

2 Mirror Telescope

1000 mm F/0.9 - Field of view $3.85^{\circ} \times 3.85^{\circ}$

Design with aspheric corrector

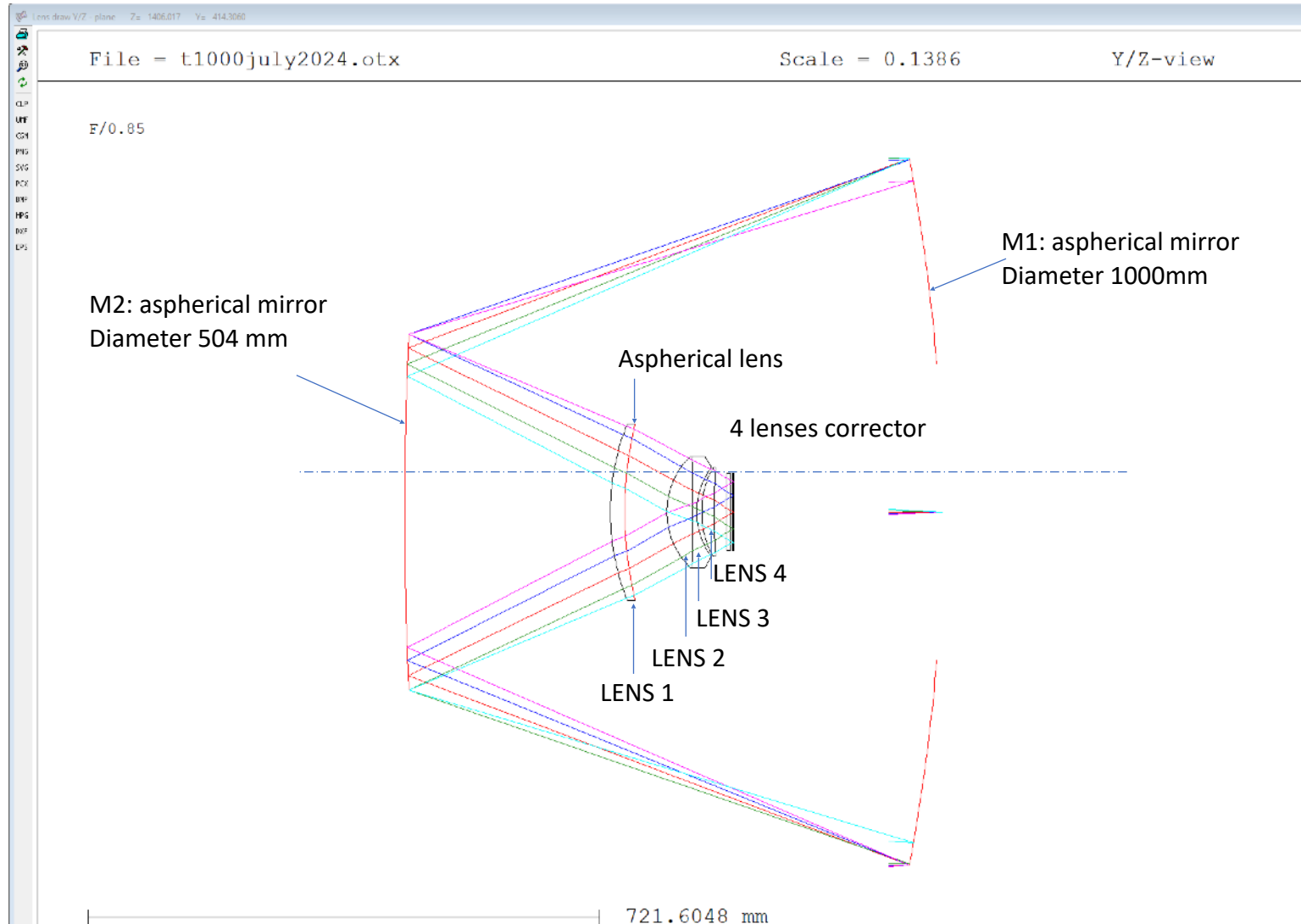
V1: 15/09/2023 - First release

V2: 31/05/2024 - Complete design 4 solutions

V3: 21/07/2024 - Complete design with 1 aspheric for the corrector lens

• • Specifications

- Telescope diameter : 1000 mm
- Secondary mirror diameter : 504 mm
- Wavelength range : 400 – 900 nm
- Focal length : 900 mm
- F/N : 0.9
- Field of view : $3.85^\circ \times 3.85^\circ$
- Corrector : 4 lenses in 3 groups (1 aspheric)
- Distance M1-M2 : 759 mm
- Obstruction : 25.4 to 29 % depending on field position



Optical surfaces

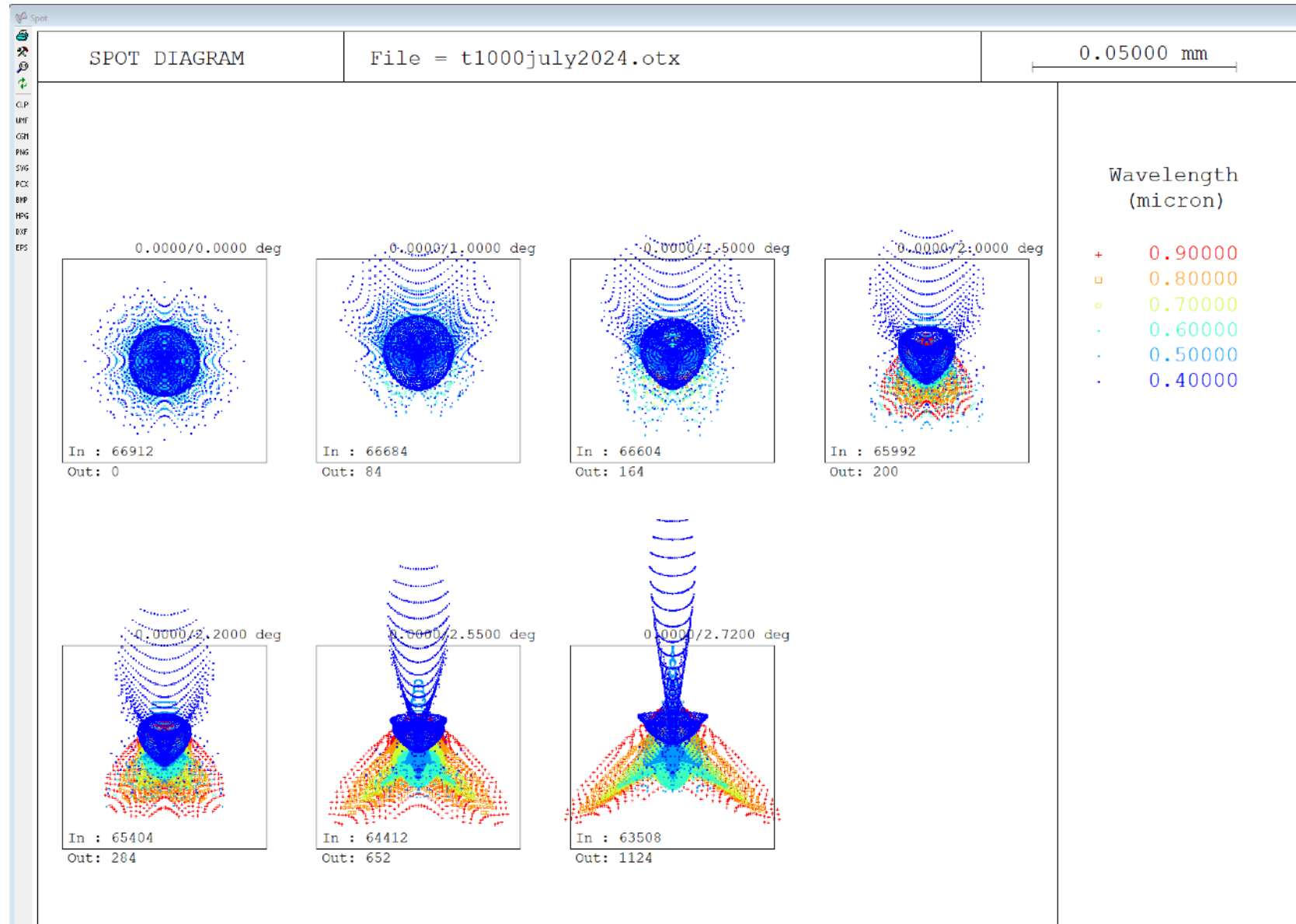
Surface Editor: C:\Optic2024\ALDORIA-TEL-1m\1000july2024.otx

Standard Data		Decenter, Tilts	Asphere	GRIN	Solves	Special Apertures	Hologram	Misc.	Array		
	TYPE	Radius		Distance		GLASS	APE-Y	*	Shape	Glb	THR
OBJ	S	0.00000000		0.1000000E+21		AIR	0.000	0	circular	0	0.00000
STO	S	0.00000000		0.0000000		AIR	500.000	1	circular	0	0.00000
2	AM	-2600.00000		-759.0000		AIR	500.000	1	circular	0	0.00000
3	AM	7344.07923	v	290.0000		AIR	252.000	1	circular	0	0.00000
4	S	337.464679	v	20.00000		N-BK7	125.000	1	circular	0	0.00000
5	A	491.177506	v	59.71191	v	AIR	125.000	1	circular	0	0.00000
6	S	110.935846	v	36.09631	v	S-FPL53	79.000	1	circular	0	0.00000
7	S	-7754.58783	v	6.000000		S-LAL18	79.000	1	circular	0	0.00000
8	S	107.797543	v	7.000000		AIR	63.000	1	circular	0	0.00000
9	S	131.623690	v	17.54948	v	S-FPL53	63.000	1	circular	0	0.00000
10	S	921.609685	v	17.90768	v	AIR	63.000	1	circular	0	0.00000
11	S	0.00000000		5.000000		N-BK7	55.000	1	circular	0	0.00000
12	S	0.00000000		3.182623		AIR	55.000	1	circular	0	0.00000
13	S	0.00000000		1.000000		N-BK7	55.000	1	circular	0	0.00000
14	S	0.00000000		0.9000000		AIR	55.000	0	circular	0	0.00000
IMG	S	0.00000000		-0.2228309E-02		AIR	55.000	1	circular	0	0.00000

