We already know this parameters:

* Sphere radius = commercial values that we can set;
* Distance eyepiece to its image = focal distance of the cellphone, you can check on your cellphone, mine was 140mm;
* Focal length of the eyepiece = you can measure in yours, mine is 4mm
* Magnifications = the desired magnifications you want, in our case, 10, 100, 500, 1000 and 2000 times

First we calculate the focal distance of the sphere, using the following formula:

sphereFocalDistance = (3\*sphereRadius) / 2

Then, we need to calculate the distance of the eyepiece to the object:

1/fe = 1/do’ + 1/di’

Where:

fe = focal distance length of the eyepiece;

do’ = distance object-eyepiece;

di’ = distance image-eyepiece;

We isolate the unknown variable, the do’:

1/do’ = 1/fe – 1/di’ -> 1/do’ = (fe - di’) / (di’ \* fe)

do’ = (di’ \* fe) / (fe - di’)

The final magnification formula is the product of the magnification of both lenses:

m = - di/do \* - di’/do’

Where:

do = distance objective – object;

di = distance objective - image

Isolating the unknown distance objective – image:

di = (m\*do’\*do) / di’

With that formula, we can insert it on the formula:

1/fo = 1/do + 1/di

Where:

fo = focal length of the objective

Isolating the unknown do:

1/fo = 1/do + 1/di -> using the di isolated in the previous equation -> 1/fo = 1/do + di’/(m\*do\*do’)

-> 1/fo = ((m\*do\*do’) + (do\*di’)) / (do2 \* m \*do’) -> 1/fo = (m\*do’ + di’) / (do\*m\*do’)

-> do = (fo \* (m\*do’ + di’)) / m\*do’

Inserting the do value into the equation above, we can find the di value.

Finally, the tube size is the sum of the distance objective – image, plus the distance eyepiece – object:

tubeSize = di + do’