

# COOKE OPTICS Ltd

## S4 Prime Lenses: Fields of View for Standard 35mm and Super 35mm Filming

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### THE BASIC FORMULA

For any distortion-free lens focussed on infinity:

$$\text{Total Field Angle} = 2 \times \tan^{-1}(\text{film format size} / (2 \times f \text{ mm}))$$

Where  $f$  is the focal length of the lens and the **film format size** is the total image width,height, or diagonal in mm, depending on whether you are calculating the horizontal, vertical or diagonal field of view.

This formula gives the total field angle, rather than the maximum off axis field angle (which is half of this total value). All the field angles given in this document are total field angles.

**So, for example**, taking the Standard 35mm Academy format size to be 22mm x 16mm, we have, for a 40mm lens, and calculating the total horizontal field of view:  
 $2 \times \tan^{-1}(22\text{mm} / (2 \times 40\text{mm})) = 30.75$  degrees.

The total vertical field of view calculates as 22.62 degrees.

And the diagonal size of the Standard 35mm format size is 27.2mm, so the total diagonal field of view for this lens is 37.56 degrees.

**Note that the basic formula given here is stated for the lens focussed on infinity.** This is what is normally regarded as the field angle of the lens. However, when you focus on an object which is closer than infinity, the field angle will be slightly less. For most of the S4 the field of view will be approximately 9% smaller at the minimum focussing distance. This is because the lenses are further from the film when the lens is focussing on a closer object.

However, for the shorter focal length lenses, and also for the close focus 135mm S4 lens the field angles reduce by approximately twice this percentage, because these lenses move further, relative to their focal length, to reach their closest focussing positions.

### FIELD ANGLES FOR THE S4 LENSES USED ON THE STANDARD 35MM FILM FORMAT

If we take the Academy format as being 22mm horizontally x 16mm vertically, we get the following values for field angles with the Cooke S4 range of prime lenses. The values are stated as rounded to the nearest two significant figures:

| f (mm)                 | 12 | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65 | 75 | 100 | 135 | 150 | 180 |
|------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| Horiz. Field (degrees) | 85 | 76 | 69 | 63 | 55 | 47 | 44 | 38 | 35 | 31 | 25 | 19 | 17 | 13  | 9.3 | 8.4 | 7.0 |
| Vert. Field (degrees)  | 67 | 59 | 53 | 48 | 42 | 35 | 33 | 28 | 26 | 23 | 18 | 14 | 12 | 9.1 | 6.8 | 6.1 | 5.1 |
| Diag. Field (degrees)  | 97 | 88 | 81 | 74 | 66 | 57 | 53 | 46 | 42 | 38 | 30 | 24 | 21 | 15  | 12  | 10  | 8.6 |

**FIELD ANGLES FOR THE SUPER 35MM FILM FORMATS**

The horizontal field angles for the three Super 35mm film formats where the image width is 23.5mm are as follows:

| f<br>(mm)  | 12 | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65 | 75 | 100 | 135 | 150 | 180 |
|--|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| <b>All three formats with the 23.5mm Image width</b> |    |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |
| Horiz.<br>Field<br>(degrees)                         | 89 | 80 | 73 | 66 | 58 | 50 | 47 | 40 | 37 | 33 | 26 | 20 | 18 | 13  | 10  | 9.0 | 7.5 |

And here are tables of vertical and diagonal field angles for the three Super 35mm formats which use this 23.5mm horizontal image width.

| f<br>(mm)                           | 12 | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65 | 75  | 100 | 135 | 150 | 180 |
|-------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|
| <b>1.85 Format: 12.7mm x 23.5mm</b> |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |     |
| Vert.<br>Field<br>(degrees)         | 56 | 49 | 43 | 39 | 34 | 29 | 26 | 22 | 21 | 18 | 14 | 11 | 9.7 | 7.3 | 5.4 | 4.8 | 4.0 |
| Diag.<br>Field<br>(degrees)         | 96 | 87 | 80 | 73 | 65 | 56 | 53 | 45 | 42 | 37 | 30 | 23 | 20  | 15  | 11  | 10  | 8.5 |

| f<br>(mm)                         | 12 | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65  | 75  | 100 | 135 | 150 | 180 |
|-----------------------------------|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|
| <b>2.35 Format: 10mm x 23.5mm</b> |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |     |     |
| Vert.<br>Field<br>(degrees)       | 45 | 39 | 35 | 31 | 27 | 23 | 21 | 18 | 16 | 14 | 11 | 8.8 | 7.6 | 5.7 | 4.2 | 3.8 | 3.2 |
| Diag.<br>Field<br>(degrees)       | 94 | 85 | 77 | 71 | 63 | 54 | 51 | 44 | 40 | 35 | 29 | 22  | 19  | 15  | 11  | 9.7 | 8.1 |

| f<br>(mm)                                    | 12  | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65 | 75 | 100 | 135 | 150 | 180 |
|--|-----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| <b>Silent (1.34) Format: 17.5mm x 23.5mm</b> |     |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |
| Vert.<br>Field<br>(degrees)                  | 72  | 64 | 57 | 52 | 45 | 39 | 36 | 31 | 28 | 25 | 20 | 15 | 13 | 10  | 7.4 | 6.7 | 5.6 |
| Diag.<br>Field<br>(degrees)                  | 101 | 93 | 85 | 78 | 70 | 61 | 57 | 49 | 45 | 40 | 33 | 25 | 22 | 17  | 12  | 11  | 9.3 |

There are also two other Super 35mm formats (see the next page)

| f<br>(mm)                            | 12 | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65 | 75  | 100 | 135 | 150 | 180 |
|--------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|
| <b>1.78 Format: 12.65mm x 22.5mm</b> |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |     |
| Horiz.<br>Field<br>(degrees)         | 86 | 78 | 70 | 64 | 56 | 48 | 45 | 39 | 36 | 31 | 25 | 20 | 17  | 13  | 9.5 | 8.6 | 7.2 |
| Vert.<br>Field<br>(degrees)          | 56 | 49 | 43 | 39 | 34 | 28 | 26 | 22 | 20 | 18 | 14 | 11 | 9.6 | 7.2 | 5.4 | 4.8 | 4.0 |
| Diag.<br>Field<br>(degrees)          | 94 | 85 | 78 | 71 | 63 | 55 | 51 | 44 | 40 | 36 | 29 | 22 | 20  | 15  | 11  | 9.8 | 8.2 |

| f<br>(mm)                                | 12 | 14 | 16 | 18 | 21 | 25 | 27 | 32 | 35 | 40 | 50 | 65 | 75 | 100 | 135 | 150 | 180 |
|--|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| <b>TV (1.33) Format: 13.6mm x 18.1mm</b> |    |    |    |    |    |    |    |    |    |    |    |    |    |     |     |     |     |
| Horiz.<br>Field<br>(degrees)             | 74 | 66 | 59 | 53 | 47 | 40 | 37 | 32 | 29 | 25 | 21 | 16 | 14 | 10  | 7.7 | 6.9 | 5.8 |
| Vert.<br>Field<br>(degrees)              | 59 | 52 | 46 | 41 | 36 | 30 | 28 | 24 | 22 | 19 | 15 | 12 | 10 | 7.8 | 5.8 | 5.2 | 4.3 |
| Diag.<br>Field<br>(degrees)              | 87 | 78 | 71 | 64 | 57 | 49 | 45 | 39 | 36 | 32 | 26 | 20 | 17 | 13  | 9.6 | 8.6 | 7.2 |