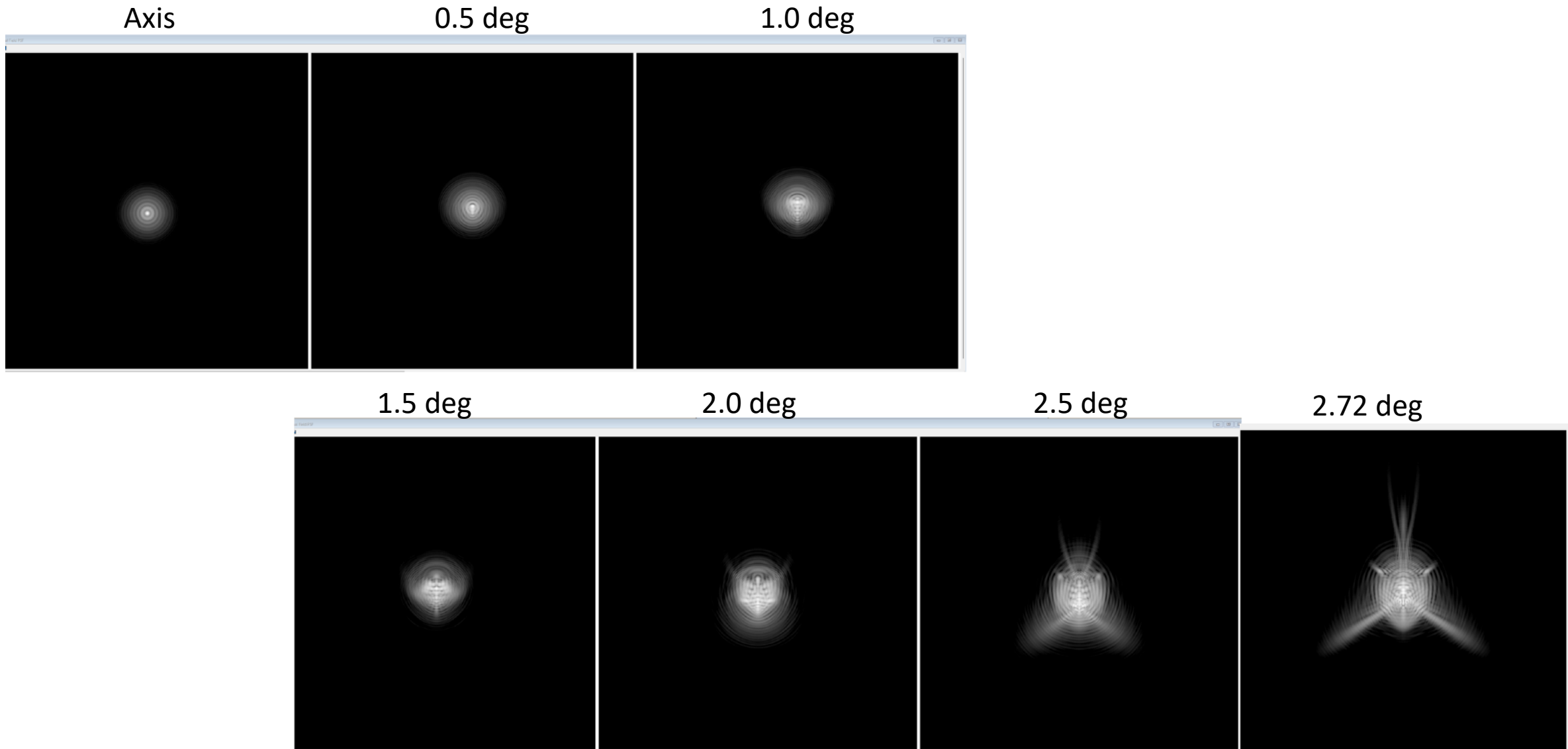
Surface Editor: C:\Optic2024\ALDORIA-TEL-1m\1000july2024.otx

Standard Data		Decenter, Tilts	Asphere	GRIN	Solves	Special Apertures	Hologram	Misc.	Array		
	Asph. Type	Pik	K (Conic Const.)		A (h^4)		B (h^6)		C (h^8)		D (h^10)
OBJ	S	even, 18th ord		0.0000000	0.0000000		0.0000000		0.0000000		0.0000000
STO	S	even, 18th ord		0.0000000	0.0000000		0.0000000		0.0000000		0.0000000
2	AM	even, 18th ord		0.0000000	0.22754960E-10	v	0.62269807E-17	v	0.29413765E-23	v	0.0000000
3	AM	even, 18th ord		0.0000000	0.40561591E-09	v	-0.14750363E-14	v	0.34550638E-20	v	0.0000000
4	S	even, 18th ord		0.0000000	0.0000000		0.0000000		0.0000000		0.0000000
5	A	even, 18th ord		0.0000000	-0.30000000E-08		-0.18855730E-12	v	0.21540667E-17	v	0.0000000

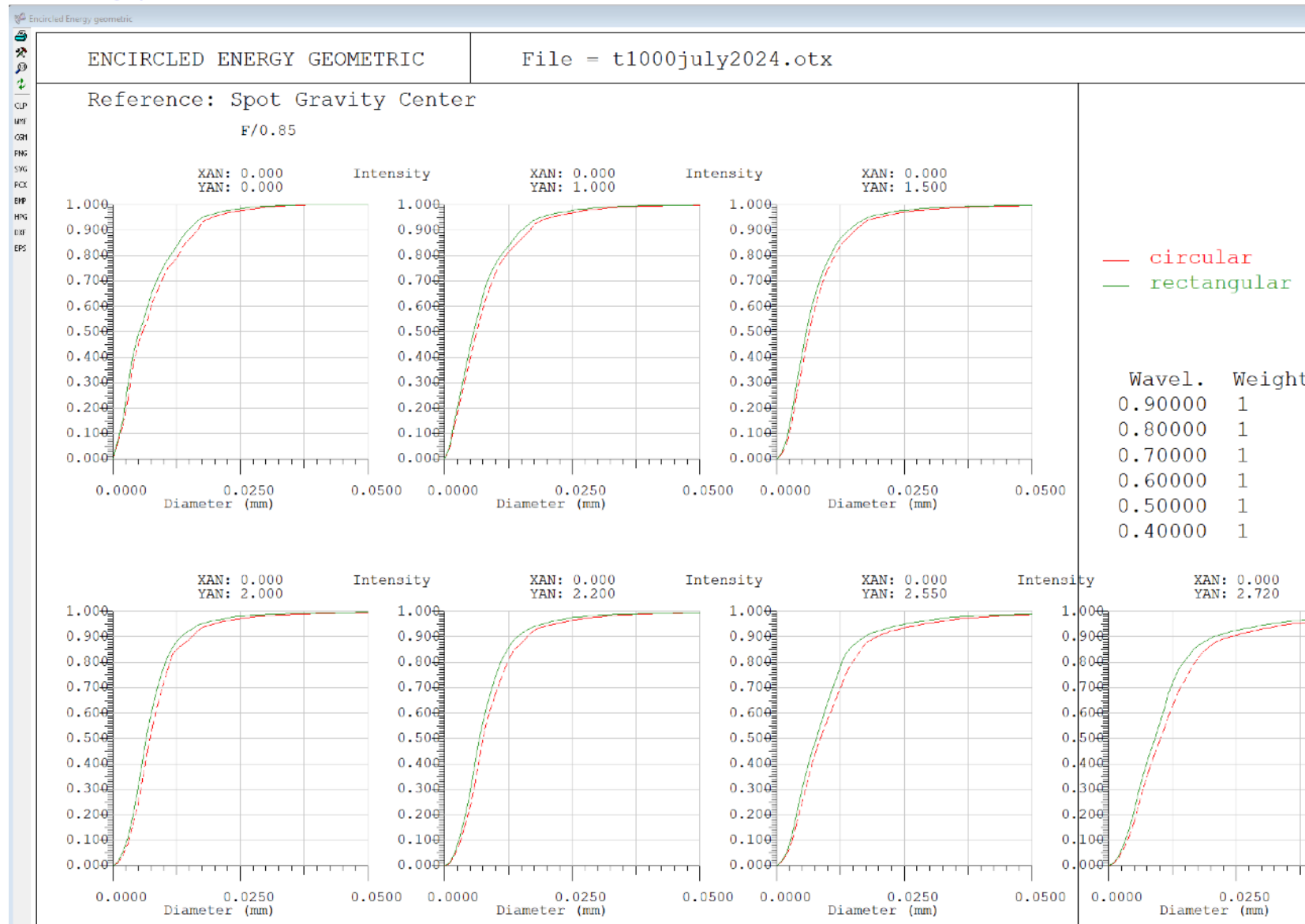
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Spot diagrams



