.150102
12      0.133300
13      0.000000
14      0.857810
IMA     0.000000

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SOLVE AND VARIABLE DATA:

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Semi Diameter   3      : Fixed
Mech Semi Diameter  3 : Fixed
Semi Diameter   5      : Fixed
Semi Diameter   6      : Fixed
Semi Diameter   7      : Fixed
Semi Diameter   8      : Fixed
Semi Diameter   9      : Fixed
Mech Semi Diameter  9 : Fixed
Glass of 10      : Pickup from 4
Semi Diameter  10      : Fixed
Mech Semi Diameter 10 : Fixed
Semi Diameter  11      : Fixed
Mech Semi Diameter 11 : Fixed
Glass of 12      : Pickup from 2
Semi Diameter  12      : Fixed
Mech Semi Diameter 12 : Fixed
Semi Diameter  13      : Fixed
Semi Diameter  14      : Fixed
Mech Semi Diameter 14 : Fixed
Semi Diameter  15      : Fixed

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INDEX OF REFRACTION DATA:

System Temperature: 20.0000 Celsius
 System Pressure : 1.0000 Atmospheres
 Absolute air index: 1.000272 at wavelength 0.587562 μm
 Index data is relative to air at the system temperature and pressure.
 Wavelengths are measured in air at the system temperature and pressure.

Surf	Glass	Temp	Pres	0.48613270
0.58756180	0.65627250			
0		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
1		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
2	<MODEL>	20.00	1.00	1.4922634386
1.4874913905	1.4853425856			
3		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
4	<MODEL>	20.00	1.00	1.7746587158
1.7552052916	1.7472878376			
5		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
6	<MODEL>	20.00	1.00	1.6742335021
1.6654524878	1.6616567889			
7		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
8		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
9	<MODEL>	20.00	1.00	1.6302099070
1.6204127384	1.6162612242			
10	<MODEL>	20.00	1.00	1.7746587158
1.7552052916	1.7472878376			
11		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			

12	<MODEL>	20.00	1.00	1.4922634386
1.4874913905	1.4853425856			
13		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
14		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			
15		20.00	1.00	1.0000000000
1.0000000000	1.0000000000			

THERMAL COEFFICIENT OF EXPANSION DATA:

Surf	Glass	TCE * 10E-6
0		0.0000000000
1		0.0000000000
2	<MODEL>	0.0000000000
3		0.0000000000
4	<MODEL>	0.0000000000
5		0.0000000000
6	<MODEL>	0.0000000000
7		0.0000000000
8		0.0000000000
9	<MODEL>	0.0000000000
10	<MODEL>	0.0000000000
11		0.0000000000
12	<MODEL>	0.0000000000
13		0.0000000000
14		0.0000000000
15		0.0000000000

GLOBAL VERTEX COORDINATES, ORIENTATIONS, AND ROTATION/OFFSET MATRICES:

Reference Surface: 11

Surf	R11	R12	R13
X	Tilt X		
	R21	R22	R23
Y	Tilt Y		
	R31	R32	R33
Z	Tilt Z		
1	1.0000000000 0.0000000000E+00 0.0000000000 0.0000000000E+00 0.0000000000 0.0000000000E+00	0.0000000000 1.0000000000 0.0000000000 0.0000000000	0.0000000000 0.0000000000 1.0000000000 -3.757650000E+00
2	1.0000000000 0.0000000000E+00 0.0000000000 0.0000000000E+00 0.0000000000 0.0000000000E+00	0.0000000000 1.0000000000 0.0000000000 0.0000000000	0.0000000000E+00 0.0000000000 1.0000000000 -2.757650000E+00
3	1.0000000000 0.0000000000E+00 0.0000000000 0.0000000000E+00 0.0000000000 0.0000000000E+00	0.0000000000 1.0000000000 0.0000000000 0.0000000000	0.0000000000E+00 0.0000000000 1.0000000000 -2.529270000E+00
4	1.0000000000 0.0000000000E+00	0.0000000000	0.0000000000 0.0000000000E+00

[illegible]

	0.0000000000	1.0000000000	0.0000000000	0.000000000E+00
	0.000000000E+00			
	0.0000000000	0.0000000000	1.0000000000	2.221700000E-01
	0.000000000E+00			
14	1.0000000000	0.0000000000	0.0000000000	0.000000000E+00
	0.000000000E+00			
	0.0000000000	1.0000000000	0.0000000000	0.000000000E+00
	0.000000000E+00			
	0.0000000000	0.0000000000	1.0000000000	2.221700000E-01
	0.000000000E+00			
15	1.0000000000	0.0000000000	0.0000000000	0.000000000E+00
	0.000000000E+00			
	0.0000000000	1.0000000000	0.0000000000	0.000000000E+00
	0.000000000E+00			
	0.0000000000	0.0000000000	1.0000000000	1.079980000E+00
	0.000000000E+00			

GLOBAL SURFACE CENTER OF CURVATURE POINTS:

Reference Surface: 11

Surf	X	Y	Z
1	0.0000000000	0.0000000000	-1.7576500000
2	0.0000000000	0.0000000000	4.1896900000
3	0.0000000000	0.0000000000	-1.8718700000
4	0.0000000000	0.0000000000	-1.0818500000
5	0.0000000000	0.0000000000	-1.0520800000
6	0.0000000000	0.0000000000	1.4208000000
7	0.0000000000	0.0000000000	-1.7955600000
8	0.0000000000	0.0000000000	-1.7949300000
9	0.0000000000	0.0000000000	1.2715600000
10	0.0000000000	0.0000000000	-0.9869800000
11	0.0000000000	0.0000000000	-6.6448500000
12	-	-	-
13	-	-	-
14	-	-	-
15	-	-	-

ELEMENT VOLUME DATA:

For centered elements with plane or spherical circular faces, exact volumes are computed by assuming edges are squared up to the larger of the front and back radial aperture.

