COS-Cost Analysis

COS computes factors which affect the cost of a lens, including surfaces per blocker and raw glass price.

When to Use the Cost Analysis (COS) Option

Use the COS option when you want to consider cost factors in your design. Recognize that no program can "price" a design when so many factors are unique to a particular manufacturing facility. COST computes two quantities that can be cost drivers in fabrication. Use them to compare the relative cost of two or more designs or to identify potential sources of high cost, for removal in further design and optimization runs. The COS option does not include information related to injection mold costs or diamond point turning manufacturing.

Default Operation

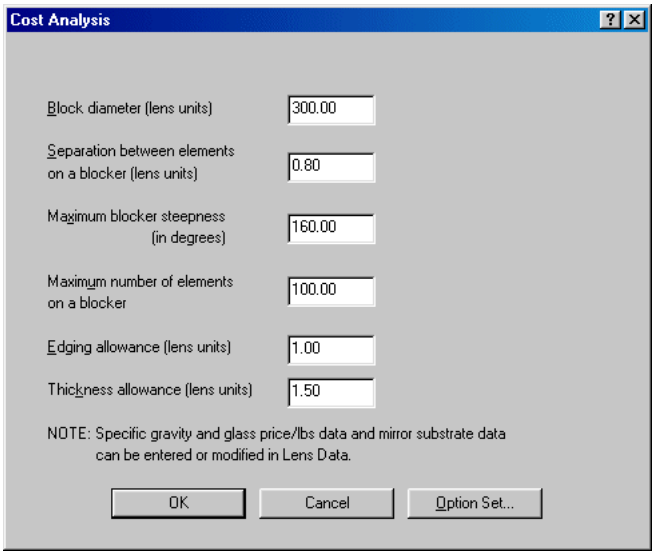
Surfaces per blocker are tabulated, including effects of traditional glass grinding/polishing blocker 'steepness' and diameter plus lens thickness and edge removal allowances; the table also includes the number of spindle loads per 1000 elements; the blocking factor, sin B', is displayed for comparison with the simpler form used in AUTOMATIC DESIGN for the BLO constraint. Raw glass price is calculated for both pressings (using strip prices) and prototypes (using slab price of the enclosing block).

Command Mnemonics
(alphabetical)

BLD DTH EDG MAX SEP STE

Defining Blocking Parameters

To define blocking parameters, select the **Analysis> Fabrication Support > Cost Analysis** menu. The **Cost Analysis** dialog box is displayed.



Command Syntax		
Screen Control	**Explanation**	**Default**
BLD block_diameter		
Block diameter (lens units)	Maximum block diameter in lens units.	Inches: 12 Centimeters: 30 Millimeters:300
SEP gap_between_blocked_elements		
Separation between elements on a blocker (lens units)	Edge-to-edge gap between elements on the blocker at the closest point of the finished surfaces, including edge allowance.	Inches: 0.03 Centimeters: 0.08 Millimeters:0.8
STE max_blocker_angle_degr		
Maximum blocker steepness (in degrees)	Maximum blocker 'steepness' in degrees. **Range**: 0 to 180 (hemisphere).	160°
MAX num_max_elements_on_blocker		
Maximum number of elements on a blocker	Maximum number of elements allowed on a blocker, if not otherwise limited.	100
EDG incr_for_edging		
Edging allowance (lens units)	Excess allowance for edging, on diameter, in lens units.	Inches: 0.04 Centimeters: 0.1 Millimeters:1.0
DTH extra_center_thickness		
Thickness allowance (lens units)	Excess allowance for surfacing, on total thickness, in lens units.	Inches: 0.06 Centimeters:0.15 Millimeters:1.5

Discussion of Input and Computations

What to Include in the LDM

No additional data is required in the LDM. The PRC command can be used to specify price data for materials not in manufacturer's catalogs.