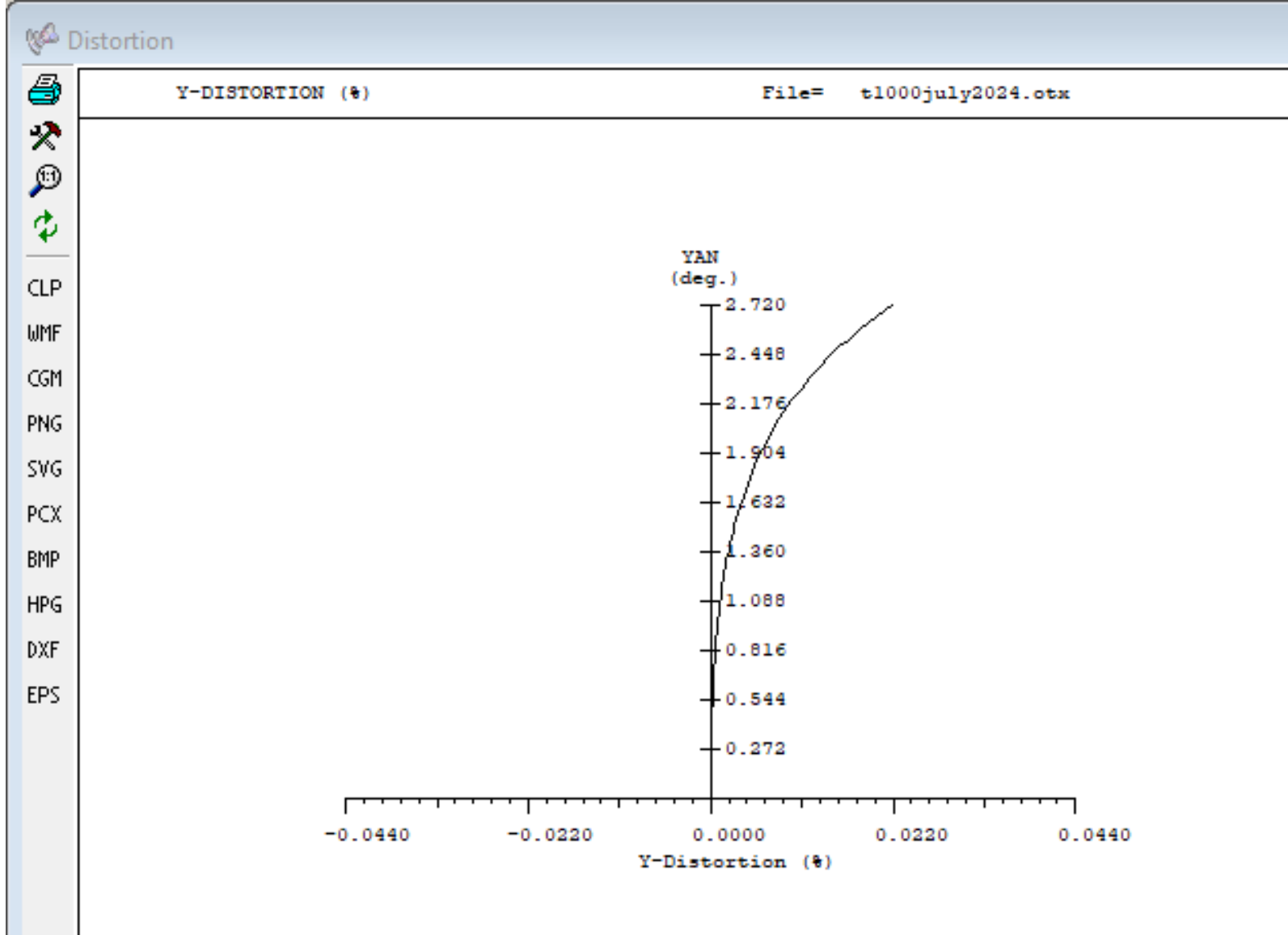
Spot diagrams



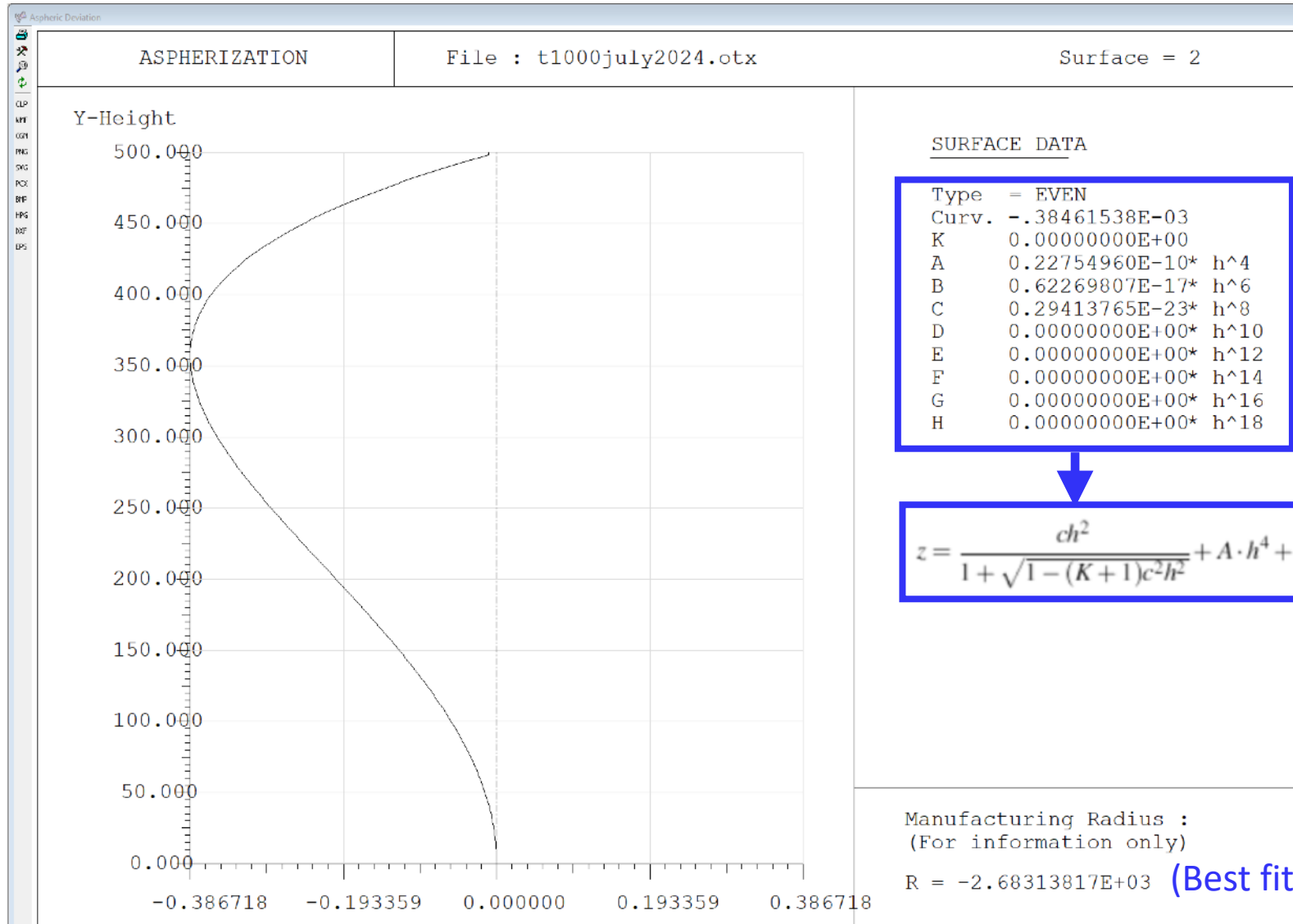
Encircled energy



Distorsion

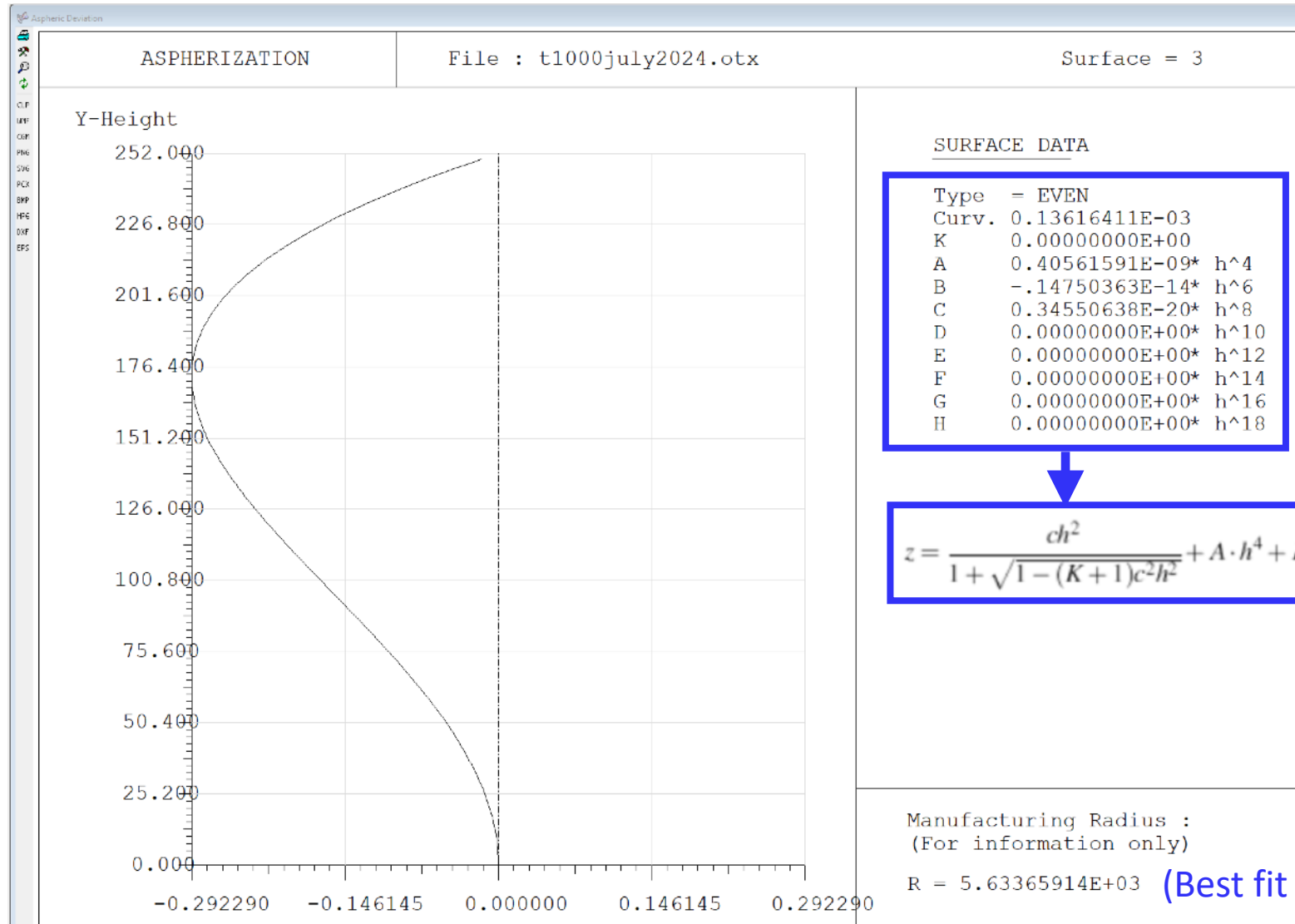


Aspheric parameters - M1-1000mm



Radial height (mm)	Z-Sphere (mm)	Z-Asphere (mm)	Difference (mm)	Slope (micron/mm)	Surface Normal		
					CXN	CYN	CZN
0.00000	0.000000	0.000000	0.000000	-0.000	0.000000	0.000000	1.000000
10.00000	-0.018635	-0.019231	-0.000596	-0.119	0.000000	0.003846	0.999993
20.00000	-0.074541	-0.076921	-0.002380	-0.238	0.000000	0.007692	0.999970
30.00000	-0.167719	-0.173064	-0.005345	-0.355	0.000000	0.011536	0.999933
40.00000	-0.298175	-0.307652	-0.009477	-0.471	0.000000	0.015379	0.999882
50.00000	-0.465913	-0.480671	-0.014759	-0.585	0.000000	0.019219	0.999815
60.00000	-0.670940	-0.692105	-0.021165	-0.696	0.000000	0.023057	0.999734
70.00000	-0.913265	-0.941931	-0.028666	-0.804	0.000000	0.026892	0.999638
80.00000	-1.192899	-1.230127	-0.037228	-0.908	0.000000	0.030723	0.999528
90.00000	-1.509851	-1.556663	-0.046812	-1.008	0.000000	0.034549	0.999403
100.00000	-1.864137	-1.921507	-0.057370	-1.103	0.000000	0.038370	0.999264
110.00000	-2.255771	-2.324623	-0.068852	-1.193	0.000000	0.042186	0.999110
120.00000	-2.684768	-2.765970	-0.081202	-1.277	0.000000	0.045996	0.998942
130.00000	-3.151148	-3.245504	-0.094357	-1.354	0.000000	0.049799	0.998759
140.00000	-3.654929	-3.763178	-0.108249	-1.424	0.000000	0.053595	0.998563
150.00000	-4.196133	-4.318938	-0.122805	-1.486	0.000000	0.057384	0.998352
160.00000	-4.774782	-4.912728	-0.137946	-1.541	0.000000	0.061164	0.998128
170.00000	-5.390901	-5.544488	-0.153587	-1.586	0.000000	0.064935	0.997890
180.00000	-6.044515	-6.214151	-0.169636	-1.622	0.000000	0.068697	0.997638
190.00000	-6.735652	-6.921648	-0.185997	-1.648	0.000000	0.072448	0.997372
200.00000	-7.464341	-7.666907	-0.202566	-1.664	0.000000	0.076189	0.997093
210.00000	-8.230613	-8.449847	-0.219234	-1.668	0.000000	0.079919	0.996801
220.00000	-9.034500	-9.270385	-0.235886	-1.660	0.000000	0.083637	0.996496
230.00000	-9.876036	-10.128435	-0.252399	-1.640	0.000000	0.087342	0.996178