For all other elements, approximate volumes are numerically integrated to 0.1% accuracy. Zero volume means the volume cannot be accurately computed.

Single elements that are duplicated in the Lens Data Editor for ray tracing purposes may be listed more than once yielding incorrect total mass estimates.

Element surf	Volume cc	Density g/cc	Mass g
2 to 3	0.000909	0.000000	0.000000
4 to 5	0.000218	0.000000	0.000000
6 to 7	0.000804	0.000000	0.000000
9 to 10	0.000690	0.000000	0.000000
10 to 11	0.001296	0.000000	0.000000
12 to 13	0.000419	0.000000	0.000000
Total Mass:			0.000000

F/# DATA:

F/# calculations consider vignetting factors and ignore surface apertures.

Wavelength:		0.486133	0.587562			
0.656273						
#	Tan	Field Sag	Tan	Sag	Tan	Sag
1		0.00 (deg):	1.7701	1.7701	1.7833	1.7833
	1.7903	1.7903				
2		30.00 (deg):	1.4779	1.7692	1.5578	1.7834
	1.5880	1.7909				
3		72.00 (deg):	1.1689	1.2605	1.1774	1.3692
	1.1818	1.4122				

CARDINAL POINTS:

Object space positions are measured with respect to surface 1.
Image space positions are measured with respect to the image surface.
The index in both the object space and image space is considered.

		Object Space	Image Space
W =	0.486133		
Focal Length	:	-0.968641	0.968641
Focal Planes	:	1.294950	-0.011310
Principal Planes	:	2.263591	-0.979951
Anti-Principal Planes	:	0.326309	0.957330
Nodal Planes	:	2.263591	-0.979951
Anti-Nodal Planes	:	0.326309	0.957330
W =	0.587562 (Primary)		
Focal Length	:	-0.977528	0.977528
Focal Planes	:	1.294783	0.000078
Principal Planes	:	2.272311	-0.977450
Anti-Principal Planes	:	0.317255	0.977606
Nodal Planes	:	2.272311	-0.977450
Anti-Nodal Planes	:	0.317255	0.977606
W =	0.656273		
Focal Length	:	-0.981963	0.981963
Focal Planes	:	1.294276	0.005647
Principal Planes	:	2.276239	-0.976316
Anti-Principal Planes	:	0.312313	0.987610
Nodal Planes	:	2.276239	-0.976316
Anti-Nodal Planes	:	0.312313	0.987610

PHYSICAL OPTICS PROPAGATION SETTINGS SUMMARY:

OBJ STANDARD

Use Rays To Propagate To Next Surface	: Off
Recompute Pilot Beam	: Off
Do Not Rescale Beam Size Using Ray Data	: Off
Use Angular Spectrum Propagator	: Off
Use X-Axis Reference	: Off
Output Pilot Radius	: Best Fit

1 STANDARD

Use Rays To Propagate To Next Surface	: Off
Recompute Pilot Beam	: Off
Do Not Rescale Beam Size Using Ray Data	: Off
Use Angular Spectrum Propagator	: Off
Use X-Axis Reference	: Off
Output Pilot Radius	: Best Fit

2 EVENASPH

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Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  3 EVENASPH
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  4 EVENASPH
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  STO EVENASPH
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  6 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  7 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  8 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  9 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
 10 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
 11 STANDARD

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Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  12 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  13 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  14 STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit
  IMA STANDARD
Use Rays To Propagate To Next Surface : Off
Recompute Pilot Beam                  : Off
Do Not Rescale Beam Size Using Ray Data: Off
Use Angular Spectrum Propagator       : Off
Use X-Axis Reference                   : Off
Output Pilot Radius                    : Best Fit

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FILES USED:

Zemax File

```
C:\Users\Kops Laptop\Dropbox\_KOPS & Prof\Customers\_Apple\zemax\HYUN
lens\1_12_2023 Hyun lens model example 1 latest.ZOS
```

Session File

```
C:\Users\Kops Laptop\Dropbox\_KOPS & Prof\Customers\_Apple\zemax\HYUN
lens\1_12_2023 Hyun lens model example 1 latest.ZDA
```

Glass Catalogs

```
C:\Users\Kops Laptop\Dropbox\_KOPS & Prof\ZEMAX
_Kessler_Zemax_presentations_zbase\ZEMAX\Glasscat\SCHOTT.AGF
```

Coating Data

```
C:\Users\Kops Laptop\Dropbox\_KOPS & Prof\ZEMAX
_Kessler_Zemax_presentations_zbase\ZEMAX\COATINGS\COATING.DAT
```

ABg Data

```
C:\Users\Kops Laptop\Documents\Zemax\ABG_DATA\ABG_DATA.DAT
```