

# INO

## FAQ

### ABOUT OUR PHANTOMS

#### **What are Biomimic optical phantoms?**

Optical phantoms are tissuesimulating objects used to mimic light propagation in biological tissue and are typically used for: biomedical devices and products calibration, testing of products in development and validation of numerical models. INO's Biomimic™ solid phantoms are made from opticalgrade polymer with absorbers, and scatterer additives enabling known optical absorption and scattering properties at given wavelengths in the 450 to 940 nm range.

#### **What material is used to fabricate Biomimic optical phantoms?**

Our phantoms are fabricated with polyurethane (PU).

#### **What is the scattering agent?**

Titanium oxide (TiO<sub>2</sub>) is used as a scattering agent.

#### **What is the absorbing dye?**

Carbon black is used as a universal absorbing dye.

#### **What do I need to specify to order a phantom?**

You need to provide us with both your desired absorption ( $\mu\text{a}$ ) and reduced scattering coefficient ( $\mu\text{s}$ ) at a reference wavelength and the phantom's exact dimensions.

#### **What absorption coefficient range can you provide?**

0.05 to 1  $\text{cm}^{-1}$ .

#### **What reduced scattering coefficient range can you provide?**

5 to 25  $\text{cm}^{-1}$ .

#### **What optical range is available for reference and characterization wavelengths?**

450 to 940 nm.

**What is the characterization technique?**

The time-domain transmittance is technique.

**What is the hardness of the phantoms?**

The Shore Hardness is 84 D (hard polyurethane).

**What is the refractive index of the material?**

The refractive index is  $1.521 \pm 0.006$ .

**What is the anisotropy factor?**

The anisotropy factor is  $0.62 \pm 0.015$ .

**Do Biomimic™ phantoms have uniform and homogeneous bulk optical properties?**

Yes. Our manufacturing process allows us to achieve uniformity greater than <2% in the bulk optical properties of the phantom.

**How do I order an off-the-shelf phantom?**

Please select the phantom of your choice in the available list on our website :

<https://www.ino.ca/en/solutions/biomimic/>

Then, fill the following form and send it to us by email:

<https://inostorage.blob.core.windows.net/media/2338/boncommandeofftheshelf-mkt-2021-bio-01.pdf>

**How do I order a custom phantom?**

Please fill in the form and send it to us by email :

<https://inostorage.blob.core.windows.net/media/2336/boncommandecustom-mkt-2021-bio-01.pdf>

For non-rectangular nor cylindrical geometries, please send us a CAD file for evaluation.

**I want to learn more about your manufacturing and metrology techniques. Do you have any reference documents available for public review?**

Please visit our website at <http://www.ino.ca/en/products/biomimic-optical-phantoms/>

A list of publications is available at the bottom of the page.

**Are the optical properties of Biomimic™ phantoms stable?**

The optical properties of Biomimic™ phantoms are highly stable. Even if we don't guarantee a stability duration, the reference phantoms we measure periodically for monitoring are over 10 years old and show little variation in their optical properties.

**What is the delivery time for an off-the-shelf phantom?**

Typically, 2 to 3 weeks.

**What is the delivery time for a custom phantom?**

Our typical lead time for custom phantoms is 12 weeks. Depending on our manufacturing load when the order is placed, the lead time may be slightly shorter. We also offer rush delivery (6 or 8 weeks) at extra cost.

**Can you reproduce the spectral features of any tissue as a function of wavelength?**

We do not offer this capability with our stock manufacturing process due to the chemical complexity involved in mixing multiple absorbing dyes in the PU matrix. Such work would require an R&D contract. Contact us if you want an evaluation.

**I cannot find a phantom that meets my specifications in your published inventory list. Can you make custom phantoms with the exact optical properties required for our application?**

We do offer build-on-order services with certain constraints due to our manufacturing process, raw materials, and metrology capabilities. We verify the optical properties of our custom phantoms using a time-domain measurement. Depending on the requested combination of absorption and reduced scattering coefficients, a variation of +/-10% to +/-30% in the measured optical properties is tolerated.

**What is the cost of a custom phantom?**

Custom phantoms typically start at US\$3,350. Prices vary depending on the requirements and the complexity of adapting our manufacturing and metrology processes. We reserve the right to change our prices at any time.

**Can you manufacture phantoms with a specific shape?**

Phantoms are typically cast first and then machined into the final shape. Machining complex shapes is limited by what can be achieved in a professional workshop. Please send us a CAD file and we will evaluate the feasibility.

**What are the minimum and maximum dimensions of the phantoms you manufacture?**

The standard maximum dimensions are 11x11x11 cm. Depending on the surface area of the slab, the minimum thickness can be as little as 1 mm.

**I want a phantom representing the tissue of organ X. Is that something you can provide?**

We can help you select or manufacture a phantom mimicking living tissue only if you provide us with your desired optical properties (absorption and reduced scattering coefficients at a specified wavelength). Because of the difficulty of measuring the optical properties of tissues, there are significant variations in the literature. We therefore cannot determine these properties for a specific tissue type ourselves.

**I want a phantom representing the biological structure Y. Is that something you can provide?**

Complex biological structures (such as multiple layers of different tissues) generally cannot be made easily and require careful thought and design. This generally involves non-recurrent engineering and is limited to certain machinable structures (such as multiple flat phantom layers), including simple insertions and holes in the bulk phantom itself. Contact us to discuss what might be feasible.

**I want a phantom with reference or characterization optical properties at wavelengths >940 nm. Is that something you can provide?**

No. Our metrology setup is not equipped with an appropriate detection stage with sensitivity greater than 940 nm.

### Can you provide the values of optical properties at multiple wavelengths?

Yes. We can measure the optical properties of your phantom at wavelengths other than the reference wavelength in the characterization report, for an additional price per wavelength. You can even order extra characterizations after your phantom has been delivered—we keep a characterization coupon for every phantom batch we produce. These coupons (called pucks), are used for optical property characterization in our metrology process and for internal traceability.

### What are the F number and the B number?

Fxxx is the phantom number and is different for each phantom. Bxxx is the batch number and can be assigned to several phantoms.

### When I order a phantom, what will I receive?

The phantom is provided in a transport case with a characterization report stating the actual optical properties vs. the targets, as well as the characterization wavelength.

## CONTACT US

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