240.00000	-10.755256	-11.023902	-0.268646	-1.607	0.000000	0.091035	0.995848
250.00000	-11.672198	-11.956689	-0.284491	-1.560	0.000000	0.094714	0.995505
260.00000	-12.626901	-12.926694	-0.299793	-1.498	0.000000	0.098378	0.995149
270.00000	-13.619405	-13.933807	-0.314403	-1.421	0.000000	0.102028	0.994782
280.00000	-14.649752	-14.977916	-0.328164	-1.328	0.000000	0.105662	0.994402
290.00000	-15.717986	-16.058901	-0.340916	-1.219	0.000000	0.109280	0.994011
300.00000	-16.824153	-17.176638	-0.352486	-1.092	0.000000	0.112881	0.993609
310.00000	-17.968299	-18.330997	-0.362697	-0.947	0.000000	0.116464	0.993195
320.00000	-19.150475	-19.521840	-0.371365	-0.783	0.000000	0.120030	0.992770
330.00000	-20.370730	-20.749025	-0.378295	-0.599	0.000000	0.123576	0.992335
340.00000	-21.629117	-22.012403	-0.383286	-0.395	0.000000	0.127103	0.991890
350.00000	-22.925690	-23.311819	-0.386129	-0.169	0.000000	0.130610	0.991434
360.00000	-24.260505	-24.647109	-0.386605	0.079	0.000000	0.134095	0.990968
370.00000	-25.633619	-26.018105	-0.384487	0.350	0.000000	0.137559	0.990494
380.00000	-27.045092	-27.424631	-0.379539	0.645	0.000000	0.141000	0.990010
390.00000	-28.494985	-28.866501	-0.371516	0.965	0.000000	0.144418	0.989517
400.00000	-29.983361	-30.343524	-0.360163	1.311	0.000000	0.147812	0.989016
410.00000	-31.510285	-31.855500	-0.345215	1.685	0.000000	0.151181	0.988506
420.00000	-33.075824	-33.402222	-0.326398	2.086	0.000000	0.154524	0.987989
430.00000	-34.680045	-34.983472	-0.303427	2.516	0.000000	0.157840	0.987465
440.00000	-36.323020	-36.599025	-0.276005	2.976	0.000000	0.161129	0.986933
450.00000	-38.004820	-38.248646	-0.243826	3.468	0.000000	0.164390	0.986395
460.00000	-39.725520	-39.932090	-0.206570	3.992	0.000000	0.167622	0.985851
470.00000	-41.485195	-41.649104	-0.163909	4.549	0.000000	0.170823	0.985302
480.00000	-43.283924	-43.399423	-0.115499	5.142	0.000000	0.173993	0.984747
490.00000	-45.121787	-45.182772	-0.060985	5.770	0.000000	0.177131	0.984187
500.00000	-46.998864	-46.998864	-0.000000	6.436	0.000000	0.180236	0.983623

