# Pyrometer Calibration Geometry Rules according to VDI/VDE 3511 Part 4.4

All infrared pyrometers, especially those measuring at long wavelengths, have a "size of source effect" (SSE), meaning that part of their sensitivity lies outside the specified spot diameter. This is caused by unwanted but unavoidable effects like diffraction or multiple reflections inside the lens and between the lens and detector.

If we calibrate to a source with the exact spot diameter, anyone measuring large areas would get tremendously high readings. On the other hand, calibrating to a very large area radiation source would result in a very low reading for those who measure an object at the spot diameter.

The official calibration rules of VDI/VDE 3511 Part 4.4 define the "calibration diameter" as a practical compromise between these two extreme positions.
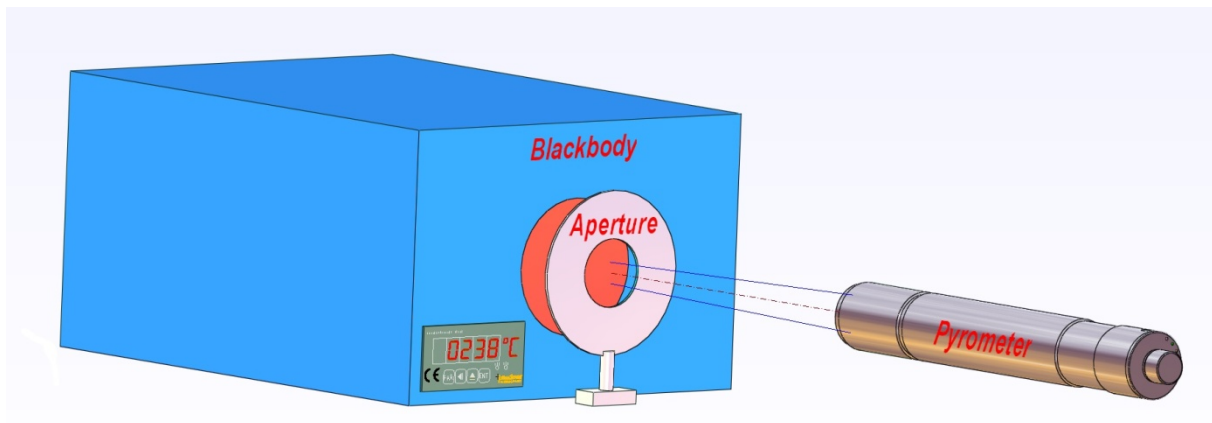
The first official calibration geometry formula for nominal distance "a" and spot size "M" gives the necessary radiation source aperture "A" when calibrated at the calibration distance "a":

$$A = \sqrt{a \cdot M}$$
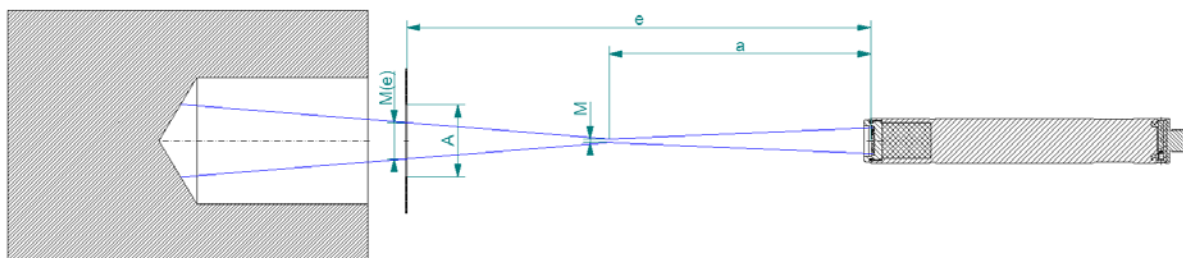
This works well for small spot sizes or short focal distances. But for an instrument with a = 800 mm and M = 16 mm, you would get

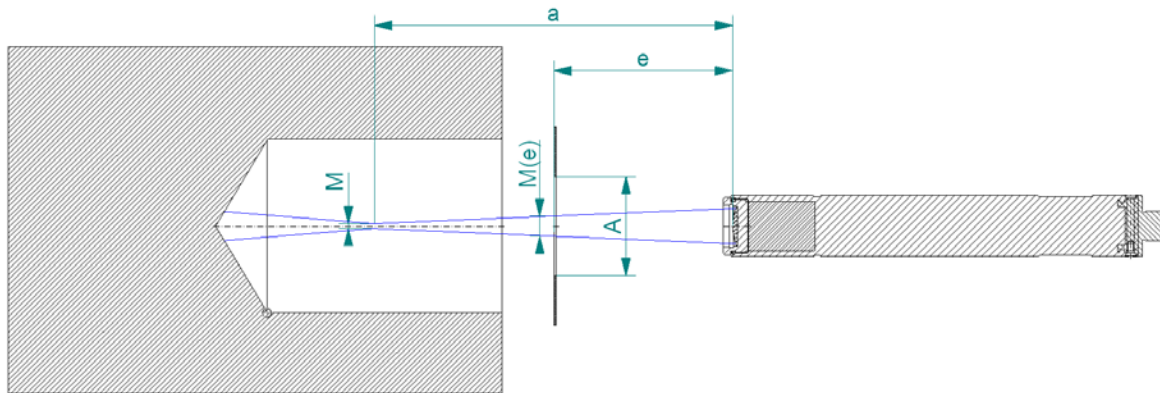$$A = \sqrt{800mm \cdot 16mm} = 113mm$$

Such a big heat source usually is not available in a calibration lab. In this case, the second official formula can be applied:
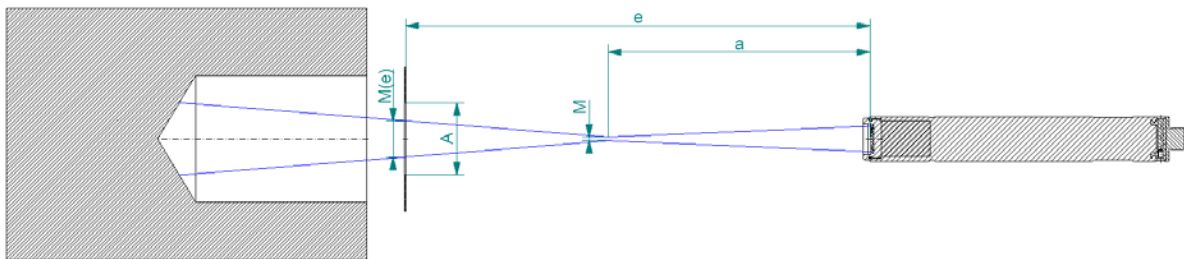
If you have a source with aperture "A" (e.g. 25 mm), a calibration distance "e" (longer or shorter than the focal distance "a") has to be chosen as

$$e = A \cdot \sqrt{\frac{a}{M}}$$

An example of this formula where e rules out to be shorter than a:

An alternative example with e larger than a:

In our numeric example we get:

$$e = 25mm \cdot \sqrt{\frac{800mm}{16mm}} = 177mm$$

The purpose of this unique definition of the calibration geometry is to create equal preconditions on manufacturer and user side. All LumaSense pyrometers are calibrated according to these rules.