A SYSTEM OF OPTICAL DESIGN

The Basics of Image Assessment and of Design Techniques with A Survey of Current Lens Types

Arthur Cox

THE FOCAL PRESS
LONDON and NEW YORK

Library of Congress Catalog Number 65-15348

Part I, pages 1 – 556, printed in Hungary
Part II, pages 557–668, printed in Great Britain
Jackets printed in Great Britain
Bound in Great Britain

PERFORMANCE DIAGRAMS

There is considerable value in having an approximate idea of the performance of an optical system, for which constructional data has been published. It enables a judgment to be made as to whether further work should be carried on, using these data as a starting point.

For this reason the performance diagrams are given in the following pages. In order to enable a rapid scan to be accomplished, a sketch of each design has been included with the performance curves. In this way it is a comparatively simple matter to pick out possible candidates, in terms of complexity, within each group.

With one exception, to be noted below, the constructional diagrams have been drawn with the long conjugate of the lens on the left hand side, so that in standard use the light can be taken as going through the lens from left to right. The one exception is for the section on eyepieces. In this case the long conjugate is on the right hand side of the lens, and the "front" of the eyepiece is the surface at the right hand of the diagram. This conforms to the usual way in which an eyepiece is shown in the layout of an optical system.

The performance is indicated in approximate terms by the following graphs:

(a) *Spherical aberration, measured by the longitudinal aberration* δs. *When the spherical aberration is under-correct then* δs *is negative;*

(b) *Offense against the Sine Condition, which indicates the presence or absence of coma in near central regions of the field;*

(c) *Sagittal astigmatism, measured by the longitudinal aberration* δs. *When the sagittal focus lies closer to the lens than the paraxial focal plane then* δs *is negative;*

(d) *Tangential astigmatism, measured by the longitudinal aberration* δt. *The sign convention is the same as in* (c)*;*

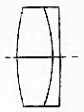
(e) *The radial distortion, measured in per cent deviation of the radial distance of the image from the centre of the field. When the deviation is positive the actual image is at a greater distance from the centre of the field than the ideal image.*

All calculations are based on a nominal focal length of 1.000 *inches.*

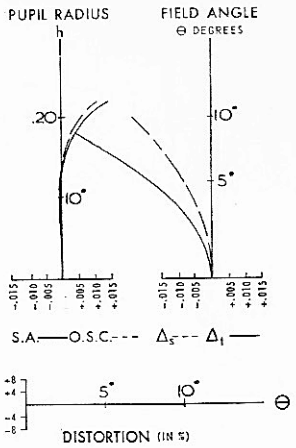
For completeness the Petzval Sum *is also given, as well as the back focus of the lens and its overall length.*

These values have been calculated at the Bell & Howell Company. *When no field or aperture values are specified in the patent literature the computers have been programmed to stop whenever the numerical value of* δs *or* δt *exceeds* 0.015.

TYPE I



E.F.L. 1.000
B.F.L. .925
OVERALL LENGTH .135
PETZVAL SUM .671

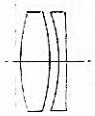


Design Example Number: 1-01

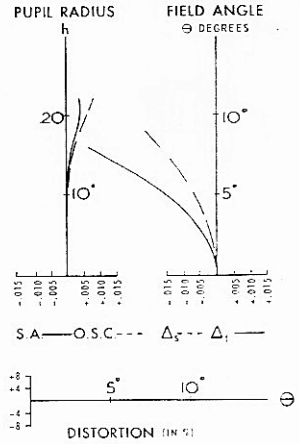
	ρ	t	μ	V
1.	1.5400	.110	1.617	55.0
2.	—2.2300	.025	1.720	29.3
3.	— .2975			

Stop Position: On ρ_1

TYPE I



E.F.L. 1.000
B.F.L. .872
OVERALL LENGTH .142
PETZVAL SUM .614

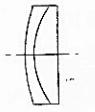


Design Example Number: 1-02

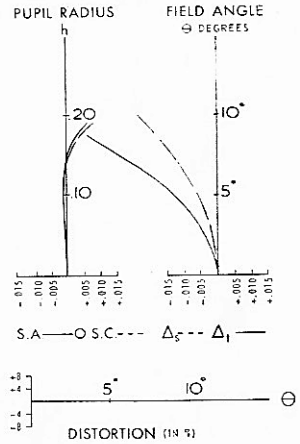
	ρ	t	μ	V
1.	1.7900	.090	1.620	60.3
2.	—1.5050	.027		
3.	—1.7900	.025	1.720	29.3
4.	—.2466			

Stop Position: On ρ_1

TYPE I



E.F.L. 1.000
B.F.L. .928
OVERALL LENGTH .102
PETZVAL SUM .659

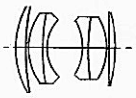


Design Example Number: 1-03

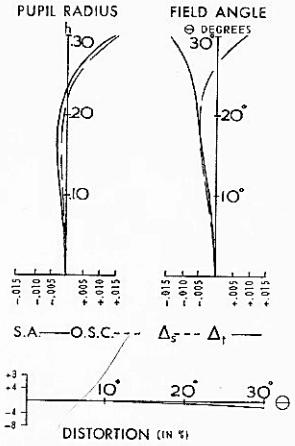
	ρ	t	μ	V
1.	2.0100	.027	1.720	29.3
2.	3.8600	.075	1.617	55.0
3.	.1024			

Stop Position: On ρ_1

TYPE 12



E.F.L. 1.000
B.F.L. .724
OVERALL LENGTH .622
PETZVAL SUM .193
PATENT No. 2,831,396 Table A
DESIGNER G.KLENT
M



Design Example Number: 12-04
Patent No. U.S.P.: 2,831,396, Table A

	ρ	t	μ	V
1.	1.8238	.0671	1.6700	47.2
2.	.6400	.0127		
3.	2.5208	.0893	1.6935	53.5
4.	.5941	.0352	1.6645	35.9
5.	3.8625	.2121		
6.	—3.3113	.0317	1.6398	34.6
7.	1.1089	.1188	1.6584	50.8
8.	—2.3883	.0021		
9.	.0424	.0525	1.7447	44.7
10.	—1.2947			

Stop Position: .10 Forward of ρ_6