Aspheric parameters - M2-504mm

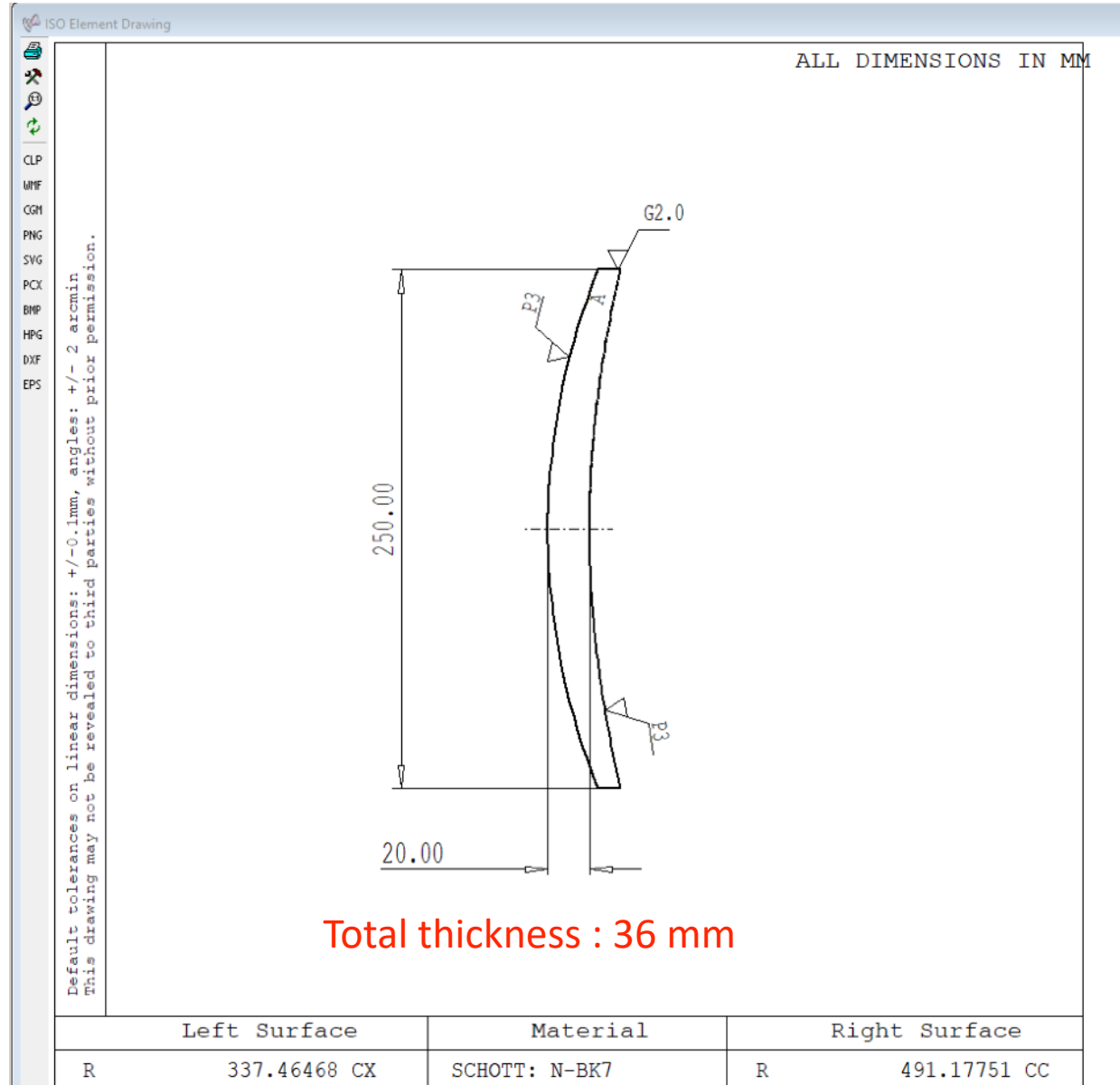


SAG - M2

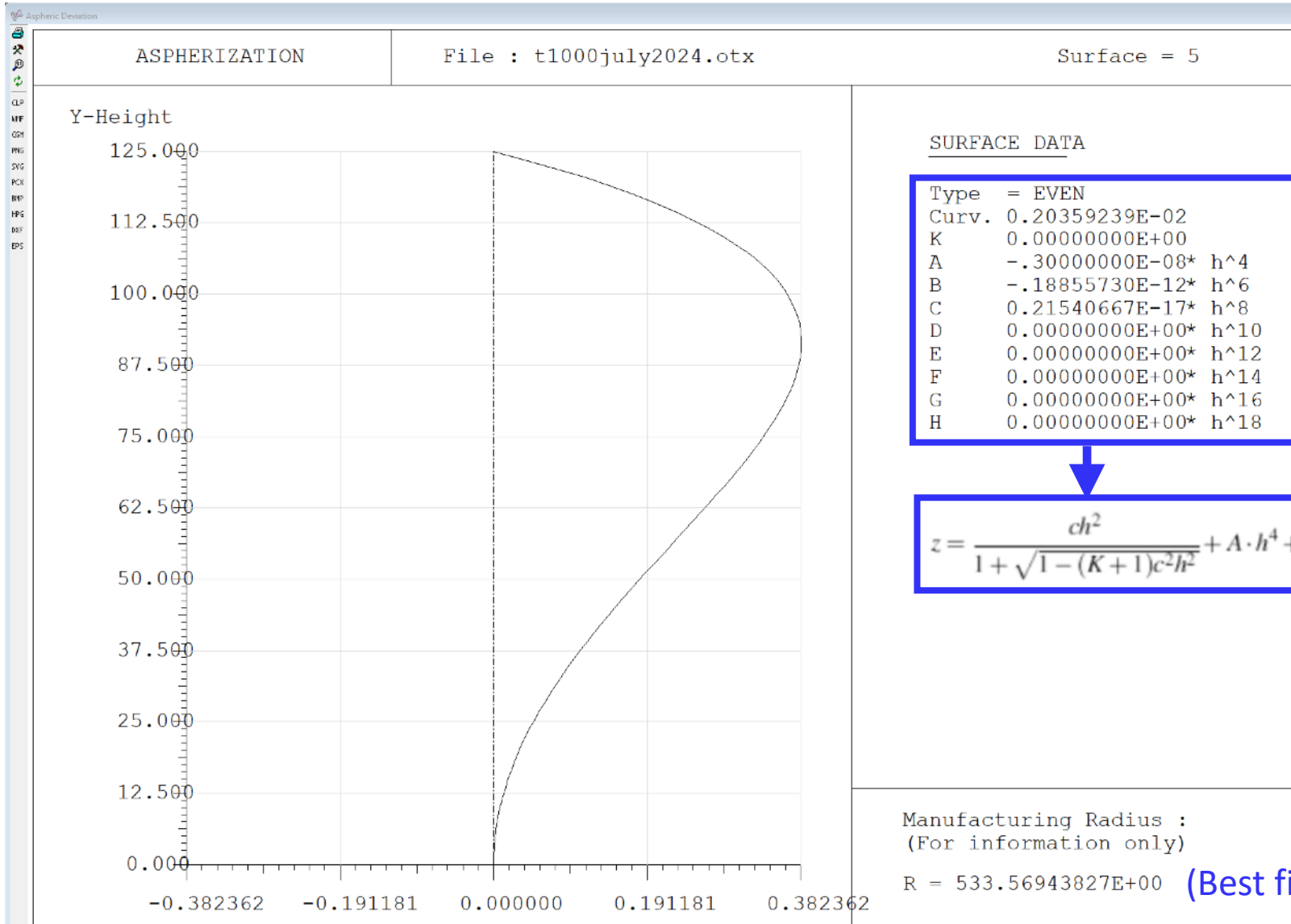
Aspherization is determined for zero deviation from sphere at center and rim. Radius = 5633.659

Radial height (mm)	Z-Sphere (mm)	Z-Asphere (mm)	Difference (mm)	Slope (micron/mm)	----- Surface Normal CXN	CYN	----- CZN
0.00000	0.000000	0.000000	0.000000	-0.001	0.000000	0.000000	1.000000
10.00000	0.008875	0.006812	-0.002063	-0.412	0.000000	-0.001363	0.999999
20.00000	0.035501	0.027298	-0.008203	-0.814	0.000000	-0.002736	0.999996
30.00000	0.079878	0.061602	-0.018276	-1.197	0.000000	-0.004129	0.999991
40.00000	0.142005	0.109964	-0.032041	-1.551	0.000000	-0.005549	0.999985
50.00000	0.221885	0.172719	-0.049166	-1.868	0.000000	-0.007008	0.999975
60.00000	0.319517	0.250288	-0.069229	-2.137	0.000000	-0.008513	0.999964
70.00000	0.434903	0.343177	-0.091726	-2.353	0.000000	-0.010073	0.999949
80.00000	0.568043	0.451971	-0.116072	-2.506	0.000000	-0.011695	0.999932
90.00000	0.718939	0.577329	-0.141610	-2.590	0.000000	-0.013386	0.999910
100.00000	0.887593	0.719973	-0.167619	-2.599	0.000000	-0.015153	0.999885
110.00000	1.074005	0.880686	-0.193319	-2.527	0.000000	-0.017000	0.999855
120.00000	1.278178	1.060300	-0.217878	-2.370	0.000000	-0.018932	0.999821
130.00000	1.500113	1.259687	-0.240426	-2.124	0.000000	-0.020953	0.999780
140.00000	1.739813	1.479754	-0.260059	-1.786	0.000000	-0.023065	0.999734
150.00000	1.997280	1.721433	-0.275847	-1.355	0.000000	-0.025272	0.999681
160.00000	2.272516	1.985669	-0.286847	-0.828	0.000000	-0.027573	0.999620
170.00000	2.565525	2.273416	-0.292109	-0.207	0.000000	-0.029969	0.999551
180.00000	2.876308	2.585627	-0.290680	0.510	0.000000	-0.032459	0.999473
190.00000	3.204868	2.923250	-0.281618	1.320	0.000000	-0.035042	0.999386
200.00000	3.551210	3.287215	-0.263994	2.222	0.000000	-0.037718	0.999288
210.00000	3.915335	3.678438	-0.236897	3.215	0.000000	-0.040482	0.999180
220.00000	4.297248	4.097811	-0.199437	4.295	0.000000	-0.043333	0.999061
230.00000	4.696953	4.546202	-0.150750	5.460	0.000000	-0.046269	0.998929
240.00000	5.114452	5.024458	-0.089994	6.708	0.000000	-0.049286	0.998785
250.00000	5.549750	5.533403	-0.016347	8.038	0.000000	-0.052384	0.998627