Usage

Projecting the cost of fabricating a lens must address:

- Surfaces per Block (labor factor)
- Raw Glass Price (raw material)

COST ANALYSIS calculates the approximate number of lens blanks that will fit on a traditional grinding/polishing blocking tool at a time for fabrication. It includes the effects of blocker "steepness" (curvature) and diameter, plus lens thickness and edge removal allowances. In addition, the number of spindle loads per 1000 elements is calculated and these values are summed to give the number of spindle loads per 1000 assemblies. This provides an overall "merit function" for comparing the blocking costs of different designs.

The blocking factor, sin B', is also calculated. This is similar to the factor calculated under BLO control in AUTOMATIC DESIGN but includes element thickness, edge allowance, and element separation on the tool in addition to radius of curvature and element diameter. (For information on blocking, see W. J. Smith, *Modern Optical Engineering*, McGraw-Hill, New York, 1966, pp. 408-410).

The cost of glass for a production element ("pressing price") is calculated from strip glass prices. For prototype costing, the glass in the smallest block enclosing an element is calculated from slab B glass prices.

User-defined Blocking Assumptions

You can alter the assumptions made by COS in the calculation of blocking factors, such as maximum block diameter (**BLD**), edge-to-edge gap between elements on the blocker at the closest point of the finished surfaces (**SEP**), maximum blocker "steepness" in degrees (**STE**), and the maximum number of elements allowed on a blocker (**MAX**). In addition, excess material allowance for edging (**EDG**) and thickness removal (**DTH**) can be altered to better represent the fit of pressings on the blocker.

If you also provide substrate thickness and back curve values for the system (THM and CUM, using the LDM), they will be used in the blocking calculation. If no values are provided, COS assumes a back curve equal to the mirror curvature and a thickness of one-tenth the mirror diameter (applies only to the blocking factor calculation, not to the weight/volume calculation).

Weight/Volume Calculations

Specific gravity and slab costs, if available, are stored for the glass catalog materials; for fictitious glasses, no cost is assigned and specific gravity is approximated with a formula using index and dispersion. To override these, to supply values for missing values or for mirror substrates, additional data must be supplied in the LDM, such as substitute glass codes, specific gravity, and strip or slab prices.

First Surface Mirrors

Unless entered in the LDM, there is no representation of the substrate in the optical data, and no cost is calculated for the substrate. To calculate substrate cost requires the additional items of thickness and back curve (and, for non-catalog substrate materials, material price and specific gravity) through the LDM.

Computation Methods

The mounting edges and chamfers determined from the clear apertures, or edges entered through the LDM, are combined with the radii and thickness of each element to provide the data necessary to calculate the volume and center of mass. From the specific gravity of the material, the weight of the element is computed. Finally, cost is calculated from the prices entered or stored in the glass catalog.

The handling of outside diameters, edges, and chamfers is identical to the VIEW option used in the same manner. See "VIE - Viewing and Plotting Lens Data" on page 15-23 for details.

The blocking factor and elements-on-a-tool calculations are typically correct within one unit or a few percent, whichever is larger, and assumes no bevels are used. "Spindle loads per 1000 elements" is calculated from the approximate number.

Description of Output

Blocking

COS generates a table of curvature thickness, clear aperture, blocking factor, number on a blocker, and spindle loads per 1000 elements for each surface (see Table 1). Assumptions and calculations are as described above.