• •
 Lens 1
 Aspherical



Aspheric parameters - Lens 1

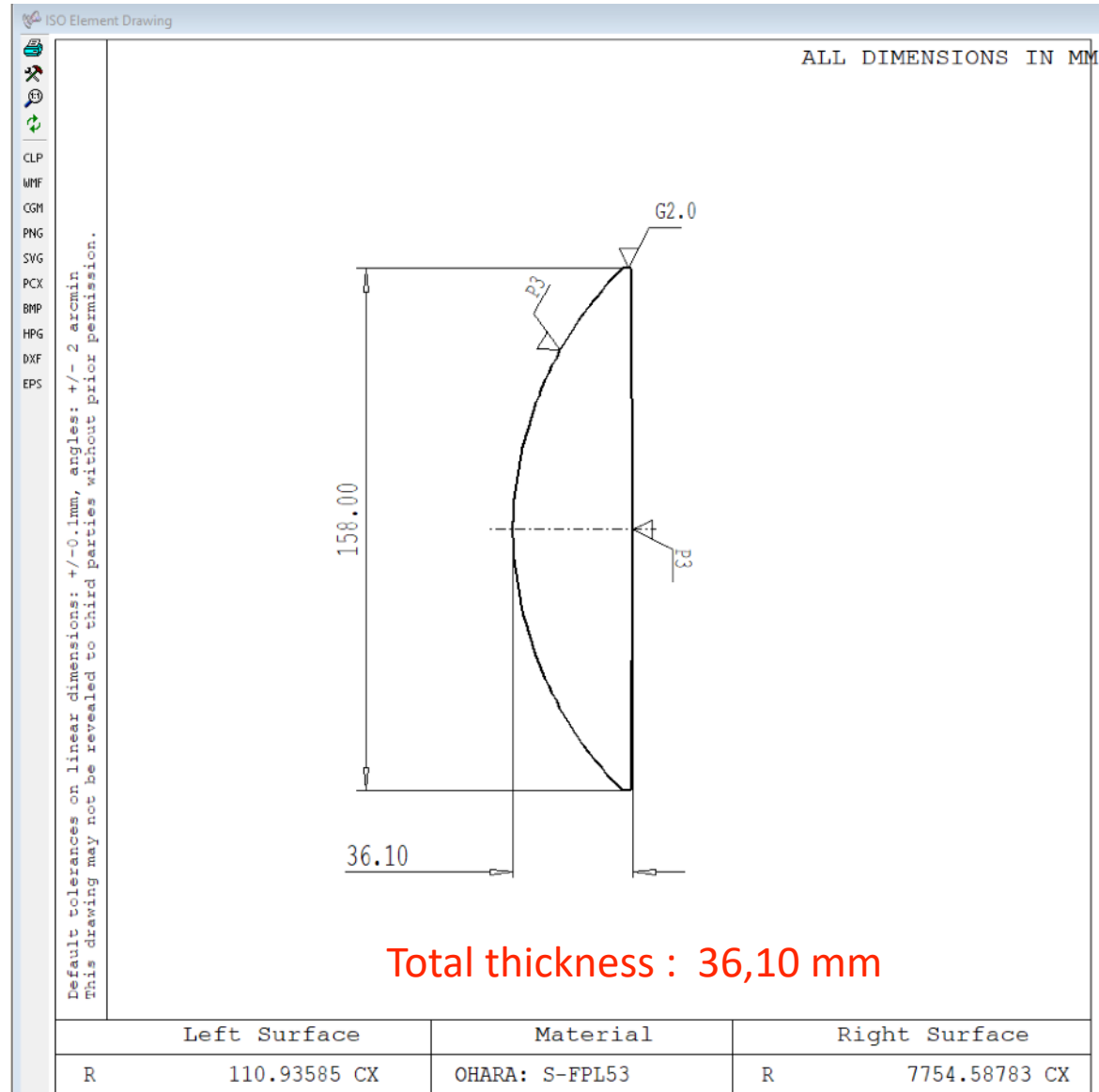


SAG - Lens 1

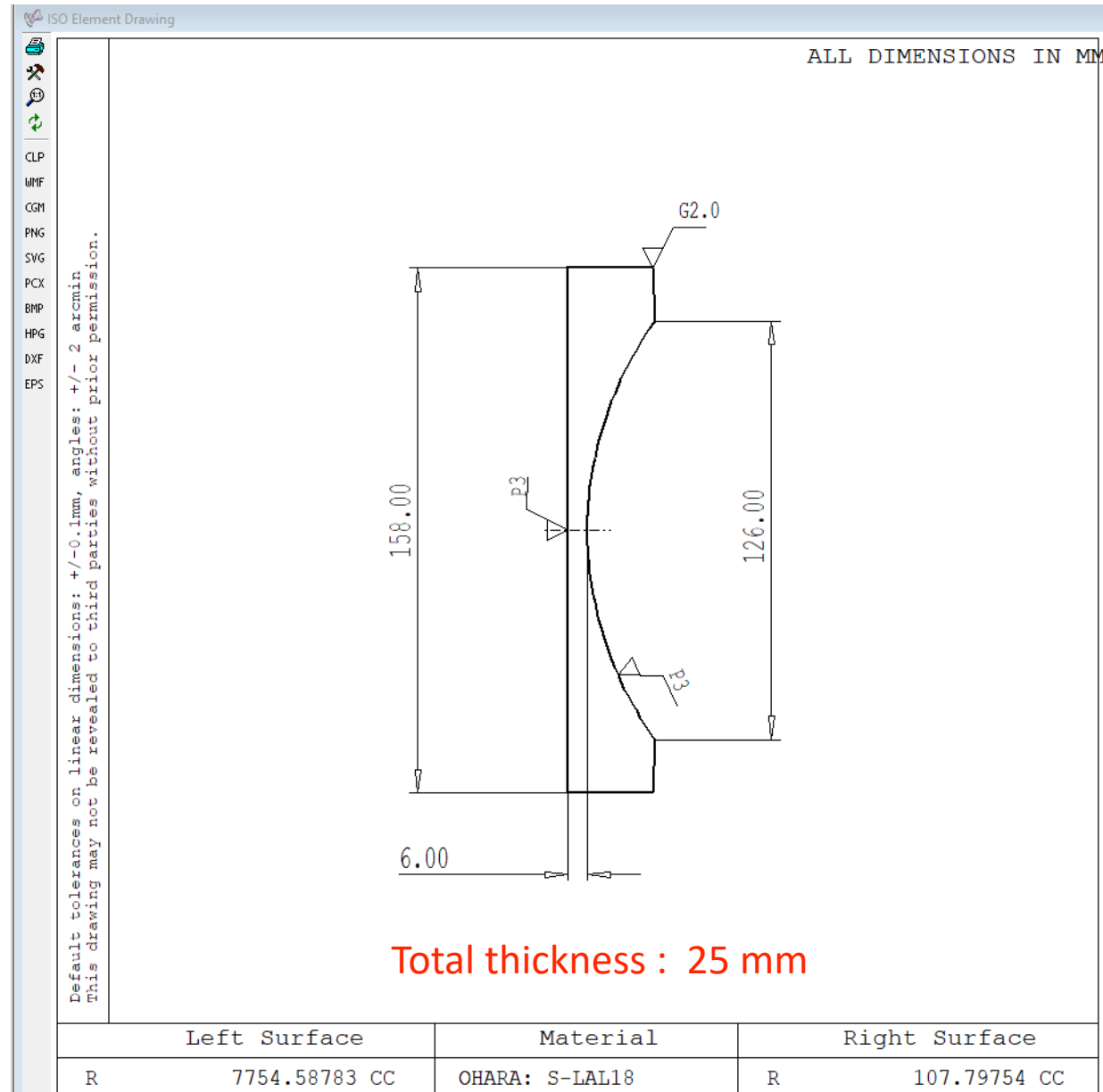
Aspherization is determined for zero deviation from sphere at center and rim. Radius = 533.5694

Radial height (mm)	Z-Sphere (mm)	Z-Asphere (mm)	Difference (mm)	Slope (micron/mm)	----- CXN	Surface Normal CYN	----- CZN
0.00000	0.000000	0.000000	0.000000	0.001	0.000000	0.000000	1.000000
4.00000	0.014994	0.016287	0.001293	0.647	0.000000	-0.008143	0.999967
8.00000	0.059977	0.065142	0.005165	1.289	0.000000	-0.016281	0.999867
12.00000	0.134957	0.146546	0.011588	1.923	0.000000	-0.024410	0.999702
16.00000	0.239948	0.260468	0.020520	2.542	0.000000	-0.032525	0.999471
20.00000	0.374966	0.406862	0.031896	3.144	0.000000	-0.040619	0.999175
24.00000	0.540034	0.585665	0.045631	3.721	0.000000	-0.048688	0.998814
28.00000	0.735181	0.796798	0.061616	4.268	0.000000	-0.056725	0.998390
32.00000	0.960440	1.040156	0.079716	4.777	0.000000	-0.064722	0.997903
36.00000	1.215848	1.315612	0.099764	5.240	0.000000	-0.072671	0.997356
40.00000	1.501449	1.623010	0.121562	5.650	0.000000	-0.080565	0.996749
44.00000	1.817292	1.962162	0.144870	5.994	0.000000	-0.088392	0.996086
48.00000	2.163430	2.332840	0.169410	6.263	0.000000	-0.096142	0.995368
52.00000	2.539924	2.734778	0.194854	6.444	0.000000	-0.103803	0.994598
56.00000	2.946837	3.167660	0.220824	6.523	0.000000	-0.111362	0.993780
60.00000	3.384239	3.631121	0.246882	6.486	0.000000	-0.118806	0.992917
64.00000	3.852207	4.124739	0.272532	6.315	0.000000	-0.126120	0.992015
68.00000	4.350820	4.648028	0.297207	5.995	0.000000	-0.133287	0.991078
72.00000	4.880167	5.200437	0.320270	5.505	0.000000	-0.140291	0.990110
76.00000	5.440339	5.781344	0.341005	4.827	0.000000	-0.147114	0.989120
80.00000	6.031434	6.390051	0.358616	3.939	0.000000	-0.153739	0.988112
84.00000	6.653557	7.025778	0.372221	2.819	0.000000	-0.160145	0.987093
88.00000	7.306818	7.687664	0.380846	1.445	0.000000	-0.166315	0.986073
92.00000	7.991332	8.374759	0.383427	-0.208	0.000000	-0.172228	0.985057
96.00000	8.707223	9.086025	0.378802	-2.163	0.000000	-0.177864	0.984055
100.00000	9.454617	9.820333	0.365716	-4.444	0.000000	-0.183203	0.983075
104.00000	10.233652	10.576463	0.342812	-7.077	0.000000	-0.188227	0.982126
108.00000	11.044467	11.353105	0.308638	-10.084	0.000000	-0.192916	0.981215
112.00000	11.887212	12.148859	0.261647	-13.490	0.000000	-0.197252	0.980353
116.00000	12.762041	12.962239	0.200199	-17.318	0.000000	-0.201218	0.979546
120.00000	13.669116	13.791681	0.122566	-21.588	0.000000	-0.204798	0.978804
124.00000	14.608606	14.635544	0.026938	-26.320	0.000000	-0.207978	0.978134

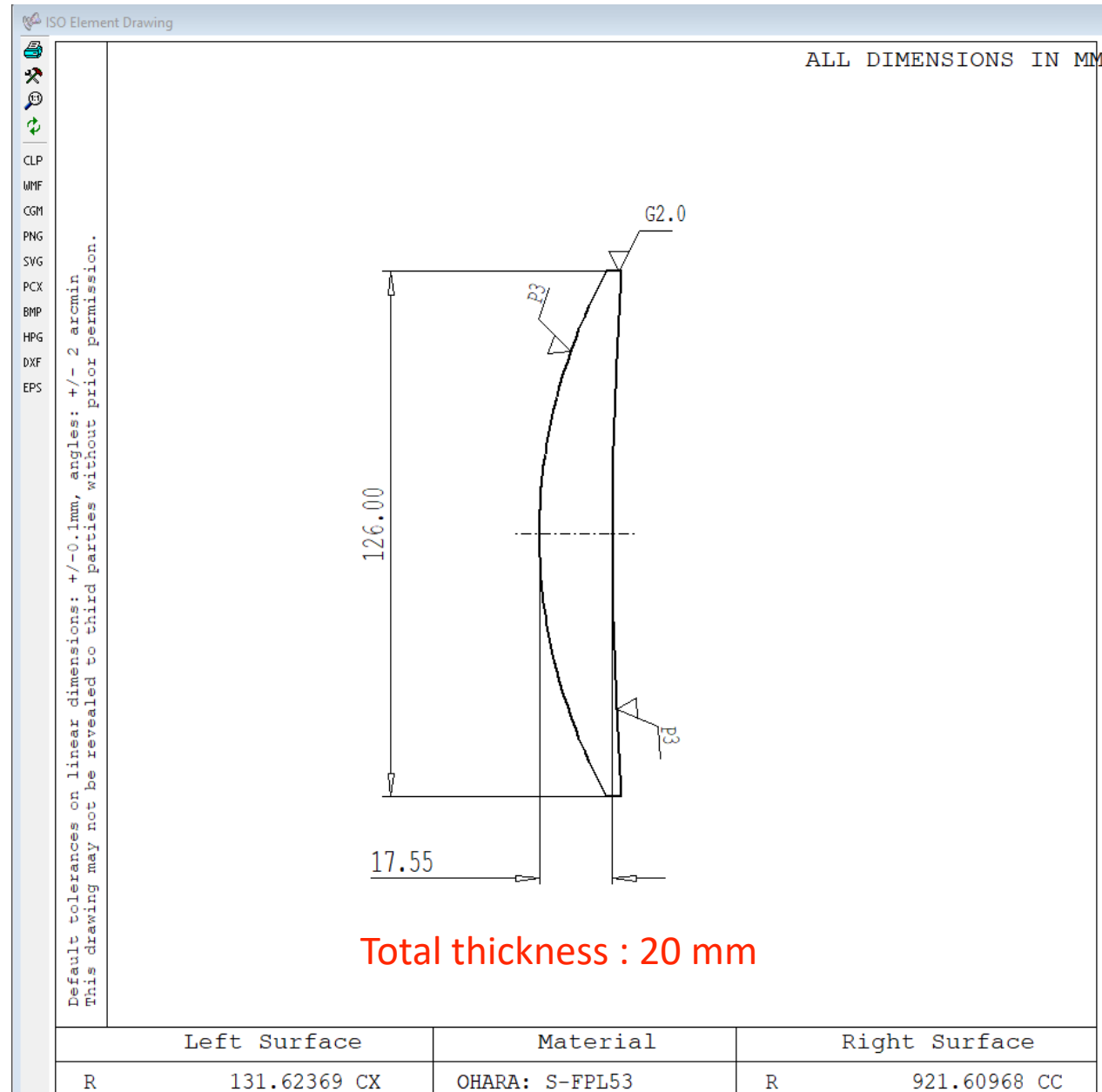
• •
 Lens 2
 Spherical



Lens 3 Spherical



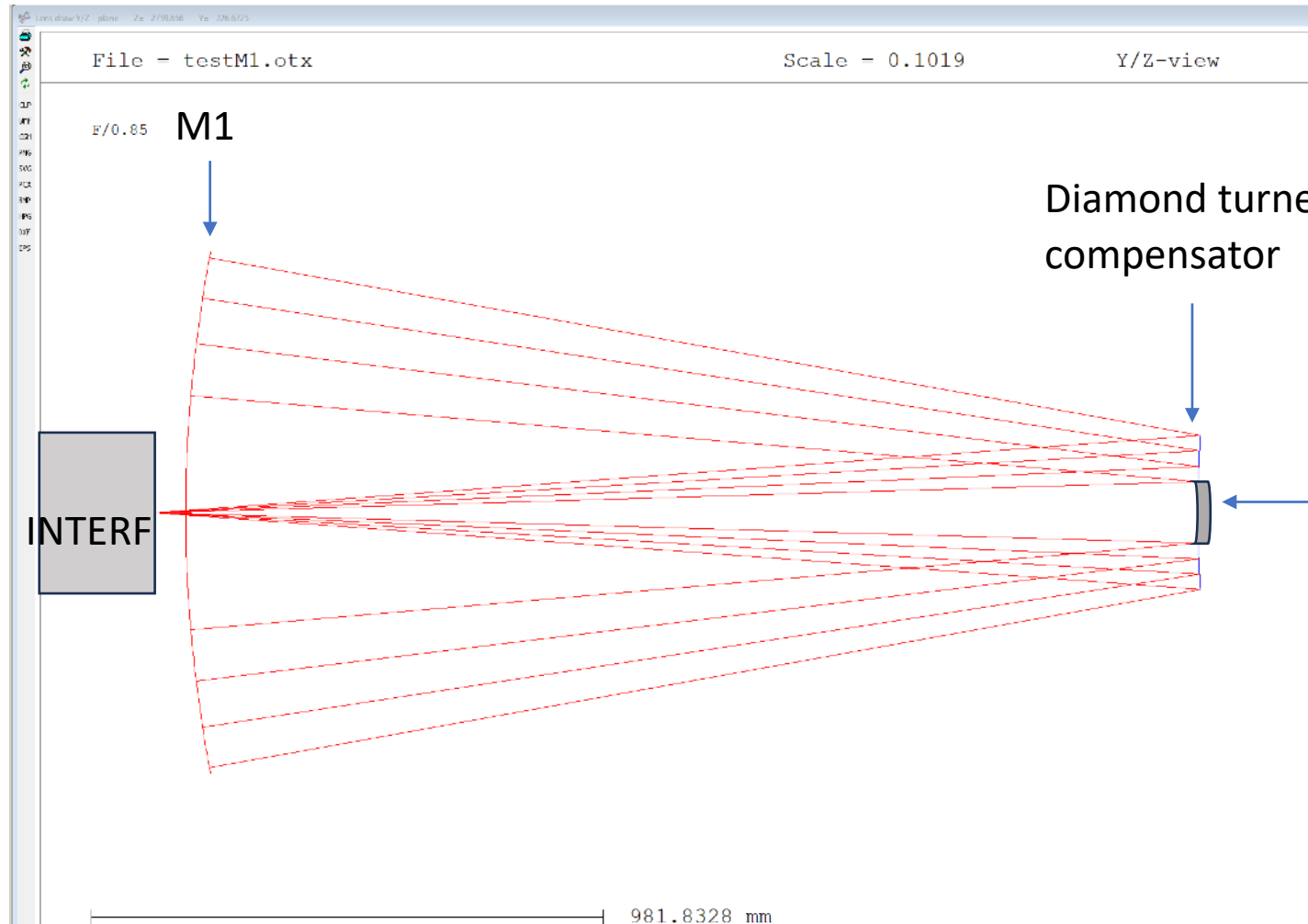
Lens 4 Spherical



MIRALU 1000 - v3

TEST MIRROR M1

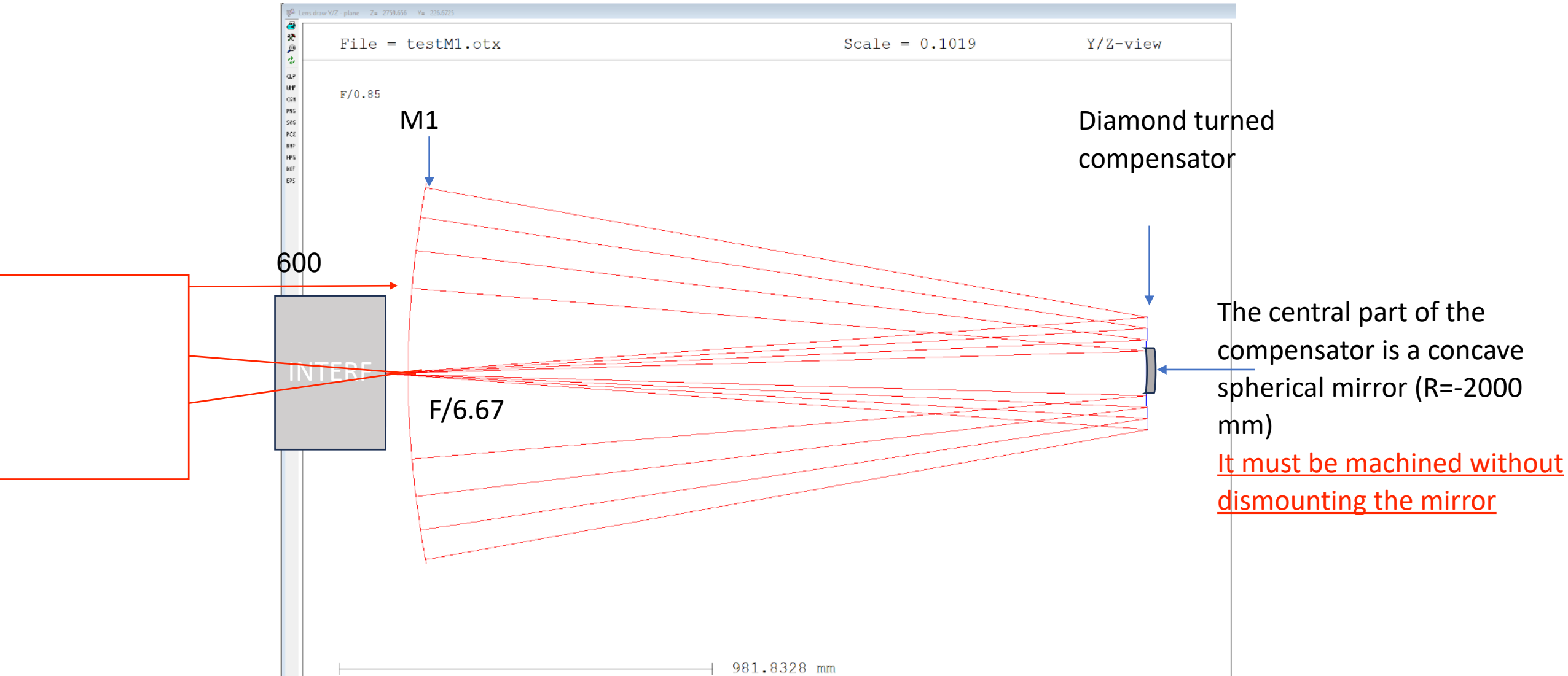
Metrology principle



The central part of the compensator is a concave spherical mirror ($R=-2000$ mm)