Table 1. Blocking Cost

```
                                        C O D E  V                                  POSITION 1

                                BLOCKING COST FACTORS FOR LENS PRODUCTION

          Cooke Triplet f/4.5

 SURFACE      RADIUS OF     THICKNESS     OUTSIDE      GLASS      BLOCKING     APPROXIMATE    SPINDLE LOADS
  NUMBER      CURVATURE                  DIAMETER      NAME       FACTOR        NUMBER      PER 1000 ELTS


     1          21.4814         2.000       15.600      SK16         0.405           6             167
     2        -124.1000                     15.600                   0.068         100              10
     3         -19.1000         1.250       10.566      F4           0.303          11              91
     4          22.0000                     10.566                   0.263          15              67
     5         328.9000         2.250       15.063      SK16         0.025         100              10
     6         -16.7000                     15.063                   0.481           4             250
                                                                                                  ------
                                                                Spindle loads for 1000 assemblies =    595

NOTE:
1. Linear dimensions are in millimeters unless otherwise noted.
2. The "OUTSIDE DIAMETER" is larger than the clear aperture for beveling/mounting purposes
3. "APPROXIMATE NUMBER" is an estimate of the number of elements on a block,
   based on the following assumptions:
      A. Maximum blocker diameter is 300.0 MM.
      B. Maximum blocker "STEEPNESS" is 160.0 degrees.
      C. Maximum number on a block is   100, which may imply a
         block diameter of less than 300.0 MM.
      D. The additional thickness and diameter of a blank required for material removal
         are  1.500 MM. and  1.000 MM., respectively.
      E. The gap between elements on the blocker is assumed to be  0.750 MM.
              F. No bevels.
```

Minimum input for a standard triplet (Table 2):

```
RES   CV_LENS:COOKE1        ! Restore Cooke triplet lens

COS                         ! Invoke COST option
GO
```

Menu
Contents
Indexes
Search

Glass Price

COS also generates a table of price of glass per element ("pressing price") and price per block from which an element can be made. Material cost, when included from the data stored on disc, is for strip prices (pressing calculation) and Grade A or B slab for SLAB prices (block price calculation).

Examples

Example 1. Minimum input for a standard triplet (Table 2)

Table 2. Glass Cost

C O D E V POSITION 1

GLASS COST FACTORS FOR LENS PRODUCTION

Cooke Triplet f/4.5

ELEMENT NUMBER	WEIGHT GRAMS	PRESSING PRICE ($)	BLOCK WIDTH	BLOCK THICKNESS	SPECIFIC GRAVITY	BLOCK PRICE ($)	GLASS NAME	PRICE PER POUND ($) STRIP	SLAB
1	0.789	0.02	15.60	2.000	3.580	0.26	SK16	12.85	34.00 *S
2	0.606	0.00	10.57	2.524	3.570	0.00	F4	0.00	0.00
3	0.846	0.02	15.06	2.250	3.580	0.26	SK16	12.85	34.00 *S
TOTAL	2.2409	0.05**				0.52**			

*S "SLAB" prices are for grade A slab from the Schott Price List dated April 1, 1998
"STRIP" prices are one half of grade B slab prices which is the Schott recommended historical ratio for estimating the raw material cost for a pressing.
* Price unavailable--consult manufacturer
** Calculated with one or more values set to zero

NOTE:
1. Linear dimensions are in millimeters unless otherwise noted.
2. "BLOCK PRICE" includes only material in the block enclosing the element. No factor is included for excess or wasted material.
3. "PRESSING PRICE" is assumed to equal the strip glass material cost in the element.

Example 2. Assumes a lens with a plastic element on surface 1 (material 'PLAST1') and a melt glass equivalent to BK7_Schott on surface 3

Any other materials are assumed to be standard Schott glasses. Block size and element separation also changed. (Output not shown.)

```
!  Note how the price (PRC) and specific gravity (SPG) values
!    are entered in the LDM, prior to invoking the COS option.

!  (See LDM for data on PRC and SPG commands)

PRC  S1  5.35  5.35

!  'PLAST1' - block & slab prices/lb are the same ($)

SPG 'PLAST1' 0.85

!  Set specific gravity of private catalog(PRV) material:'PLAST1'

PRC S3 BK7_SCHOTT

!  Set surface 3 price to that of BK7_Schott

SPG S3 BK7_SCHOTT

!  Set specific gravity of surface 3 to that of BK7_Schott

COS                          ! Invoke the COST option

BLD 250                      ! Block diameter in mm

SEP 1.0                      ! Element separation on block in mm

GO
```