It must be machined without dismounting the mirror

Alignment of the compensator with the interferometer



Optical surfaces for the test

Surface Editor: C:\Optic2024\ALDORIA-TEL-1m\testM1.otx

Standard Data		Decenter, Tilts		Asphere		GRIN		Solves		Special Apertures		Hologram		Misc.		Array	
	TYPE	Radius	.	Distance	.	GLASS	.	APE-Y	.	Shape	Glb						
OBJ	S	0.00000000		2000.000		AIR		0.000	0	circular	0						
Compensator	STO	1964.79413	v	-1941.245	v	AIR		150.000	0	circular	0						Compensator
M1	2	2600.00000		1941.245	-1	AIR		502.905	0	circular	0						M1
Compensator	3	1964.79413	1	-2000.000		AIR		150.000	0	circular	0						Compensator
IMG	S	0.00000000		-0.7749200		AIR		140.760	0	circular	0						

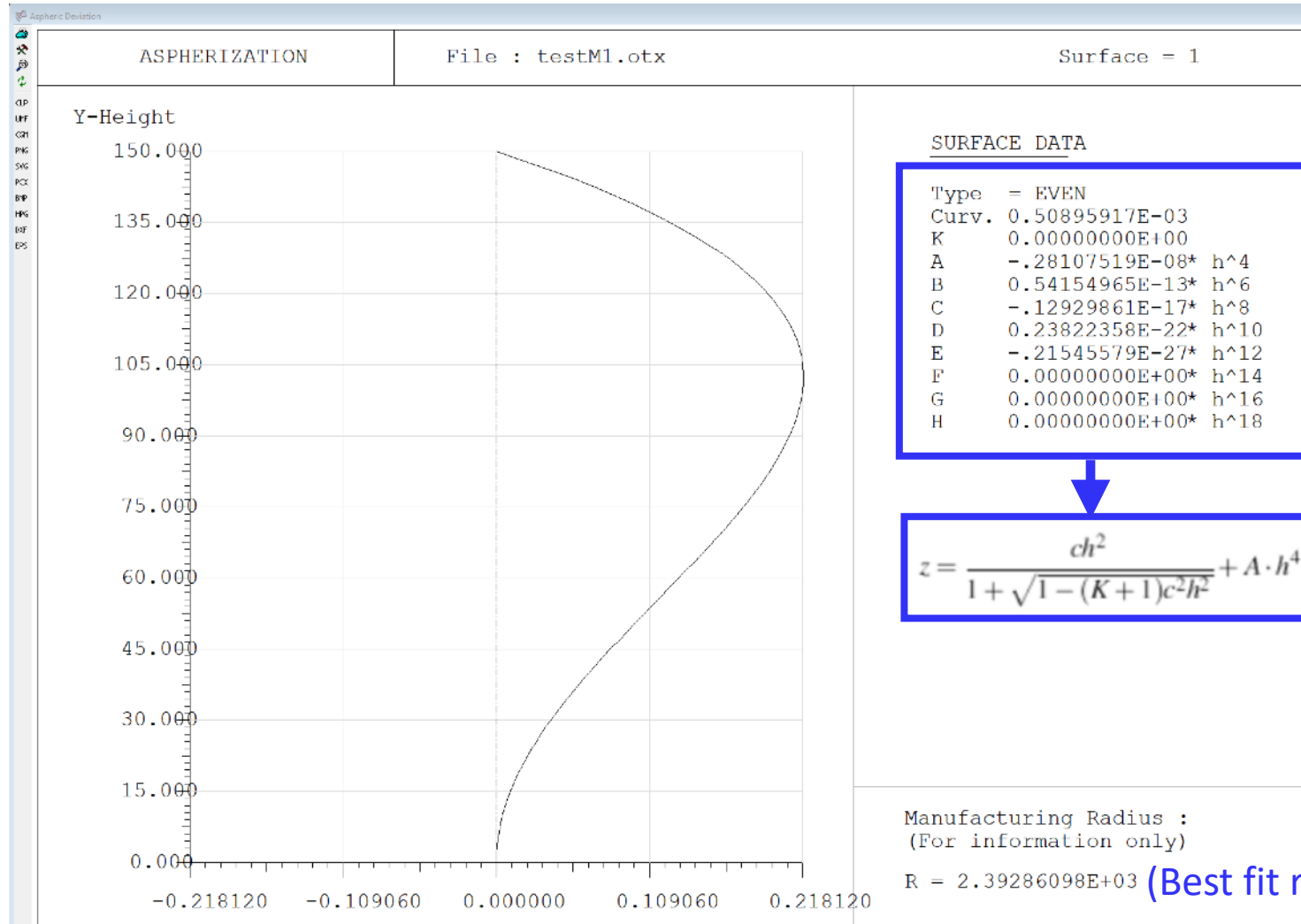
Aspheric coefficient

$$z = \frac{ch^2}{1 + \sqrt{1 - (K+1)c^2h^2}} + A \cdot h^4 + B \cdot h^6 + C \cdot h^8 + D \cdot h^{10} + E \cdot h^{12} + F \cdot h^{14} + G \cdot h^{16} + H \cdot h^{18}$$

Surface Editor: C:\Optic2024\ALDORIA-TEL-1m\testM1.otx

Standard Data		Decenter, Tilts		Asphere		GRIN		Solves		Special Apertures		Hologram		Misc.		Array	
	Asph.Type	Pik	K (Conic Const.)	.	A (h^4)	.	B (h^6)	.	C (h^8)	.	D (h^10)	.	E (h^12)	.	F (h^14)	.	
OBJ	S	even, 18th ord	0.0000000		0.0000000		0.0000000		0.0000000		0.0000000		0.0000000		0.0000000		
Compensator	STO	AM	even, 18th ord		-0.28107519E-08	v	0.54154965E-13	v	-0.12929861E-17	v	0.23822358E-22	v	-0.21545579E-27	v	0.0000000		Compensator
M1	2	AM	even, 18th ord		-0.22754960E-10		-0.62269807E-17		-0.29413765E-23		0.0000000		0.0000000		0.0000000		M1
Compensator	3	AM	even, 18th ord	1	-0.28107519E-08		0.54154965E-13		-0.12929861E-17		0.23822358E-22		-0.21545579E-27		0.0000000		Compensator

Aspheric parameters - Compensator - 300mm



SAG - Compensator

Aspherization is determined for zero deviation from sphere at center and rim. Radius = 2392.861

The central part of the compensator is a concave spherical mirror (R=-2000 mm) diameter to be given.

Radial height (mm)	Z-Sphere (mm)	Z-Asphere (mm)	Difference (mm)	Slope (micron/mm)	----- CXN	Surface Normal CYN	----- CZN
0.00000	0.000000	0.000000	0.000000	0.001	0.000000	0.000000	1.000000
7.50000	0.011754	0.014306	0.002552	0.679	0.000000	-0.003812	0.999993
15.00000	0.047015	0.057117	0.010102	1.329	0.000000	-0.007597	0.999971
22.50000	0.105786	0.128121	0.022335	1.923	0.000000	-0.011325	0.999936
30.00000	0.188067	0.226807	0.038740	2.437	0.000000	-0.014973	0.999888
37.50000	0.293861	0.352482	0.058621	2.846	0.000000	-0.018516	0.999829
45.00000	0.423171	0.504292	0.081121	3.132	0.000000	-0.021936	0.999759
52.50000	0.576001	0.681245	0.105243	3.276	0.000000	-0.025214	0.999682
60.00000	0.752356	0.882236	0.129880	3.267	0.000000	-0.028338	0.999598
67.50000	0.952240	1.106075	0.153835	3.093	0.000000	-0.031298	0.999510
75.00000	1.175660	1.351507	0.175847	2.747	0.000000	-0.034087	0.999419
82.50000	1.422622	1.617234	0.194612	2.226	0.000000	-0.036700	0.999326
90.00000	1.693134	1.901938	0.208804	1.527	0.000000	-0.039136	0.999234
97.50000	1.987203	2.204287	0.217085	0.650	0.000000	-0.041395	0.999143
105.00000	2.304838	2.522958	0.218120	-0.405	0.000000	-0.043478	0.999054
112.50000	2.646048	2.856636	0.210588	-1.635	0.000000	-0.045386	0.998970
120.00000	3.010845	3.204031	0.193187	-3.036	0.000000	-0.047125	0.998889
127.50000	3.399237	3.563882	0.164645	-4.605	0.000000	-0.048698	0.998814
135.00000	3.811238	3.934964	0.123726	-6.336	0.000000	-0.050110	0.998744
142.50000	4.246859	4.316092	0.069233	-8.225	0.000000	-0.051367	0.998680
150.00000	4.706113	4.706113	0.000000	-10.267	0.000000	-0.052472	0.998622

Synthetic interferogram

